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Promoting Teacher Education for Climate Change Education through Collaboration between Asian Centres of Excellence for Education for Sustainable Development (ATECCE)

Project Interim Report

Organized by Okayama University in cooperation with Asia-Pacific Cultural Centre for UNESCO (ACCU), with the support of UNESCO Bangkok, UNESCO Beijing and Japan Society for the Promotion of Science (JSPS)

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Promoting Teacher Education for Climate Change Education through Collaboration between Asian Centres of Excellence for Education for Sustainable Development (ATECCE) – Project Interim Report
Okayama, Japan: Okayama University ESD Promotion Centre

Contents

Forewords

This international joint research will focus on climate change in relation to all of sustainability issues, and will develop the "Asian Framework of Teacher Education Programme for Climate Change Education" and a guide for its dissemination through the collaboration of Asian centres of excellence on Education for Sustainable Development. This research is built on a prior project on school education programmes for climate change education, jointly carried out by Japanese researchers and co-researchers in Asian countries under the support of the Japan Society for the Promotion of Science (JSPS) Grants-in-Aid for Scientific Research (FY 2018-2020). The research identified the competency requirements of teachers who implement the climate change education programmes and it was found that the competencies can be fully utilized for the development of teacher education programmes for climate change education.

Furthermore, through the JSPS Core-to-Core Programme (FY 2017-2019) and Japanese Official Development Assistance (ODA) Grants for UNESCO Activities (FY 2018-2019) organized by the team members of this research, several teacher education institutions in Asian countries have grown as centres of excellence on ESD (See http://ceteesd.ed.okayama-u.ac.jp/). They are ready to develop teacher education programmes for climate change education. Through these research projects, the numbers of young researchers who will be key figures in the next generation, are growing in each centre of excellence, allowing research teams to play a central role in programme development in this field.

Hiroki Fujii
Research Coordinator
Director, Okayama University ESD Promotion Centre at
UNESCO Chair on Research and Education for Sustainable Devleopment

Acknowledgement

The substantial contributions made by project members during the first half of this project to promote teacher education for climate change education in the Asia region are greatly appreciated. The members of the project hail from nine Asian nations, including China, India, Indonesia, Japan, Kazakhstan, Malaysia, Mongolia, the Philippines and Thailand. The faculty members of the UNESCO chair at Okayama University also deserve our appreciation for their consistent project management and guidance for the network's future development. Lastly, we would like to express our gratitude to Asia-Pacific Cultural Centre for UNESCO (ACCU), UNESCO Bangkok, UNESCO Beijing and Japan Society for the Promotion of Science (JSPS) "Fund for the Promotion of Joint International Research" (20KK0047) for their generous support.

Research Plan

Promoting Teacher Education for Climate Change Education through Collaboration between Asian Centres of Excellence on Education for Sustainable Development (ATECCE)

Hiroki Fujii
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OBJECTIVES

Upon the announcement of UNESCO's new ESD policy *Education for Sustainable Development: Towards achieving the SDGs (ESD for 2030)* in November 2019, Japan is expected to continue to demonstrate a leadership role in promoting ESD. This research will embody such a leadership in teacher education, create a widely applicable framework for teacher education programmes through the collaboration in in nine Asian countries: China, India, Indonesia, Japan, Kazakhstan, Malaysia, Mongolia, the Philippines and Thailand. (**Fig. a**)

This research will not only present a framework of teacher education programmes for climate change education, but also develop a guide for its effective dissemination. The guide will be informed and disseminated to teacher education institutions in Asian countries, UNESCO regional offices and/or national commissions for UNESCO and the Ministries of Education

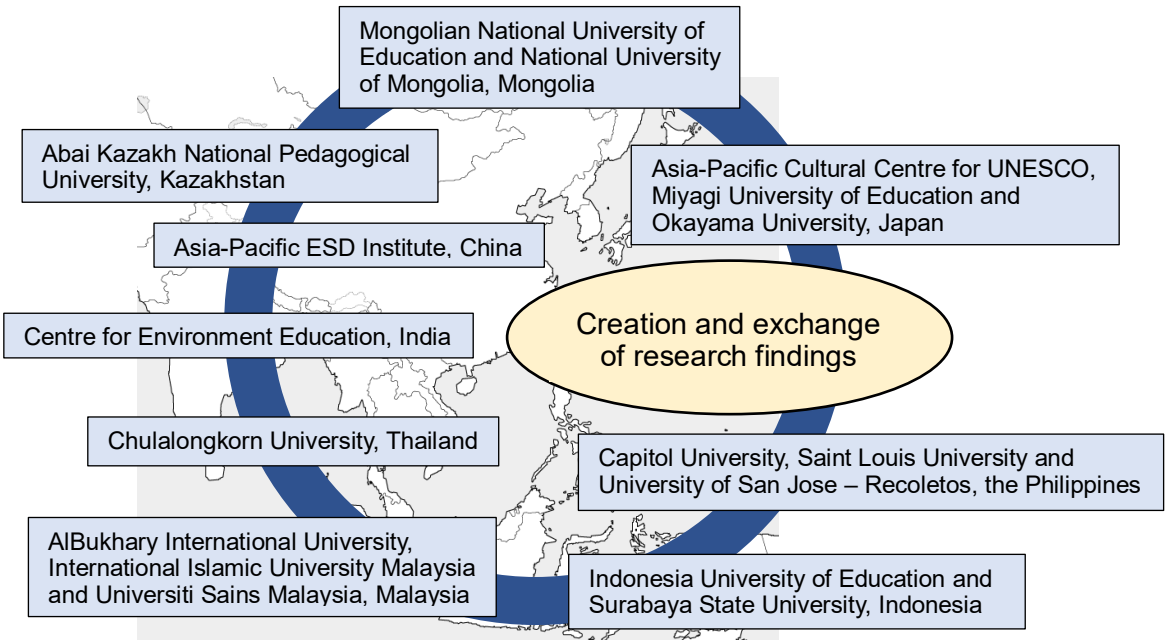

Fig.a Member institutions of the project

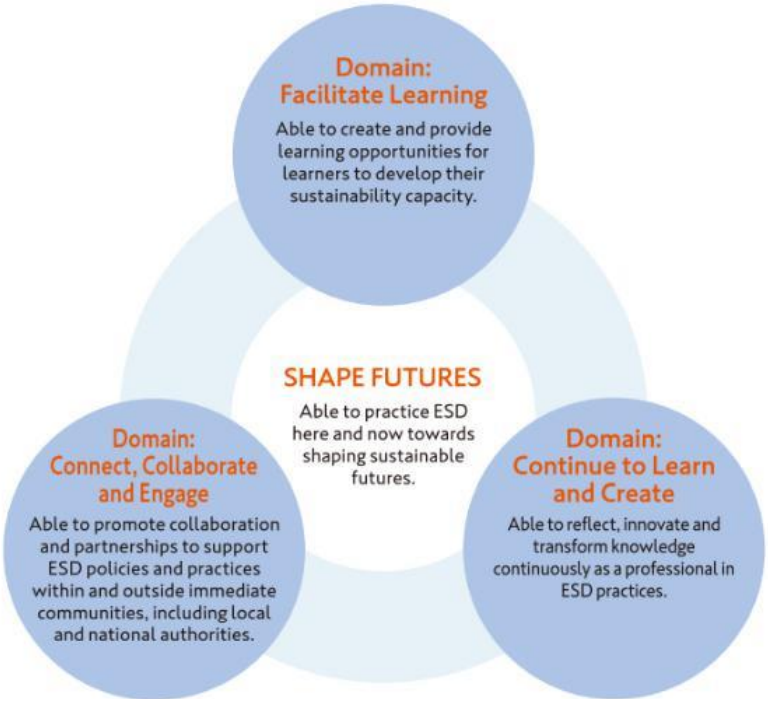

Fig. b Asia-Pacific ESD Teacher Competency Framework

(divisions of teacher education), for mainstreaming climate change education in the existing teacher education programmes.

METHODOLOGY

Review and systematizing teacher education programmes for climate change education (March 2021 to September 2021)

Based on the "Asia-Pacific ESD Teacher Competency Framework" (**Fig. b**) and school education programmes of climate change education already developed by the research team, the competencies required for teachers to practice climate change education will be reviewed and systematized through curriculum analysis, field work and workshops. Subsequently, teacher education programmes to promote the competencies will be identified and adapted at the centres of excellence in each country. Specifically, objectives, content, teaching methods and evaluation methods of the programmes will be defined.

Implementation and Evaluation of the Developed Teacher Education Programmes for Climate Change Education (October 2021 to September 2023)

The teacher education programmes will be implemented by participating institutions and a longitudinal survey and analysis of the process of promoting the competencies for pre- and in-service teachers as the programmes are undertaken.

Developing an "Asian Framework of Teacher Education Programmes for Climate Change Education" and its Dissemination Guide (October 2023 to March 2024)

The programmes will be evaluated in terms of content, process and effectiveness and the results will be summarized, which will be compiled as an "Asian Framework of Teacher Education Programmes for Climate Change Education" for adoption by teacher education institutions in Asia. At that time, the framework will be externally evaluated by researchers at ESD-related research and education centres in Europe, North America and other countries to examine its international applicability.

Furthermore, a guide for the effective dissemination of the framework will be created. In order to contribute to the programme development of many teacher education institutions in Asia, the experience of programme development at centres of excellence in each country as well as its merits and values will be specifically incorporated in the guide. The guide will be informed and disseminated to teacher education institutions in Asian countries, UNESCO regional offices and/or national commissions for UNESCO and the Ministries of Education (divisions of teacher education) that have collaborated with the research team, and will contribute to the wide spread of teacher education for climate change education in Asia.

Developing an "Asian Framework of Teacher Education Programme for CCE"

In the basic design of the programme, what is required for teachers practicing climate change education, in particular competencies, will be reviewed, identified and adapted based on the existing ESD teacher education competencies. Utilizing these competencies, the researchers will develop, implement and evaluate the programmes at each teacher education institution. At that time, participating institutions and researchers will collaboratively conduct field surveys, participatory observations and workshops to enhance the quality of the programmes. In creating the Asian framework of the programme, they will integrate the results of programme development and prepare basic data for creating the framework. Finally, they will examine the structure and contents of the framework and complete it.

Developing a Dissemination Guide for an "Asian Framework of Teacher Education Programme for CCE"

In the basic design of the guide, the research team will synthesize main project findings and outcomes as key components for the dissemination of the framework at three levels (institutional, national and international). They will create a guide based on the key components, incorporating the experiences, merits and values of their own programme development. This incorporation will contribute to the programme development of many teacher education institutions in Asia. In order to disseminate the guide, the researchers will inform teacher education institutions in their own countries, UNESCO regional offices and/or national commissions for UNESCO and the Ministries of Education (divisions of teacher education).

Report from China

1. The Research and Practice on CCE Teacher Education of Chinese National Working Committee for UNESCO on ESD (CNWCESD)

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ABSTRACT

At present, climate change is the most urgent problem facing all mankind. The task of educational practitioners is to arouse their attention to climate change issues through climate change education for students and teachers, and take actively actions to response to and deal with climate change problems at the same time. The research of CCE teacher education in Asia led by Professor Fujii from Okayama University provides an opportunity for CCE teacher education to participate in international exchanges and widely disseminates the concept of climate change education in Asia area. It has set off a climax of climate change education in the region and led many institutions and universities to participate in climate change education. The research and practical activities of teacher education for climate change education carried out by our institution are part of the research project "Promoting Teacher Education for Climate Change Education through Collaboration between Asian Centres of Excellence for Education for Sustainable Development."

We participated in Professor Fujii's questionnaire survey on in-service teachers. The questionnaire gives the feedback of climate change knowledge, ability and action among in-service teachers, and reflects the urgency of carrying out climate change education among teachers. Then we developed the core literacy of climate change education, and carried out the training activities of climate change education for front-line teachers from the perspectives of ecological civilization and double carbon and etc. After the several rounds of teachers' training, we evaluate the teacher training through teaching cases competition. Schools with large-scale activities on climate change education will be awarded the title of Education for Ecological Civilization (EEC) and Sustainable Development demonstration school. The collection of climate change education cases is ongoing.

Keywords: climate change education, teacher education

1.1 INTRODUCTION

1.1.1 International Background

In 2021, the 26th conference of the parties to the United Nations Framework Convention on climate change (COP26) was held in Glasgow, England, and many countries committed to

carry out climate change education. Okayama university shouldered the international responsibilities and led the international research on CCE teacher education.

1.1.2 Domestic Background

In order to solve the problems arising from the destruction of resources, environment and ecology in the process of economic development and coordinate the harmonious development of man and nature, China creatively put forward the national strategy of ecological civilization construction, promote green development and build a beautiful China. Ecological Civilization Thought of Xi points out that "*Work together to build global ecological civilization, participate in global environmental governance in depth, form solutions for world environmental protection and sustainable development, and guide international cooperation in addressing climate change* " (Xi, 2018).

1.1.3 Basic Policy

Deployment of the CPC Central Committee and the State Council are carrying out Education for Ecological Civilization. The *Opinions of the CPC Central Committee and the State Council on accelerating the construction of ecological civilization* issued by the State Council pointed out: Take Education for Ecological Civilization as an important part of quality education and bring it into the national education system and officials' education and training system; take ecological culture as an important part of the construction of modern public cultural service system; tap excellent traditional ecological culture ideas and resources; create a number of cultural works; and create a number of educational bases to meet the needs of the broad masses of the people for ecological culture. Widely mobilize the whole people to participate in the construction of ecological civilization through typical demonstration, exhibition and post creation (The State Council, 2015).

The 13th five-year plan for the development of national education emphasized the need that strengthen the education for ecological civilization, integrate the concept of ecological civilization into the whole process of education, encourage schools to develop courses related to ecological civilization, strengthen the education of national and world conditions in terms of resources and environment, and popularize laws, regulations and scientific knowledge of ecological civilization. We will extensively carry out ESD, deepen education on water, electricity and food conservation, guide students to practice strict economy and oppose waste, establish the awareness of ecological civilization of respecting nature, conforming to nature and protecting nature, form the concept, knowledge and ability of sustainable development, practice a diligent, frugal, green, low-carbon, civilized and healthy lifestyle, and lead the green fashion of society (The State Council, 2017). In the speech of Zheng Fuzhi, vice Minister of Education, at the 3rd World ESD Conference, he said that focusing on Education for Ecological Civilization in China will integrate ESD into the national plan of education development.

1.2 THE RESEARCH AND PRACTICE OF CCE TEACHER EDUCATION

As China's ecological civilization construction has entered a critical period focusing on carbon reduction, Education for Ecological Civilization is also focusing on the "double carbon" goal and playing a greater role in coping with climate change. Education is an important force to effectively respond to climate change and help achieve the "double carbon" goal. Therefore, under the current situation, climate change education is the main part of our ecological civilization education.

1.2.1 Questionnaire Investigation

Using the questionnaire designed by Professor Fujii, a questionnaire on climate change education was launched for some in-service teachers in Haidian District, Beijing. The teachers are 100 in-service teachers of various disciplines in primary and secondary schools in Haidian District. Haidian District is one of the most developed areas in Beijing on education. The questionnaire shows that teachers have rich knowledge of climate change and can recognize the ongoing climate change. But they did not realize the urgency of climate change education, so they did not act in teaching activities and their own activities. The survey shows that only teachers of individual disciplines will consciously infiltrate climate change education in teaching, which also shows the urgency of carrying out climate change teacher education.

1.2.2 Organizing Experts to Study the Core Literacy Framework of CCE

Summing up and refining the core literacy framework of climate change education can solve the category problems in curriculum design and teaching design, and it is an important link in carrying out climate change education. **Fig.1.1** displaying the research results of Dr. Shi Gendong, Wang Qiaoling and Zhang Jing.

1.2.3 Organizing Experts to Compile the Labor and Social Practice Activities Courses

In order to make climate change education get better implementation in the classroom, we organized experts to compile the labor and social practice activities courses. Dominated by education for ecological civilization, the courses are integrating climate change education into the specific life. Many activities related to climate change are designed. These activities focus on how to understand climate warming occurs for the students, how to find the specific ways to reduce carbon emissions, and how to response to ecological disasters. Labor and social practice activities designed in the courses facing the needs of ecological civilization construction must be the combination of labor and various practical activities at the campus, family and social levels, starting from the actual and future needs of coping with ecological disasters and building ecological civilization, and aiming at cultivating teenagers' ecological civilization and sustainable development literacy.

Capacity dimension	Concrete content
Learning ability	The learner should know the relevant basic concept and knowledge about climate, understand the characteristics of global climate system and climate distribution of their own country, and understand climate related knowledge, such as green-house effect, carbon emission and extreme weather.
Adaptability	Actively response to climate change, flexible use the relevance between climate and people's life and production, predict and prevent disastrous weather and extreme weather in advance, and master the capacity to deal with the issues in subsequent life and production under different weather conditions.
Scientific evaluation ability	Rationally judge and effectively disseminate the correct information on climate change, reflect on their role in climate change, and take appropriate actions to improve the climate.
Innovation ability	Be good at discovering problems related to climate change and conduct experimental exploration through investigation or model-making.
Self-awareness ability	Raise awareness of climate protection, regulate their own behaviors, engage in climate action.
Social-service ability	Utilizing climate knowledge what they learned and practical action, serve and mobilize public to real engage in the climate action.

Fig. 1.1 Core literacy framework of climate change education

1.2.4 Carrying Out Teachers Training of Theoretical Learning on Climate Change Education

Our institute organized the front line teachers to study a series of UENSCO and Chinese government documents related to SDG13 and the documents on how to understand the double carbon. We invited the experts from Chinese Academy of Social Sciences, etc, in the field of climate change to give lectures. Due to the impact of the pandemic, these meetings are currently held online. The pandemic has had a certain impact on the current work. There will be less interactive links in the learning process. These practical courses are mostly in the form of school-based courses. Mainly based on the actual situation of students and teachers in the local region, designed specific activities for students to participate. Some of these activities can be completed in the classroom, and some need to be completed outdoors. The implementation of the curriculum requires the approval of school leaders. Therefore, the teacher training of climate change education needs to involve more principals to drive the school's climate change education. In order to mobilize the enthusiasm of principals, for schools with high participation and well-designed activities, which will be given EECESD experimental schools or EECESD demonstration schools depends on the degree of meet the standards designed for this purpose.

1.3 EVALUATION AND MONITORING OF CCE TEACHER EDUCATION

The evaluation and monitoring of CCE teacher education is achieved through the evaluation of the implementation of climate change education activities to schools and the

implementation of climate change education courses to teachers.

1.3.1 The Evaluation on School

The evaluation on schools is the effective way to assist teachers to conduct climate change education and achieve expected results.

Guideline of the High-quality Schools' Construction on Education for Ecological Civilization

High quality EECESD school construction needs to meet the following aspects: Creating experimental schools and demonstration schools of Education for Ecological Civilization schools; cultivating teenagers' Ecological Civilization – sustainable development literacy; constructing Education for Ecological Civilization-Sustainable Development curriculum; conducting practical research on sustainable learning class; organizing labor and social practice activities guiding by Education for Ecological Civilization; creating ecological smart and sustainable schools; and improving teachers' professional development level on Education for Ecological Civilization and Sustainable Development.

How to Create Demonstration Schools of Education for Ecological Civilization

Establish the leading concept of school education in promoting Education for Ecological Civilization – Sustainable Development. Design the curriculum system with "learning sustainable development" and "moving towards ecological civilization" as the main line. Sustainable learning classroom + sustainable project learning has become a normal teaching learning method. Teachers and students generally practice sustainable lifestyles. It has become a common practice for young people to participate in the construction of an ecological and civilized society, create an ecological smart campus and become a local demonstration base for energy conservation, emission reduction and carbon reduction.

Create Routes of Demonstration Schools on Education for Ecological Civilization

The guarantee of carrying out ecological civilization education in depth from the perspective of schools as follows: theoretical study on Education for Ecological Civilization and Sustainable Development for school leaders; under the guidance of ecological civilization education, sort out the school running concept and write it into the school running plan; collectively formulate the characteristic curriculum system of "ecological civilization +" and "education for sustainable development +;" prepare and implement the syllabus of sustainable learning classroom and ecological civilization project learning according to the discipline (or discipline combination); implement sustainable lifestyles in a planned and organized way and carry out scientific and technological innovation activities for youth in energy conservation, carbon reduction and emission reduction; and construct "ecological smart and sustainable schools" step by step.

1.3.2 The Evaluation on Teachers

Teachers are the main body of curriculum implementation on climate change education. Their daily teaching work is relatively heavy. How to mobilize their enthusiasm to participate in activities is also what we have been trying to do. From the perspective of teachers' professional development, help them grow in the secondary direction. In order to motivate and evaluate their teaching activities, we usually reward their classroom teaching or teaching plans by organizing competitions among teachers. We will show excellent cases of climate change education regularly. The situation of climate change is becoming more and more serious, and climate change education is becoming more and more urgent. Climate change education should be paid more attention in the whole society. More and more people should be mobilized to act on climate change. This is also our common social responsibility.

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Report from India

2. Evaluation of the Teachers' Education Landscape for Climate Change Education in India

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ABSTRACT

The research report seeks to develop an understanding based on the existing literature of how climate change education is represented in the environment and education policies of India as well as how climate change policies in India prioritize education. We attempt to capture the expansion of environmental education by considering practice, policy and research developments throughout the various contemporary and environmental education movements in India, with an emphasis on the Centre for Environment Education's role as a Centre of Excellence. Additionally, the report investigates the resources and training programmes available for teachers to elevate climate change pedagogy. Apart from providing an overview of the available literature, it delves deeper into the teacher education landscape by sharing the reflections of the consultations conducted with teachers, educators and ESD experts to understand teachers' perspectives on climate change education in India. Lastly, the report outlines the key challenges faced and shared by the teachers to impart climate change education. In doing so, we identify a theory-practice gap amongst teachers and a dire need of implementing climate change education in India. In conclusion, we discuss possible future directions to help teachers upgrade climate change pedagogy as a Centre of Excellence on Environmental Education in India and Education for Sustainable Development globally.

Keywords: climate change education, teacher education, climate change pedagogy, policy analysis, teachers consultation, environmental education, education for sustainable development (ESD), centre of excellence.

2.1 INTRODUCTION

Understanding the complex workings of the climate system and predicting the responses to increased emissions makes climate science a difficult subject to decipher for many. Younger generations, by virtue of their age, are the most vulnerable to the ongoing impacts of the climate crisis. Conversely, they can become the agents of change by adopting behavioural change through sustainable choices and creating a significant impact on the climate crisis. It is imperative that today's youth is empowered to act against climate change, which needs to be reflected in the education provided to them.

Thus, educating young populations on climate change, especially through the integration of climate curriculum in mainstream education and via supporting informal learning

mechanisms is significant in fighting the negative impacts of climate change. While awareness of younger generations is crucial to addressing the climate crisis, climate change education fundamentally relies on how it is taught in various settings. The concept, pedagogy and approach through which climate education is integrated, mainly in the formal education system, is key for the large-scale adaptation of climate change curriculum.

The role of teachers is, thus, paramount. Teachers are one of the most influential and powerful forces for equity, access and quality in education and hold the key to sustainable global development (UNESCO, 2021). Furthermore, in order to make a younger generation cognizant of socio-scientific issues, teachers must have a deeper understanding of science to help navigate the assumptions, potential reasoning patterns, and moral developments held by students (Sadler et al., 2004).

The research study, "Evaluating teachers education landscape for climate change education in India" is being undertaken by the Centre for Environment Education (CEE) on a national level, under the aegis of the collaboration between Asian Centres of Excellence on ESD as part of the overall research project. It aims to assess the present scenario of climate change education in India from a teacher's perspective by drawing upon observations made by analysis of existing documentation and policies as well as communicating with teachers from all over the country to understand the conceptual gaps and hindrances faced to effectively teach climate change to students. Appropriate recommendations with suggestive mechanisms to empower teachers to effectively teach climate action education are discussed. The research project intends to chart out resources and capacity-building needs for teachers on climate change education in order to effectively teach climate change concepts in the formal education sphere.

Empowering teachers with the correct pedagogical knowledge of climate change will help shape the narrative of an entire generation who will face (and are facing) the consequences of climate change in the future. The rationale behind this study was to conduct a situational analysis to identify the state of climate pedagogy for teachers from a science, policy and practice perspective. Hence, the key research questions developed for this research study are as follows:

1. To what extent is the current educational landscape favourable for teaching climate change education in India for teachers?
2. What is the mechanism and policy framework required to effectively equip teachers in imparting climate change pedagogy?
3. What are the gaps and capacity-building opportunities to facilitate mainstream climate change education?

One of the aims of this research is also to identify specific areas of intervention on climate change for teachers in India, and as a Centre of Excellence, to design customized educational resources and training programmes to deliver theoretical as well as action-based resources based on the outcomes of the study.

2.2 METHODOLOGY

This research study aims to review and analyze the scope of climate change education in teacher education programmes in India from a multidimensional perspective. The methodology of this research study was developed based on the "Asia-Pacific ESD Teacher Competency Framework" and a combination of primary and secondary research methods. Adopting this methodology will help reveal the present scenario of climate change education in formal education which will contribute to developing a framework for teachers in the later stages of the research. An action plan was proposed with an eight-month timeline to conduct the research study at the commencement of the first phase of the research project. The methodology of this study involved four components.

Landscape Analysis

The initial stages of the research study included conducting a comprehensive landscape analysis of the state of environmental education and assessing the inclusion of climate change concepts in the formal education domain at a national level.

Policy and Resource Mapping

This was followed by mapping the national policies around climate change education for teachers and reviewing the existing climate change curriculum and resources for teachers' education in the country. This qualitative research was undertaken by conducting desk-based research of extensive secondary data available in the public domain.

Teachers' Consultations on Climate Change

To further draw upon the findings of the desk research, four Focus Group Discussions (FGDs) in the form of online consultations were conducted in the month of November 2021. To ensure maximum representation at a national level, the consultations were conducted in English and three Indian regional languages namely, Hindi, Gujarati, and Bangla. More than 50 teachers attended these consultations with representatives from over 6 Indian states. Additional inputs from teachers were also collected by the electronic circulation of a Google Form containing the questionnaire to all registered participants (teachers) post consultation.

Forum on State of Climate Change Education for Teachers in India-Preliminary Reflections

The initial findings from the Focus Group Discussions (FGDs) were discussed in an online forum discussion organized in December 2021 which included multiple participants such as in-house and external ESD experts, research team and selected teachers from FGDs. Recommendations from this discussion were included in the final research report.

2.3 RESULTS AND DISCUSSION

Based on the findings of the primary and secondary research, it was apparent that a lot of interest and effort has been devoted to making environmental education mandatory and

mainstream in the Indian formal education system. However, the same cannot be said about the evolution of formal climate change education in India. The New Education Policy, 2020 has put forth ambitious objectives for spreading climate change education to make the upcoming generation climate-resilient. The challenges that India might face in executing climate change education in the coming years can be clearly indicated by the strengths and weaknesses arising from the secondary data analysis.

The scope for climate change education has not been critically defined thus far. There is a need for a deeper understanding and implementation of Education for Sustainable Development (ESD) and climate change education to achieve the SDG target of Quality Education by 2030 (Tikly et al., 2020). Climate change is still a peripheral topic in both educational research and practice and is mostly restricted to science education (UNESCO, 2012).

Responses from the online teachers' consultation revealed that environmental education is more ornamental in the application, limited to the syllabus coupled with tree plantation and cleanliness drives, competitions, etc, and not taught in an interdisciplinary manner. It is left to the teachers' initiative and the schools' own interest where environmental education gets into action. Teachers feel the need for space, knowledge and enhancement of skills for effective environmental education. While the urgency of climate change is understood on a policy level, there is a lack of clear articulation of the scope, processes and implications of climate change education. Implementation of climate change education is hindered due to factors such as poor infrastructure facilities in schools, teacher-student ratio, rigid syllabi, time constraints, etc. as observed in the consultations and also in the report published by the Transforming Education for Sustainable Futures project (Tikly et al., 2020). There is a great scope for the incorporation of regional and target-specific themes in climate change education to connect people and encourage them in engaging in environmental education processes, as the textbooks are developed at the level of state government. However, the cycle of curriculum reform occurs every 4 to 5 years, contributing to a lack of monitoring, evaluation and revision of environmental education content that makes it less contemporary (NITI Aayog, 2021).

While assessing the inclusion of climate education in the formal curriculum, it was observed that environmental education is made compulsory across all levels of the school system. Additionally, as formal education in India is imparted through English and varied regional languages, there is a scope for variation in theoretical concepts when translated which could result in inconsistencies. This was specifically flagged by the teachers who participated in the consultations.

Lastly, there is a dire need for acknowledgment of students and teachers as important stakeholders as well as increased participation by the community, NGOs, corporate sector and other academic institutions for the proper utilization of such entities in promoting climate change education.

The increased gravity of the climate urgency has put the spotlight on the state of environmental education and climate change curriculum in India where there is massive

scope for rejuvenating climate change education and bringing it into the mainstream. Climate change education is not a separate subject but is practiced only through cross-curriculum methods (Scoffham, 2000). Teachers receive inadequate knowledge and skills in infusing theoretical knowledge of climate change into their students. After analyzing the responses from teachers during the consultations, the prominent factors highlighted were lack of qualified teachers, diversity of the nation, archaic pedagogical methods, institutional pressure and lack of training and resources which has resulted in a deficient climate change pedagogy in the country.

The full report is now published on our website and could be visited/downloaded from here.

2.4 NEXT STEPS

Climate change education has been conducting extensive training programmes and has developed educational materials with a network of 200,000+ educational institutes across India. The materials mostly focus on the issues of environment, leadership development, waste management, plastic pollution, biodiversity, water conservation etc.

As the next phases of the project, we intend to focus on the development of specialized climate change modules, based on the findings of the study report and inputs from teachers to close the climate education gaps observed in the study report. The modules will be incremental in nature based on the participants (grade, language, geographical locations, taught disciplines, etc.). In partnership with our existing Youth and School Programmes Division, we would like to institutionalize climate change training as part of our organizational model to make teachers well-versed with the key climate concepts and support them in undertaking projects as well as activities for children in schools to enhance climate action.

We would like to develop two climate change modules for teachers in the next two years: Basic and Advanced. The basic module will focus on key climate change concepts that would be disseminated to teachers across all disciplines, while the advanced module will focus on climate change in depth, and will be disseminated to teachers teaching science, geography and allied disciplines. Pilot training of both the modules will also be conducted during the project period.

Additionally, a note to reflect upon the competencies of climate change pedagogy would also be developed based on the training experiences and feedback from teachers.

A tentative timeline for the same is as follows:

June 2022 - Dec 2022

Develop basic module for teachers across all disciplines.

January 2023 - March 2023

Dissemination of the basic module by conducting one regional in-person training.

Apr 2023 - Dec 2023

Develop advanced module for teachers teaching science and allied disciplines and disseminate it by conducting a national online training.

Jan 2024 - Mar 2024

Develop a note of 2-3 pages to reflect on the increased key competencies of teachers in climate change pedagogy as part of the project.

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Report from Indonesia

3. Promoting Literacy, Awareness and Willingness to Act on Climate Change

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ABSTRACT

School plays a central role in educating people about the danger of climate change to our life. Educating the younger generation can be a key for a more sustainable community involvement in the future. Promoting students' literacy and awareness of climate change are certainly the bases for building their willingness to act on controlling climate change. Students' literacy, awareness and willingness to act are certainly influenced by the quality of teaching and learning delivered by the teachers. Therefore, teachers' competencies and teaching strategy are two areas that need to be improved. This project focuses on the two areas, namely promoting teachers' competencies and exploring suitable teaching strategies. Since climate change is usually integrated into science lessons and no teacher is deliberately prepared to teach it, this project starts by constructing a standard of science teacher competencies to teach ESD. The standard is very important as a reference for both pre-service and in-service teacher training. For the second area, this project explores a variety of teaching strategies that may be effective in promoting students' literacy, awareness and willingness to act on climate change. Due to the pandemic, the teaching strategies were largely digital and computer-based, such as computer modeling, virtual learning and future workshops. It seems that such strategies can promote students' literacy but they fail to raise students' awareness. Experiential learning by observing changes of coast line and observing changes of the local climate were also explored but they do not give significant contribution to students' awareness and willingness to act. The project will continue to work on developing effective teaching strategies, especially towards teaching strategies that require students to have direct experience and involvement in efforts to combat climate change.

Keywords: climate change literacy, climate change awareness, teaching strategies, teacher competencies. willingness to act

3.1 INTRODUCTION

Climate change has been a concern of countries around the globe. There are plenty of evidence that the climate of our planet has changed, e.g. changes of the global temperature, the decline of mountain glaciers and the reduction of polar ice (Thompson & Kuo, 2012) and that such a change affects our life. As an archipelagic and agricultural country, the effect of

climate change on Indonesia is very obvious such as extreme drought, rob flood and changing of the coastal line. Reports on the effect of climate change also show that climate change affects crop production (Gonzalez, 2015) that farmers need to be prepared for the changing situation (Gnanasubramaniam & Hemachandra, 2020). Although no data is available about Indonesian beliefs about climate change, it seems that people tend to believe that the disasters are caused by nature instead of due to human actions (Arbuckle et al., 2015). People's lack of understanding could be the root of their limited awareness and participation in programmes to reduce the effect of climate change (Halady & Rao, 2010; Vainio & Paloniemi, 2011). Therefore it is necessary to raise people understanding and belief about climate change in order to promote their willingness to act (Vukeli´c et al., 2022).

As acknowledged by UNESCO (2012), education plays very important roles in promoting people's understanding, awareness and willingness to act on climate change. Education is not limited to formal education in all its forms (curricular and extracurricular) but also informal education. A review on government policy (Læssøe & Mochizuki, 2015) shows that climate education still needs improvement. Since teachers are the key in climate change education, preparing teachers' competencies should be a central concern both in pre-service and in-service teacher education programmes. As reported (Tibola da Rocha et al., 2020), teachers have difficulties in understanding and implementing climate change education in the class. This programme aims to promote people's literacy, awareness and willingness to act on climate change. Unlike the existing programmes on climate change education, this programme attempts to be more comprehensive by addressing both formal and informal education. The formal education covers teacher education and the implementation of climate change teaching at schools while the informal education covers community awareness programmes. This programme also develops a framework of teacher competencies and an instrument to assess the competencies.

3.2 METHODOLOGY

As mentioned earlier, the programmes aim to promote understanding, awareness and willingness to act on climate change. Four different areas were covered, namely teachers, students, schools and communities (**Fig. 3.1**). Teachers are key people for the implementation of climate change education in schools. However, no teachers are actually prepared to teach climate change education. Since climate change is usually integrated into science lessons, this project attempts to construct a standard of science teacher competencies to teach Education for Sustainable Development (ESD). The standard is needed as a reference for both pre-service and in-service teacher training. For the second area, this project explores a variety of teaching strategies that may be effective in promoting students' literacy, awareness and willingness to act on climate change. For the third area, the programme tried to infuse climate change education in the existing environmentally friendly schools. The programme is still at the preparation stage. Finally for the fourth area, community awareness programmes were conducted and a website was constructed.

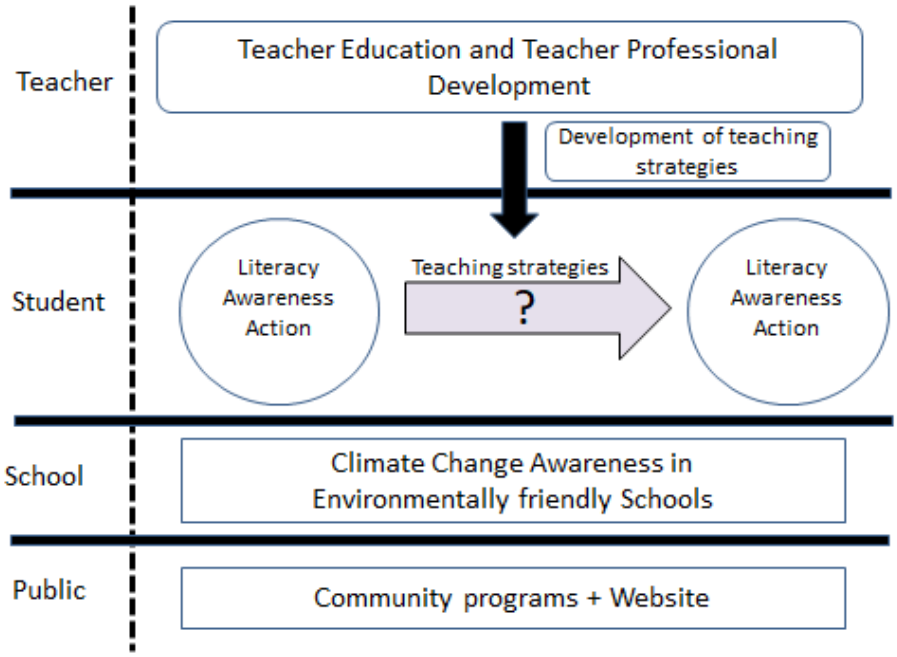

Fig. 3.1 The outline of the programme

3.3 RESULTS AND DISCUSSION

3.3.1 Developing a Framework of Science Teacher Competencies to Teach ESD

In the school curriculum climate change is one of the science topics. Therefore, climate change is taught by science teachers. Integrating climate change into science is at the one hand helping students to understand the phenomena but at the other hand it sacrifices the true nature of climate change education as action oriented education. Science teachers traditionally viewed climate change as a science phenomenon and the objective of the lesson is to promote students' understanding of the phenomenon. Since school science is traditionally content mastery-oriented a shift in teachers' teaching paradigm is needed. Science teachers should be able to teach climate change not only as a science content but also as awareness raising and action-oriented topics. Science teachers that are able to teach climate change need to have not only science teacher competencies but also ESD teachers competencies. A synthesis of standard for science teacher competencies (e.g., Morrell et al., 2020; Australian Institute for Teaching and School Leadership, 2011) and standard of ESD teachers (Okayama University ESD Promotion Centre, 2020) was done and a framework for science teachers competencies to teach ESD was formulated.

The final science teacher competencies standard to teach ESD consist of six standards, i.e. (1) The competencies to master ESD content and integrate ESD content into science concepts; (2) The competencies to implement inquiry lessons on ESD issues; (3) The competencies in professional practice especially in applying learning techniques for science that incorporate ESD; (4) The competencies in assessing students learning that are not only limited to understanding of the content; (5) The competencies in participating in professional development to become an agent of change in promoting ESD-based science learning; and

(6) The competencies in responding to social, economic and environmental changes to realize ESD learning in a community. The framework will be further validated and used as a reference for preparing science teachers to teach climate change. In addition, an instrument to assess teachers' performance on the framework was also developed and has been validated.

3.3.2 Promoting Students' Literacy, Awareness and Willingness to Act on Climate Change

A variety of teaching strategies that could possibly improve students' literacy, awareness and willingness to act on climate change were explored. Due to the pandemic the teaching strategies were largely focused on digital and computer-based teaching, such as computer modeling, virtual learning and future workshops, but some experiential learning were also explored, such as observing changes and making documentary videos about the changes of coastal line. The results show that students' literacy, awareness and willingness to act on climate change are fairly low ($x \leq 60$). It is also found that the teaching strategies were not so effective as at the end of the instruction there is no statistically significant difference. Modification and refinement are done to improve the teaching strategies especially for the implementation in post pandemic situations.

3.3.3 The Infusion of Climate Change Awareness in Environmentally Friendly School

Some schools are declared as environmentally friendly schools by the government. The criteria for such status covers the school environment and the school programme. Hydroponic farming and passion fruit growing were introduced to a school. The two programmes were designed as city farming techniques suitable for people who live in big cities. It is expected that learning hydroponic farming could open up students' ideas to make use of limited space in their houses and therefore contribute to the reduction of greenhouse gasses. The passion fruit planting was introduced due to its pollination issue. Passion fruit needs the help of human beings for pollination due to the absence of the natural pollinators. It is an excellent case for the students to think of a solution to bring back the natural pollinators.

3.3.4 Promoting Climate Change Awareness to Public Community

Two programmes were run to promote public awareness on climate change. The first programme is educating the community about the effect of climate change on our life. Energy consumption and energy saving strategies were introduced to raise people's awareness about energy consumption and climate change. The use of solar cells were introduced as an alternative energy source. A website was also developed to provide information about climate change to broader communities.

The fact that the level of students' literacy, awareness and willingness to act were fairly low suggests that a lot of effort is needed to work on. Since understanding of climate change is the base for awareness and willingness to act (Halady & Rao, 2010; Vainio & Paloniemi, 2011; Kim et al., 2012), understanding of climate change should be given sufficient attention. Although the teaching strategies were student-oriented, it seems that they failed to engage

students, as students' engagement is very important for the success of climate change education (Monroe et al., 2017). It seems teachers have difficulties to engage students in online class setting. Moreover, the absence of direct experience seemed also affect students' learning.

Analysis of the effectiveness of the programme indicates that promoting literacy, awareness and willingness to act require more than just teaching strategies that focus on climate change. It seems that even when using climate change oriented teaching strategies the teachers did not really change their old views of climate change as a science content. As a result they tended to focus on the scientific concepts of climate change instead of the impacts and the actions to reduce the impacts of climate change. This suggests that partial improvement of teachers' competencies is insufficient for teachers to implement climate change lessons. As another study suggested, teaching climate change is very challenging and demands teachers to master a variety of competencies (Favier et al., 2021). Our results also suggest that explaining the teaching strategies is insufficient. Teachers need to improve all six areas of competencies as identified in the framework prior to implementing the lessons.

3.4 NEXT STEPS

The upcoming programme will continue the current programme. In the first step, revision and refinement will be conducted. Implementing the framework of teachers' competencies, both in pre-service and in-service teacher education, will be given a priority. The detailed programme is as follows.

No	Activity	Time frame	Deliverable
1	Improving teachers' competencies		
	a. Training for in-service teachers	Jul – Dec 2022	Training materials
	b. Infusion of the framework into pre-service teacher education	Sep 2022 – Jun 2023	Book/learning materials for students
2	Exploring teaching strategies, especially for face to face situations	Jan – Jun 2023	Teaching models, methods, and media
3	Promoting public awareness on climate change		
	a. Improving website and social media	Sep 2022 – Jun 2023	Website and social media
	b. Promoting climate change to school students	Jan – Jun 2023	Promotion materials

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Report from Japan

4. Promoting Climate Change Education for Pre-service and In-service Teacher Training Collaboration with Local School Networks

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ABSTRACT

Climate Change Education (CCE) has been developed according to the international agreements – Article 6 of the United Nations Framework Convention on Climate Change (UNFCCC) since the Convention's text was adopted on May 9, 1992, Article 12 of the Paris Agreement Conference of Parties to the United Nations Framework Convention on Climate Change(COP) 20 in Lima, December 2014 and Doha Work Programme on Article 6 of the Convention including the final review in 2020. Under these agreements, significant initiatives were undertaken locally and internationally. UN CC:Learn, UNESCO's Getting Climate-Ready and OECD's Global Teaching Insights – Climate Action, are the effective global initiatives which suggest the learning contents of CCE. The research question of this presentation is regarding the learning contents of climate change education and research teachers' recognition of it. To answer this question, this research investigates in-service and pre-service teachers. Consequently, teachers' recognition of CCE mainly focused on litter, low waste, recycling, saving energy and green plant.

First, it can be said that these contents almost belong to behavioral learning dimension, project base and does not tend to link to the cognitive learning dimension. Second, teachers' recognition of CCE is limited. It does not refer to climate change and biodiversity, climate change and health, climate change and gender issues which are mentioned in global initiatives. Third, transformation caused by CCE is limited to individual transformation. Especially, pre-service teachers will not focus on collaborating with and engaging the local community. This trend is similar to incorporating Education for Sustainable Development (ESD) issues into pre-service teacher training. These conclusions will contribute towards the quality of climate change education for Asian Pacific countries.

Keywords: learning contents, recognition of CCE, in-service and pre-service teachers, quality of CCE

4.1 INTRODUCTION

4.1.1 Background

Climate change education has been gradually developed through the international argument. Most represent the Article 6 of the United Nations Framework Convention on

Climate Change (UNFCCC) since the Convention's text was adopted on May 9, 1992. The United Nations Framework Convention on Climate Change (UNFCCC) works with UNESCO and an alliance that includes other UN agencies under its Action for Climate Empowerment (ACE) programme, which liaises with an increasingly active network of government focal points. Article 12 of the Paris Agreement COP 20 in Lima, December 2014, and Doha Work Programme on Article 6 of the Convention Under these agreements, famous significant initiatives for CCE teaching practices has been created locally and internationally (**Table 4.1**)

4.1.2 Previous Study

The One UN Climate Change Learning Partnership, also known as UN CC:Learn is a collaborative initiative of 36 multilateral organizations working together to help countries build the knowledge and skills they require to take action on climate change. UN CC:Learn provides guidance and quality learning resource to understand, adapt and build resilience to climate change. It suggests the learning contents of CCE which includes the following issues: climate change science, climate finance, international climate negotiations, adaptation planning, climate change and health, climate change and forests, climate change education for children and youth and gender and climate change.

It mentioned gender and the environment are deeply connected. Understanding this connection can help bring benefits to societies and ecosystems. Human health is directly affected by the weather, climate variability and climate change.

UNESCO (2016) also suggested the learning contents of climate change education focusing on the school as follows: biodiversity and nature, energy, responsible consumption, health and well-being, litter and waste and transport. (**Table 4.2**)

4.1.3 Purpose, Originality and Creativity

The implications of the CCE are not clear. There are several spaces to discuss about learning contents and topics on the school practice of CCE. Walter et al. (2021) considered how to hand climate change education at universities, and except this research, there is no argument about the learning contents of CCE. Therefore, the research question of this study regarding the learning contents of climate change education is, especially for the school practices and teacher education. In this research, to understand the characteristics of the CCE practices,

Table 4.1 Representative CCE international practices

Programme name	Year	Description
UN CC:Learn	2011～	13 national climate change learning strategies launched. One regional climate change learning strategy in Central America. Over 25 learning actions implemented.
UNESCO Getting Climate-Ready	2017～2019	55 schools in 12 countries. All schools in the survey are part of UNESCO's Associated Schools Project Network (ASPnet).
OECD Global Teaching Insight – Climate Action	2021～	Overall, about 850 teachers actively contributed to this initiative, with engagement from more than 6500 visitors across 157 countries.

Table 4.2 Learning contents of CCE by UNESCO (2016) Source: UNESCO (2016)

Theme	Possible ways to model climate change action
Biodiversity and nature	• Plant native flowers, trees, shrubs, fruits and vegetables. • Plant trees that provide shade for play areas, outdoor learning areas and the school building.
Energy	• Turn off lights, computers and other electronics when not in use. • Regularly inspect mechanical equipment to ensure it is working efficiently.
Responsible consumption	• Buy local products. • Buy products made in farms, plantations and factories with responsible labor and health and safety practices.
Health and well-being	• Serve healthy, organic, local and minimally packaged foods in the school cafeteria. • Maintain sinks and faucets to encourage regular hand washing.
Litter and waste	• Encourage students and staff to bring litter less lunches. • Place recycling, compost and garbage bins in key locations to encourage students. and staff to dispose of waste in the right place.
Transport	• Encourage students and school staff to use sustainable transport. • Locate new school buildings in areas easily accessible by public transportation.
Water	• Turn off water when not in use. • Replace pavement with natural surfaces that will absorb rainwater from heavy storms. • Make sure all chemicals are disposed of properly (not just thrown down the drain).

learning dimension of CCE practices will also be examined.

4.2 METHODOLOGY

4.2.1 Target

The target group of this research is in-service and pre-service teachers, and 24 Japanese teachers who are the participants of UNESCO Getting Climate-Ready project in 2018. Pre-service teacher are the 120 students of International Understanding, at Miyagi University of Education, of 2021 and 2022. Worksheets were delivered and collected to write suggestions for practicing CCE. Lesson plan was also proposed by the pre-service teacher.

4.2.2 Data Collection and Analysis

Data was collected through the worksheets designed to write about the classroom activities of CCE. It comprised reading the data carefully, devising the code and applying the code to the data. The code was categorized by the topic of CCE, such as energy, litter and waste and transportation. These categories were referenced by the theme of UNESCO Getting Climate-Ready, other previous CCE materials and in certain cases by the original definition. Moreover, data was analyzed using the three dimensions of learning: “cognitive learning dimension," “social and emotional learning dimension" and “behavioural learning dimension."

4.2.3 Elapsed Timeline and Deliverables

This study aims to understand the recognition of the learning area of CCE. Success factor for teacher education programmes on CCE is to improve quality of CCE practices. We aim to broaden the scope of CCE's school practice and activate school practice by conducting surveys continuously for three years (2021-2023) and furnish feedback of the results.

4.3 RESULTS AND DISCUSSION

4.3.1 Interim Results

Teachers' recognition of CCE mainly focused on litter, low waste, recycling, saving energy and green plant (**Fig. 4.1** and **Table 4.3**). Comparing with UN CC:Learn teachers' recognition of CCE is limited. It does not refer to climate change and biodiversity, climate change and health, climate change and gender issue. For climate change education, saving energy, litter and low waste tend to be imaged. Pre-service teachers in particular attach great importance to saving energy and are more likely to attempt to teach climate change itself. In-service teachers can consider a more holistic approach of CCE. Regarding collaboration with the community, students tend to propose more positive ideas about collaboration than students. Pre-service teachers could not understand/suggest a link between climate change and transportation. Transformation caused by CCE is limited only for individual transformation.

Litter, low waste, saving energy and green plant – these activities mainly focused on "behavioural learning dimension." The contents of learn about CCE mainly covered "cognitive learning dimension." As a perfect learning process CCE should cover all three dimensions of learning.

4.3.2 Discussions

Success factor for teacher education programmes on CCE is to improve the quality of CCE practices. Introducing good practice of CCE in teacher training programmes will be one of the useful solutions to improve the quality of CCE.

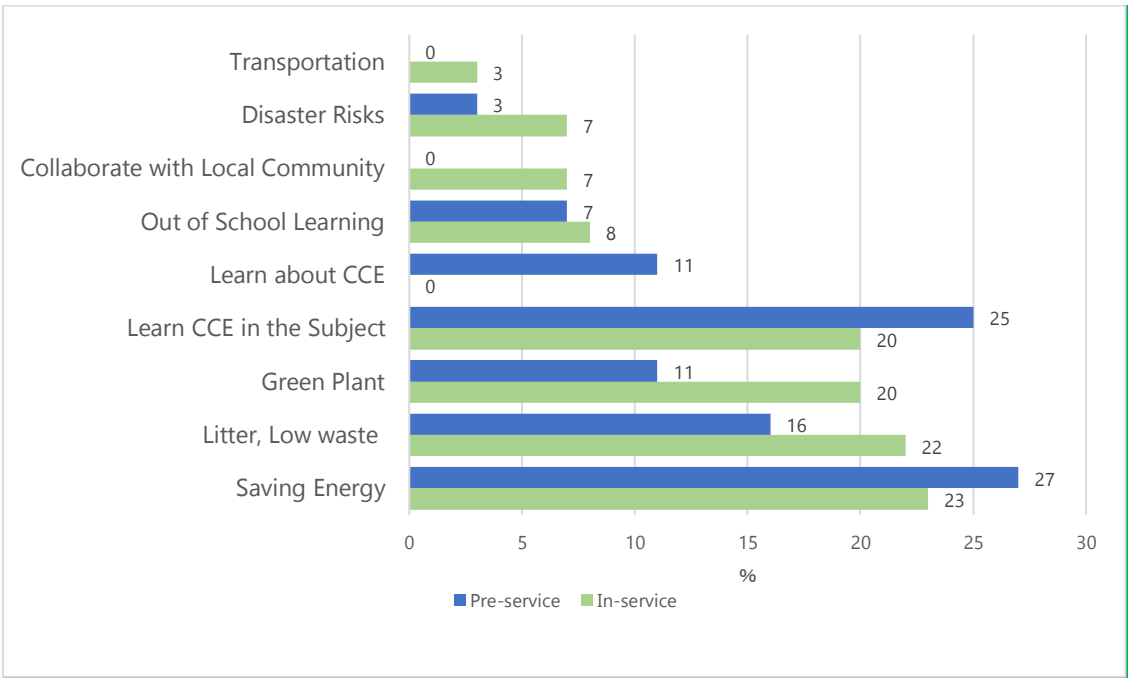

Fig. 4.1 Recognition of the learning contents of CCE

Table 4.3 Example of the pre-service teachers' learning contents of CCE

Litter, low waste	**Know the amount of plastic waste being disposed of**
	Consider creating a city with zero littering.
	Clean up after local events, pick up trash.
	Check the amount of garbage in a day and devise ways to reduce it.
	Use compost to fertilize swill.
	Perfect waste separation.
Saving energy	Calculate food mileage and examine its CO_2 emissions.
	Know your daily energy.
	Investigate the power consumption in the school and work to reduce it.
	Find out how much electricity you use in your homes.
	Spend a week at Cool Biz.
	Measure daily energy consumption (such as water heater, TV, lighting).
	Checking the contents of the refrigerator to reduce the number of times the refrigerator is opened and closed.
	Compare the amount of leftover food with lunch and school lunch.
	Find out about leaving on.
	Learn about local production for local consumption.
Green plant	Create a green curtain to reduce the power consumption of air conditioners.
	Plant trees in the school playground to create green curtains and lower the temperature of the entire school.
	Grow vegetables and eat them yourself.
	Grow plants in school and on the way to school.
	Utilize resources (bottles, cardboard, magazines) and exchange for flower seeds.
Learn about CCE	Find out the causes and impacts of climate change.
	Ponder on climate change actions.
	Create a picture-story show to raise awareness about climate change.
	Learn by watching videos of climate-affected areas.
	Imagine the future 30 years from now.
Learn CCE in the subject	Graph global CO_2 emissions.
	Create and programmeme a robot to raise awareness of climate change.
	Become Greta and create a speech for the world.
	Create a poem on the theme of climate change in English.
	Become the earth and write a message for the people of the world.
	Graph the rise in sea level.
Biodiversity	Examine the nature of the area and learn about changes in the historical environment.
	Find out about changes in familiar ecosystems.
	Find out about endangered species.
Out of school learning	Interview people in agriculture, fishing, and forestry about the impact of climate change.
	Water quality survey (such as water services, school playground, rivers).
Disaster risks	Learn about the location, number, and size of typhoons.
	Learn about climate change disaster.

One example is Mr. Kentaro ONO's practice; he is the famous promoter of climate change in his district. He was born in Sendai in Tohoku district, went to Kiribati for high school in 1993 and continued to remain there after graduation. He was naturalized in Kiribati in 2000, being

the first naturalized Japanese – Kiribati. After the powerful/devastating Earthquake and Tsunami of 2011, he went back and has been living in Sendai. He has been actively engaging in advocacy on the impact of climate change and global warming to Kiribati in human capacity. Many CCE practices in school were developed as a result of his advocacy.

Another useful practice is for reducing marine plastic waste. Students in Tadami town have adopted "Climate Emergency Declaration" and "PET Free Monday" after the experimental study on the seacoast. "Climate Emergency Declaration" is an action to acknowledge humanity is in a climate emergency. "PET Free Monday" means students' action to free their daily lives from the use of PET bottles. Another useful practice has been that initiated by Hachinohe Kodai-2 Senior High School for tackling marine plastic waste. Students promote scientific reach to understand the character of microplastic by experimental study. Consequently, they devised a method to detect microplastics absorbed by the body of planktons.

4.4 NEXT STEPS

Working Plan from July 2022

The detailed working plan from July 2022 is to continue research in pre-service and in-service teachers training course in Miyagi University of Education. Pre-service teacher training programme, CCE teacher training programme will be developed on the subject "International Understanding Education," "Multicultural Education" (Elective, 2 credits) which is for the second year and third-year school students for the teacher training course. In-service teacher training programme will be developed on the subject "Local and Global collaboration based on SDGs" (compulsory, 20 hours) which is for the First-year in-service teacher training course.

As for the local school activities, Tohoku Consortium is the regional network for promoting ESD and SDGs, which was supported by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) from 2014. ESD promotion hub districts were established in collaboration with the Regional ESD Activities Support Centre, collaborating with Tohoku Consortium, exploring and developing local CCE practices during July 2022-December 2023.

Upcoming Timeline and Deliverables

As Tohoku district is surrounded by sea, representative practices of CCE created by the schools are mainly for protecting the environment of the sea. Another specific character of Tohoku district is disaster risks. For improving the quality of CCE, collaborating with Tohoku Consortium, the practice of CCE conserving about the topic of marine plastic garbage and disaster risks will be explored this year. Research meeting will be held thrice during the financial year 2022.

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Report from Japan

5. Fostering Future Thinking using Climate Action Simulation

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ABSTRACT

This report provides interim result of a study that seek to explore pedagogical approach to foster future thinking, or the ability to assess different future scenario and make action plan accordingly. The study also introduces climate action simulation module which consists of lesson featuring computer based physical simulation and role-play based social simulation regarding dynamics of energy-climate policies. This report also contains the results of the preliminary study on the awareness and acceptance of pre-service science teachers regarding different climate actions available in the climate action simulation module. The preliminary study showed that while respondents self-reported that they understanding of climate action policy such as carbon pricing or zero carbon technology as low. Interestingly, despite having lower level of understanding they self-reported their acceptance of those policies as higher. Next step of the study will follow the ADDIE (Analyze, Develop, Design, Implement, Evaluation) model of instructional design to develop the climate action simulation module for use in Japan.

Keywords: ESD, future thinking, climate action simulation, science education

5.1 INTRODUCTION

Leading the charge in the initiative to accelerate mainstreaming of Education for Sustainable Development (ESD) into formal education, the UNESCO (2017) published a guideline covering key competencies for sustainability. In addition to other established competencies like systems thinking or critical thinking, the guideline also includes a more recent competency such as the "Future Thinking" or "the ability to assess different future scenario and make action plan accordingly", is gaining traction in the last decade (e.g. Wiek, 2011). However, one could argue that this competency is unique to ESD because it adheres to the sustainable development philosophy of balancing the needs of present and the future generation.

Additionally, the UNESCO (2017) guideline also included specific learning objectives that are designed to correspond to each Sustainability Development Goal (SDGs), with each learning objective is broken down into three domains: cognitive, socio-emotional and behavioral. For SDG 13 "Climate Action", the learning objectives demands learner to understand basic scientific concepts related with climate change and global warming, as well as being able to support policies regarding with climate mitigation and adaptations at different scale (local, regional, global) and different contexts (environmental, technological, socioeconomical).

Against the above background this report aimed to introduce climate action simulation module, which is a lesson model that combines two types of simulations: (1) An interactive computer model that simulates dynamics between energy policies and the change in physical climate; (2) A simulation of the social dynamics of decision-making in the form of role-playing. Combining those two types of simulations is potential to foster the future thinking as well as addressing the three domains of ESD learning.

5.2 METHODOLOGY

This report incorporates review of literatures pertaining to both future thinking and climate action simulation module (e.g., Holz et al., 2018; Rooney-Vargas et al., 2019; Kapmeier et al., 2020; Eker et al., 2021). Moreover, this report also contains the result of the preliminary study on the awareness and acceptance of pre-service science teachers of different climate actions available in the climate action simulation module.

5.3 RESULTS AND DISCUSSION

5.3.1 Future Thinking

Numerous theoretical frameworks, such as anticipatory thinking (Crofton, 2000), foresighted thinking (de Haan, 2006), transgenerational thinking (Kelly, 2006), and future thinking (Wiek, 2011), inspired the conception of this study. Rieckmann, Mindt and Gardiner (UNESCO, 2017) proposed an operational definition of anticipatory competency as "(1) The abilities to comprehend and evaluate multiple futures – possible, probable and desirable; (2) to create one's own visions for the future; (3) to apply the precautionary principle; (4) to assess the consequences of actions; and (5) to deal with risks and changes." Notions contribute to the development of anticipatory competence, prediction (1,2) and action planning (3,4,5), are arguably aligns well with the objective of climate change education, which is to motivate meaningful and prompt action to combat climate change and its impact.

This study adopts operational definition of this competency by synthesizing notions from the above literatures (mainly Wiek, 2011; UNESCO, 2017; Redman & Wiek, 2021) and work of the Japanese National Institute for Educational Policy Research (NIER, 2012), which resulting into the identification of three components constructing the future thinking competency (**Fig. 5.1**): (1) **"Picturing"**, the ability to analyze and picture different future probabilities based on existing information; (2) **"Predicting"**, the ability to collect and evaluate evidence in determining the most probable future; and (3) **"Planning"**, the ability to reflect on actions needed to achieve the desirable future while preventing undesirable future from happening.

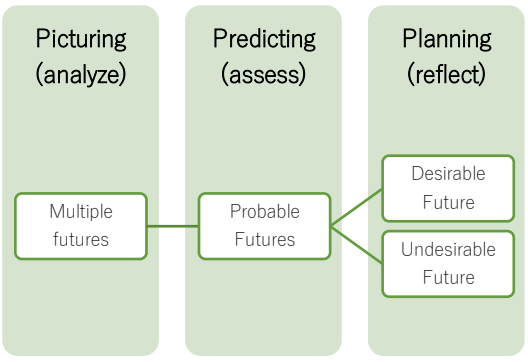

Fig. 5.1 Future thinking components

5.3.2 Climate Action Simulation

The Climate Action Simulation is built on the En-ROADS computer model (Siegel et al., 2018), which stands for Energy Rapid Overview and Decision Support (**Fig. 5.2**). En-ROADS enables users to build energy and societal transition scenarios interactively while providing real-time feedback on the impact of decisions and policies on the energy supply, greenhouse gas emissions and anticipated outcomes for the global climate over the twenty-first century. En-ROADS was designed for learners with little to no knowledge about climate action. It is also enable learners to examine scientific model underlying the simulation. It is publicly available online and runs in less than 0.1 second on a laptop or over an internet server. EN-ROADS allows users to mix and match 18 policies in 6 different sectors (energy supply, transport, buildings and industry, population and economic growth, land and industry emission, carbon removal technology) (**Table 5.1**) in order to simulate the impact of different scenarios on achieving the goal of 1.5 °Celsius threshold of temperature increase since the industrial revolution.

In regards of fostering future thinking as the key competency in ESD, the climate action simulation demonstrates a high degree of congruence. In the Climate Action Simulation, learners assume various roles and are empowered to make different scenario policies within their own sector while seeking to influence the actions of other sectors (**picturing**). The simulation enables them to collect evidence and assess the probability and feasibility of their own scenarios (**predicting**). Together, they seek to provide a technically and scientifically viable approach to achieve the climate action objective (**planning**). The Climate Action Simulation varies from typical role-plays in that it is framed by an interactive computer model, allowing players to get instant feedback about the projected results of their own actions based on the simulation made possible by En-ROADS.

Fig.5.2 Display of the EN-ROADS climate action simulator (https://en-roads.climateinteractive.org/scenario.html?v=22.5.1)

Table 5.1 Different policy scenarios available in EN-ROAD

No	Policy	Sector
1	Reducing energy use from coal	Energy supply
2	Reducing energy use from oil	
3	Reducing energy use from natural gas	
4	Promoting use of bioenergy	
5	Promoting use of renewable energy	
6	Promoting use of nuclear energy	
7	Promoting zero carbon technology	
8	Promoting carbon pricing policy	
9	Promoting energy efficiency in transportation	Transportation
10	Promoting electrification in transportation	
11	Promoting energy efficiency in buildings and industry	Buildings and industry
12	Promoting electrification in buildings and industry	
13	Reducing population growth	Growth
14	Reducing economy growth	
15	Reducing deforestation	Land use and industry emission
16	Removing other GHG (e.g. methane)	
17	Promoting afforestation	Carbon removal
18	Promoting carbon removal technology	

5.3.3 Preliminary Study Results

Fig.5.3 displayed preliminary study to evaluate the content of the climate action simulation module as shown in **Table 5.1**, but expanding the promoting carbon removal technology policies into five detailed examples (DAC: Direct Air Capture, BECCS: Bioenergy Carbon-Capture and Storage, Mineralization and the biochar technology). The evaluation is conducted by administering a 5-scale self-evaluation sheet to a respondent of students taking the "Science Education Course" in Okayama University. The "low" category corresponds to the score 1-not at all understand and 2-slightly understand; moderate corresponds to the score 3-moderately understand; while high corresponds to score 4-very understand, and 5-extremely understand.

Moreover, **Fig. 5.3** showed that while it is apparent that while there is a high understanding in regards to policy regarding energy use (e.g. reducing fossil fuel, promoting renewable energy) and the importance of land use policy (halting deforestation while promoting deforestation). Respondents report that they have low understanding of carbon pricing, zero carbon technology and carbon removal technology, or even promoting electrification in buildings and industry. Interestingly, As shown in **Fig. 5.4**, there is a level of self-reported acceptance despite lower level of self-reported understanding about each climate action policy. Thus, there is a need to give background information regarding those policies for better learning experience during the climate action simulation.

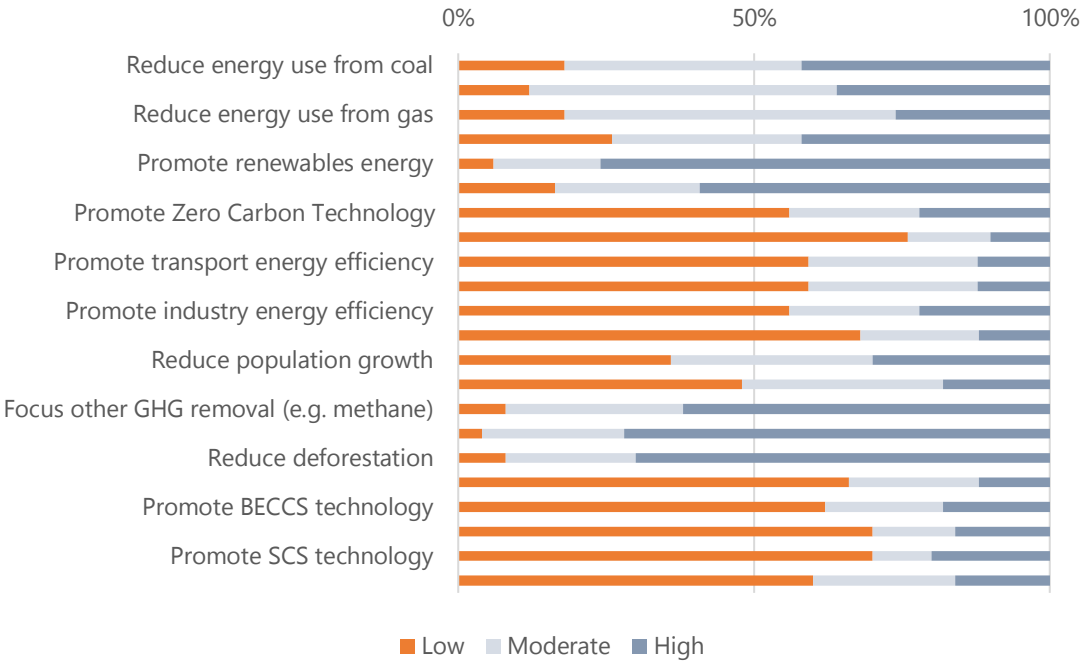

Fig. 5.3 Preliminary study result of 5-likert like self-evaluation score of respondents of pre-service science teachers in Okayama University (n=50) regarding content in the climate action simulation.

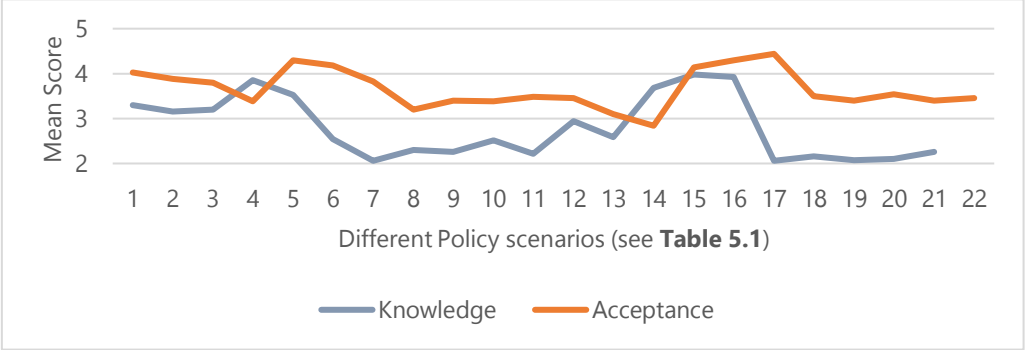

Fig. 5.4 Preliminary study result of 5-likert like self-evaluation score of respondents of pre-service science teachers in Okayama University (n=50) regarding understanding and acceptance of climate action policies content in the climate action simulation module

5.4 NEXT STEPS

Next step of this study is the development of the climate action simulation module to foster future thinking, targeted for pre-service science teachers. The module development is following the ADDIE model (Morrison, 2010) of instructional design, as shown in **Fig. 5.5** and **Table 5.2**. The "analyze phase" will expand findings of the preliminary study to design an appropriate instrument that can asses both understanding of the climate action policy and the acquisition of future thinking as the key competency. For the "*design, development, implement, evaluate"* phase of the research, authors will collaborate and consult with educational researchers and practitioners for the validation of the final module.

Fig. 5.5 ADDIE Model of instructional design

Table 5.2 Explanation for each research phases

	Phase	Process/Deliverables	Target
1.	Analyze	Need analysis, target analysis and content analysis	Jul'22
2.	Design	Learning objectives, instructional strategy, evaluation strategy	Aug'22
3.	Development	Content development (Japanese version)	Sep'22
4.	Pilot Implementation (1)	Intervention class targeting Japanese pre-service teachers	Oct'22
5.	Pilot Evaluation (1)	Pre- and post-test, usability survey, results comparison	Oct'22
6.	Pilot Implementation (2)	Intervention class targeting Japanese pre-service teachers	Nov'22
7.	Pilot Evaluation (2)	Pre- and post-test, usability survey, results comparison	Nov'22
8.	Data analysis	Analysis of pilot evaluation	Dec'22
9.	Revision development	Content revision based on pilot implementation and evaluation	Dec'22
10.	Final Implementation (1)	Intervention class targeting Japanese pre-service teachers	Apr'23
11.	Final Evaluation (1)	Pre- and post-test, usability survey, results comparison	Apr'23
12.	Final Implementation (2)	Intervention class targeting Japanese pre-service teachers	May'23
13.	Final Evaluation (2)	Pre- and post-test, usability survey, results comparison	May'23
14.	Overall dissemination	Final analysis and design of the lesson module	Dec'23

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Report from Kazakhstan

6. Promoting Teacher Education for Climate Change Education at Abai Kazakh National Padagogical University

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ABSTRACT

The analysis of the survey's preliminary results showed the readiness of teachers at the school level and faculty members at the university level to adapt their consciousness, as well as the inconsistency of behavioral, and environmental skills with theoretical knowledge in the framework of adaptation to climate change. Thus, 53% of respondents believe that the use of bicycles and other environmentally friendly modes of transport helps to reduce air pollution, but nevertheless, only 1% of them use such modes of transport. The survey revealed a deep and correct understanding by the respondents of the economic and social consequences of climate change, and the priority of solving environmental problems associated with environmental pollution. Geography teachers generally believe that the catastrophic effects of climate change can be prevented or mitigated. An important finding is that, compared to other activities, educating students has an exceptional advantage in combating climate change (about 61% of respondents consider it very important, 38% important). Taking this into account, the research group of Abai Kazakh National Pedagogical University (Abai KazNPU) initiated the introduction of a new course "Climate Change and its Consequences" into the educational programme of geography teacher training. The purpose of the discipline is to study the essence and analyze the causes and consequences of modern climate change on the Earth. The course with the amount of 4 credits will be included in the module "Interaction of Society and Nature," and is planned to be taught in the 4th semester. In order to promote climate change education in Abai KazNPU, a number of activities at university, national and international levels have been organized: exhibitions, project competitions, international Olympiads and conferences. These activities are aimed at forming theoretical knowledge and environmental skills of students in the framework of adaptation to climate change, as well as the promotion of climate knowledge among students, school teachers and university staffs.

Keywords: Kazakhstan, Abai KazNPU, teacher training, teacher survey, climate change, climate change education

6.1 INTRODUCTION

The Earth's climate is changing, and it's happening right now. This is not a distant

phenomenon that will occur sometime in the future, and it is not just about the temperature rise. In some parts of the world, annual precipitation is expected to decrease over the long term, while in other regions fluctuations in precipitation and temperature will markedly affect the growing season of some plants. Elsewhere, annual precipitation may remain the same, but at longer intervals, in the form of much heavier and shorter showers, causing more droughts and floods. Severe storms and their variant, hurricanes, may increase in intensity. The potential consequences of climate change are varied and extensive, so preventing these consequences has become a high priority on the global development agenda. The aim of this study is to analyse the main trends of climate change and to integrate the research findings into the content of a teacher training course for climate change education through collaboration between leading Asian centres of excellence in Education for Sustanable Development (ESD).

6.2 METHODOLOGY

Primary information is collected on the basis of literary sources, analysis of articles, books and monographs, as well as analysis of best practices in climate change education. The study uses both theoretical (analysis, induction) and empirical research methods (comparison, survey). The preliminary results of the survey of school teachers and pedagogical university faculty members were analyzed; the structure of the new discipline "Climate Change and its Consequences" inputted in the geography teacher training curriculum is proposed, activities for promoting teacher education for climate change education at Abai KazNPU are presented.

The survey of school teachers and pedagogical university faculty members in Almaty and the Almaty agglomeration was conducted in order to determine their awareness of international agreements in the field of climate change and decisions made within their framework. The survey used the questionnaire developed by Okayama University that was adapted to local conditions and national characteristics. Bachelor's degree graduates of Abai KazNPU who completed their studies in the last 5 years participated in the survey. Respondents showed a high level of awareness of the causes and consequences of the greenhouse effect, knowledge of climate change's negative consequences, but insufficient awareness of international agreements in the field of climate change (COP 21, held in Paris in 2015, etc.) and the decisions made within them.

Earlier, one of our researchers wrote a dissertation on "Shaping knowledge about the environment based on climate concepts in conditions of updated geography content," and the following results were obtained [1]: The analysis of foreign experience in the state of geography teaching, content and didactics of textbooks forming knowledge about the environment was carried out. The tendencies in educational directions in the conditions of modern globalization were revealed.

Based on the analysis of educational and methodical literature the methodical system of teaching climate concepts in which traditional approaches considering the peculiarities of teaching climate processes are supplemented with achievements of digital technologies and harmonized with new pedagogical technologies of teaching is developed. It is made in the

form of a content-structural model consisting of blocks in which all components of the teaching process are considered. A methodology for teaching climate change, which has not yet been considered in domestic research, is given.

The attention to climate change education reflected in trends on the international agenda is among the most important issues in education policy research and international development. However, in most cases, it is perceived only as 'alternative education' in the education system, as education has not much to do with basic development goals. Climate change is currently being explored through the inclusion in certain curricula [1]. The potential of approaches and methods in education is focused on the learner's knowledge and understanding of themselves, their environment, and the creation of personal or social change. Education that addresses critical thinking and problem-solving skills is key to the issue of climate change and sustainable development [2; 3].

It was important for us to first analyze the current scientific evidence on climate change in Kazakhstan in order to use this material later in training teachers on climate change. The climatic conditions of Kazakhstan are determined by its geographical location. The Republic is located at the junction of two continents, Europe and Asia. The territory of Kazakhstan is 2,724.9 thousand km^2. The length of the state border of the Republic is 13,394 km. The Republic takes ninth place in the world in terms of land area. Kazakhstan is the largest country in the world that has no access to the world ocean. The relief of the territory is predominantly flat - more than 90% of the total area. High mountains occupy only the southeast and east parts of the country. Large parts of the country are occupied by flat areas, aggravated by outcrops of heavily destroyed ancient mountain structures. Most of the country is occupied by arid natural zones: desert, semi-desert, and arid-steppe. Only in the north of the territory there are steppes and forest steppes, which are more favorable in terms of moisture conditions. A special feature of the climate of the territory is aridity. And almost all lands are located in the zone of extreme agriculture and any irrational use of water, vegetation and land resources leads to land desertification.

Systematic climate observations in Kazakhstan are carried out by the Republican State Enterprise (RSE) Kazhydromet, which is a structural subdivision of the Ministry of Energy. The RSE has 15 branches located in all oblast centers of Kazakhstan and Almaty. The hydrometeorological network in Kazakhstan has 328 meteorological stations and 307 hydrological posts (in 2011 their numbers were 260 and 298 respectively). 86 meteorological stations (out of the available ones) transmit information to the World Meteorological Organization (WMO) Global Observing Network on a daily basis. 66 weather stations belong to the WMO Regional Synoptic Reference Network and 44 to the WMO Regional Climate Reference Network. In addition, RSE Kazgidromet provides information on the agrometeorological and ecological state of the environment.

According to the analysis of this service for the period 1976 - 2019, the average increase in average annual air temperature in Kazakhstan is 0.31 ºC every 10 years. The highest rate of increase is observed in the spring period (0.60ºC/10 years), the lowest in the winter period (0.11ºC/10 years). All of the air temperature trends obtained are statistically significant except for the winter season. Also, there is a tendency for annual precipitation to increase by 4.3

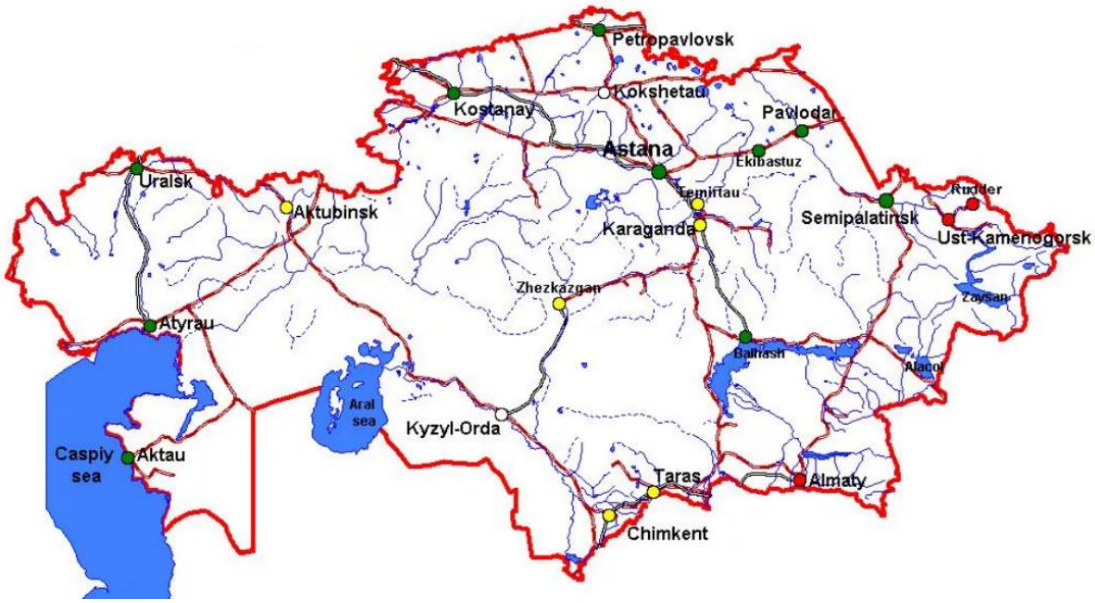

Fig. 6.1 Kazhydromet's atmospheric observation network

mm/10 years between 1976 and 2019. In all seasons, except autumn, the amount of atmospheric precipitation increases by 1.9 - 3.2 mm/10 years. A statistically significant change in precipitation is noted only in spring.

6.3 RESULTS AND DISCUSSIONS

The analysis of trends in extremes of surface air temperature and amount of atmospheric precipitation showed that for the period 1961 – 2019 [4]:

- there has been a steady increase in the number of days with temperatures above 35°C and nights with temperatures above 20°C, especially in the south, south-west and west parts of the republic;
- there has been a widespread increase in the total duration of heat waves and a reduction in the total duration of cold waves;
- a steady increase in the number of days with average daily temperatures above 10°C is observed everywhere;
- in the west, north and south parts of the country, the number of days with daytime frost, when the daily maximum temperature is below 0°C, is decreasing;
- in many regions, the number of days with severe frosts, when the daily maximum temperature is below minus 20°C, is significantly reduced;
- there is a reduction in the heat deficit during the cold season and an increase in the cold deficit during the warm season, especially in the south-west and west parts of the country;
- in most of the territory of Kazakhstan, a decrease in the maximum annual values of daily precipitation is observed;

- the share of extreme precipitation in annual precipitation varies mostly insignificantly; and
- there are weak statistically insignificant both positive and negative trends in the maximum duration of the rainless period.

6.3.1 Detailed Consideration of Individual Meteorological Elements in the Territory of Kazakhstan [5]

In Kazakhstan, a widespread increase in surface air temperature has been observed over the last 75 years. The average annual air temperature anomaly has increased up to 2°C. Average annual air temperature increased the most in West Kazakhstan region - by 0,38 °C/10 years, the least in South Kazakhstan, Almaty, East Kazakhstan, Pavlodar, Atyrau, Aktobe, Karaganda, Akmola regions - by 0,22 ... 0,29 °C/10 years. In other regions growth of average annual temperatures was observed within 0,30 ... 0,31 °C/10 years.

The average rate of increase in average annual air temperature in Kazakhstan is 0.28 °C every 10 years. As per seasons for Kazakhstan overall, the highest temperature increase occurs in spring and autumn - by 0.30 and 0.31 °C/10 years, slightly less in winter - by 0.28°C/10 years, in summer the lowest temperature increase rate is observed - by 0.19°C/10 years. In most cases, temperature trends are statistically significant at 95% confidence interval, the trend contribution to the total variance of mean annual temperature is 40%, for the seasons - from 7 to 27%.

The most vulnerable water basins are Ural-Caspian and Shu-Talas basins, due to the fact that the rate of increase in average annual temperature is 0.36 and 0.31°C every 10 years. The rate of increase in average annual air temperature in winter in the Ural-Caspian and Ertis basins by 0.41 and 0.31 °C/10 years, in spring in the Yesil and Ural-Caspian basins by 0.37 and 0.39 °C/10 years.

The lowest increase in average annual temperatures was observed in summer, the highest rates of increase in average annual temperatures were in the Shu-Talas and Ural-Caspian basins and amounted to 0.28 and 0.32 °C/10 years. In autumn, the Shu-Talas and Ural-Caspian basins were also the most vulnerable basins. If we consider the linear trend of the air temperature anomaly (relative to the base period 1961 ... 1990) by season and year, we can observe that all trends in the series of average annual and seasonal values of surface air temperature are positive and statistically significant, which indicates a steady increase in air temperature in the territory of Kazakhstan from 1941 to 2015.

Trends in average annual temperature across Kazakhstan were positive and statistically significant. This is also true for spring, summer and autumn. Trend values for mean annual, spring and autumn temperatures were mainly 0.21 ... 0.40 °C/10 years, in spring in the west and in the north 0.41 ... 0.60 °C/10 years. Summer temperature trends in most of the area were within 0.21 ... 0.40 °C/10 years, in the southeast, east and north - up to 0.21 °C/10 years. Winter temperatures increased significantly in the western and south-eastern parts, as well as in some northern regions, to a maximum of 0.41 ... 0.60 °C/10 years.

6.3.2 Observed changes in precipitation in Kazakhstan and its regions

In contrast to air temperature, changes in precipitation regime in Kazakhstan during the research period present a heterogeneous picture. A general idea of the nature of contemporary precipitation regime changes in Kazakhstan is shown by the time series of annual and seasonal precipitation anomalies for the period from 1940 to 2015, calculated relative to the baseline period of 1961 to 1990, and spatially averaged over Kazakhstan.

On average in Kazakhstan for the period from 1940 to 2015 annual precipitation decreased slightly by 0.2 mm/10 years. If we consider changes in precipitation by region, Aktobe, Karaganda, Pavlodar, Akmola, Almaty and North Kazakhstan regions showed a slight increase in annual precipitation by 0.1-5.0 mm/10 years, while in the rest of the country it decreased by 0.1-4.2 mm/10 years. All the obtained trends of annual precipitation are statistically unreliable.

For the period from 1941 to 2015 on average for Kazakhstan in all seasons, there is a weak trend (statistically insignificant) decline in precipitation by about 0.7 mm/10 years, except for the winter season, when the trend is 1.5 mm/10 years and is significant. Thus, in the changes in precipitation regime over the research period, there is a significant tendency for precipitation to increase in winter and to decrease in other seasons.

6.3.3 Analysis and Assessment of Extreme Events in Kazakhstan that Caused Deaths and Significant Material and Financial Losses

Seven of the ten warmest years between 1936 and 2020 occur at the beginning of the 21st century. The absolute maximum temperature was observed in 2020 at 1.92°C, surpassing the record of 1983 with an anomaly of 1.89°C, which remained the warmest year in Kazakhstan for three decades in the history of instrumental observations. 2015 was also one of the hottest years on record, ranking third. Ten anomalously warm years for Kazakhstan with corresponding anomalies are shown below (**Table 6.1**).

Table 6.1 Ten anomalously warm years and corresponding anomalies of mean annual air temperature averaged over the territory of Kazakhstan [6]

Year	Anomaly, C°
2020	1,92
2013	1,89
1983	1,86
2015	1,66
2002	1,61
2004	1,55
2007	1,47
1995	1,43
2008	1,31
1997	1,27
2005	1,19

Table 6.2 Number of extreme weather events in Kazakhstan in 2013-2015 [5]

EWE	Year		
	2013	**2014**	**2015**
Heavy rain	45	26	41
High wind	32	44	39
Heavy snowstorm	35	27	16
Heavy snow	26	18	18
Heavy fog	7	8	6
Dust storm	0	0	5
Wet snow deposition	3	2	0
Hail	1	0	3
Ice	0	3	0
total	149	128	128

Table 6.3 Hydrometeorological emergencies in Kazakhstan [5]

Year	Number of emergencies	Number of casualties	Number of deaths
2011	43	12	5
2012	39	20	15
2013	36	12	3
2014	43	19	9
2015	75	8	-

In 2013, the total number of extreme weather events in Kazakhstan was slightly higher (149 cases) than in 2014 and 2015 (128 cases each) (**Table 6.2**). The year 2013 is characterised by frequent occurrences of heavy precipitation in the form of rain and snow (71 cases), heavy snowstorms (35 cases) and strong winds (32 cases). All these EWEs (138 cases out of 149) were the main causes of emergencies in the Republic of Kazakhstan. 2015 was a record year in terms of the number of hydro-meteorological emergencies (mainly heavy precipitation, floods and mudflows). The number of hydrometeorological emergencies in 2015 was almost 2 times higher than in the previous 4 years (**Table 6.3**).

6.3.4 Analysis and Assessment of Changes in the Frequency and Intensity of Extreme Meteorological Phenomena by Regions of Kazakhstan

Extreme meteorological phenomena, which are typical for the territory of Kazakhstan during the cold period, are heavy snowfalls and blizzards accompanied by storm and even hurricane winds, severe long-lasting frosts, ice and frost phenomena and late spring frosts. Heavy showers accompanied by thunderstorms, hail and strong winds are recorded during the warm period. Cases of extreme fire danger are noted during the summer period. In addition, severe droughts are characteristic of Kazakhstan, leading to a sharp decrease in crop yields. Abnormally low air temperatures pose a significant threat to normal life activities of the population and lead to emergencies related to accidents at heat and power systems, engineering networks.

Table 6.4 shows the frequency of severe and moderate droughts causing significant damage

to agriculture in Kazakhstan. In the main grain-producing regions of Kazakhstan, severe droughts, leading to a decrease in average regional grain crop yields by 50% or more, have a high recurrence in West Kazakhstan, Aktobe, Karaganda and Kostanay regions. In the first three regions a severe drought is likely once every 4-6 years, and in Kostanay region once every 8 years. **Table 6.5** provides a list of natural (extreme) meteorological events and their criteria for the period from 1990 to 2015.

During the period under review (26 years), a total of 3,840 cases of EMPD were reported in Kazakhstan, an average of 148 cases per year. The maximum number of cases with EWE (268) was registered in 1999 due to the high frequency of heavy precipitation, heavy snowstorms with storm winds and hail (**Fig. 6.2**), while the minimum number of cases (72) was registered in 1995. Overall, there is an increasing trend in the total number of cases with EWE. The most recurring EWEs are: high wind, heavy rain, heavy snow, heavy snow and heavy fog (**Fig. 6.3**)

Table 6.4 Recurrence of droughts between 1966 and 2010 (%) [5]

Region	Drought recurrence rate, %		Drought is likely to occur once every ... year	
	all categories	**strong**	**all categories**	**Strong**
West Kazakhstan	38	24	3	4
Aktobe	31	20	3	5
Karaganda	36	16	3	6
Pavlodar	40	9	3	11
Kostanay region	27	13	4	8
Akmola	33	4	3	23
East Kazakhstan	27	7	4	15
North Kazakhstan	22	2	5	45

Table 6.5 Extreme weather events and their characteristics [5]

№	**Events**
1	Heavy rain (sleet, rain with snow) with rainfall ≥30 mm or less in 12 h in mudflow and avalanche-prone areas; rain and rain with snow with rainfall ≥50 mm or less in 12 h in the rest of the area
2	Heavy snow (snowfall) with rainfall ≥20 mm in 12 h and less
3	Heavy snowstorm (blizzard, total) lasting 12 hours or more with wind speeds ≥15 m/s
4	High wind (including squalls and tornadoes) with a maximum wind speed of 30 m/s or more
5	Hail with hail diameters ≥20 mm or intensive hail of smaller size causing significant damage
6	Severe dust (sand) storm with a duration of 12 hours or more and an average wind speed ≥15 m/s
7	Severe fog with visibility of 100 m or less for 6 hours or more
8	Heavy ice ≥20 mm in diameter
9	Snow deposit with a diameter ≥35 mm

The cumulative frequency of these events is 94.3%.

The statistical results were obtained by dividing the period under review into 2 parts (13 years each) (**Table 6.6**). Thus, the average annual number of occurrences of heavy rain (49.3) increased by almost 2.5 times, and of heavy snow (24.9) by 2.7 times in the period 2003-2015, compared to the period 1990-2002. The number of cases with strong wind and hail has increased, but slightly, by 20 and 30% respectively. On the contrary, the following EWEs have decreased in recent years: heavy snowstorm (1.8 times), heavy fog (2.7 times) and heavy dust storm (3.4 times).

Looking at the recurring EWEs by regions (heavy rain, wind, snow and blizzard), the Almaty region has the highest recurrence of EWEs in the country (**Table 6.7**). Almost every second occurrence of heavy rain, heavy snow and strong wind in Kazakhstan occurs in this region. Moreover, in the period from 2003 to 2015, compared to the previous period (1990-2002), the average annual number of cases of heavy rain increased by 3.9 times, with heavy snow by 3.3 times and strong wind by 1.6 times.

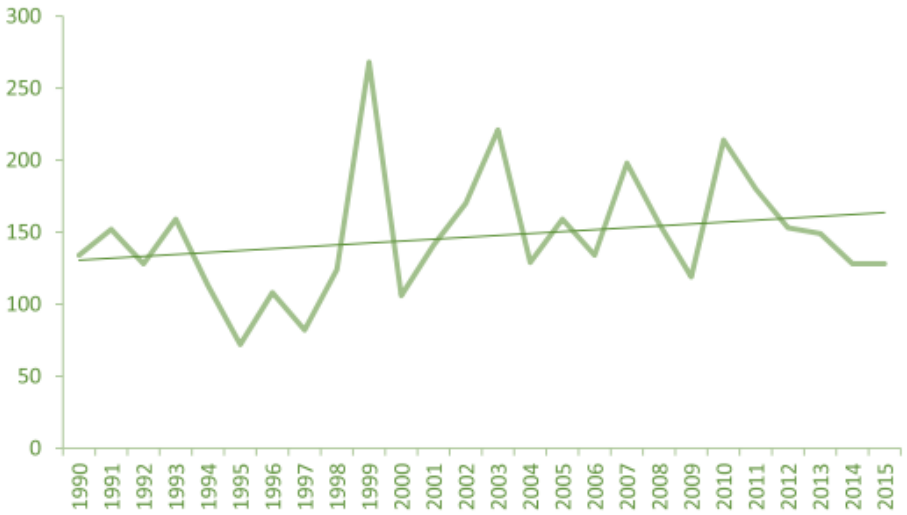

Fig. 6.2 Evolution of the total number of days with EWE in Kazakhstan from 1990 to 2015 [5]

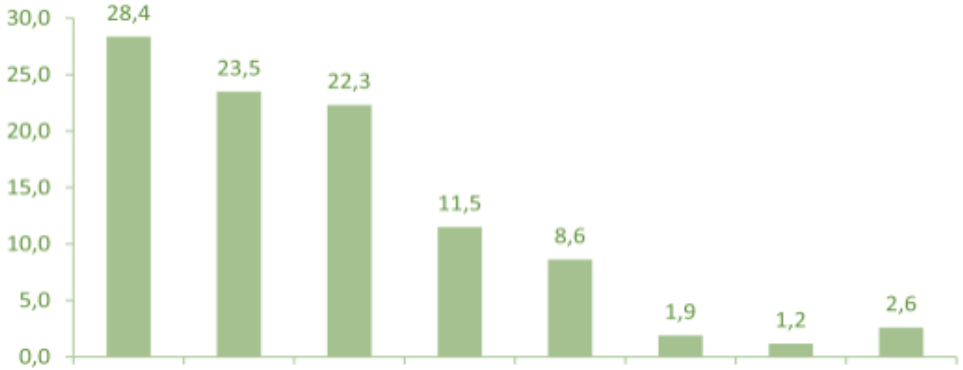

Fig. 6.3 Average share of EWE in Kazakhstan (%) over the period 1990-2015 [5]

Table 6.6 Average annual number of cases with EWE in Kazakhstan over different periods

EWE	Number of EWE cases	
	1990-2002	2003-2015
Heavy rain	20,1	49,3
High wind	38	45,8
Heavy snow	9,1	24,9
Heavy snowstorm	42,4	23,5
Hail	2,5	3,2
High fog	18,6	6,8
Heavy dust storm	2,7	0,8

Table 6.7 Repeatability (%) of EWE by region in Kazakhstan [5]

Region	EWE			
	Heavy rain	Strong wind	Heavy snowstorm	Heavy snow
Kyzylorda	0,1	1,2	1,5	0,3
South Kazakhstan	14,5 (1,7)	2,7 (0,4)	1,0	28,1 (2,3)
Zhambyl	6,0 (1,5)	10,2 (1,5)	1,3	3,7 (1,3)
Almaty	59,2 (3,9)	43,6 (1,6)	0,5	43,8 (3,3)
East Kazakhstan	4,8 (3,7)	14,5 (0,7)	15,3 (0,8)	11,6 (7,6)
Karagandy	1,8	4,4 (0,8)	12,3 (0,4)	1,7
Pavlodar	1,8	1,2	4,3 (0,1)	0,9
Akmola	2,7 (0,7)	9,7 (1,6)	19,4 (0,5)	2,6 (4,0)
North Kazakhstan	2,8 (4,0)	5,0 (3,4)	6,1 (0,5)	0,0
Kostanay	2,9 (5,3)	3,6 (2,7)	18,4 (0,8)	4,3 (3,5)
Aktobe	0,8	0,8	14,8 (0,8)	1,7
Atyrau	0,7	0,4	3,1 (1,3)	0,3
West Kazakhstan	1,3	1,2	1,5	1,1
Mangistau	0,6	1,6	0,3	0,0

Considering all the EWEs observed in Kazakhstan in recent years, it is observed that Almaty region ranks first in terms of the number of reported EWEs, i.e. 38.7% of all EWE cases in Kazakhstan. It is followed by South Kazakhstan and East Kazakhstan regions, 10.9% and 10.7% respectively. The share of Akmola and Zhambyl regions is 8.3 and 7%, respectively. In the remaining regions, the repeatability ranges from 1% (Mangistau region) to 6% (Kostanai region).

In conclusion, it is highly probable that 2016 will enter a series of years with a high incidence of EWE in Kazakhstan. Only in Almaty city from April to July 2016 there were 10 cases of heavy rainfall, accompanied by gusty winds, sometimes with hail, which hampered traffic and people, broke trees, and flooded houses. For example, in the evening of 18 July 2016, Almaty was immersed in the gloom of a summer storm, with a thunderstorm accompanied by heavy downpours, gusty winds, and large hail in places.

Such events are no longer uncommon in the Ili Alatau foothills, but this one was special. In the photo (**Fig. 6.4**) you can see that the city of Almaty was covered by a powerful thunderstorm. Almaty was covered by a powerful thunderstorm cloud, a kind of mesocyclone with a characteristic rotating rising airflow. Such mesocyclones, although small in scale

Fig. 6.4 Powerful thunderstorm cloud over Almaty (18 July 2016)

(diameter up to 50 km), can cause heavy precipitation with hail and storm winds.

This is not an isolated case of observed EWE in the Almaty area. Thus, on 17 May 2011, heavy rain with storm wind and hail caused tens of thousands of trees in the Small Almaty Gorge to fall and be damaged. This caused considerable damage to the protected area. A comparison of the dynamics of average wind speeds and the number of days with dust storms by periods revealed the following features.

The first period, an increase in the frequency of dust storms, is generally consistent with an increase in wind speed. However, at the end of the period, a sharp increase (almost 4 times) in the number of days with dust storms is noticeable, while the average wind speed increased by only 0.3-0.4 m/s. Probably, a significant increase in dust storm frequency is connected with the intensive lowering of the Balkhash lake level, which reached its minimum in 1987.

The second period – despite a significant decrease in wind speed, the number of days with dust storms though had a negative tendency but remained at a high level (on average 40 days per year). This period (1988-2001) coincided with the period when the level of lake Balkhash was below the norm.

The third period is characterized by dynamics of wind speed and Balkhash lake level increase and small changes in the number of days with dust storms from year to year. Based on the results obtained above, it can be concluded that a sharp increase in dust storm frequency in the area of the Aral Sea Meteorological Station and Kuigan Meteorological Station (in the area of Balkhash Lake) was mainly connected with a decrease in water content of these objects.

Thus, global climate change has also affected Kazakhstan and various regional and local manifestations of changes in the parameters of key climate elements have been observed. All of this requires efforts to introduce climate change information into the educational environment of schools and higher education institutions, especially pedagogical higher education institutions.

6.3.5 Discussions

The increased focus on climate change highlights the need for new practices in education to actively engage citizens of different ages [7]. Although there is common knowledge and research initiatives that can help to achieve this goal, climate change education has not been sufficiently explored and implemented in the educational field. According to the problems emerging in the environment and society, we understand that the topic is fundamental and relevant from both research and policy perspectives. On the one hand, the problem of educating young people is central to the policies of all nations, as it affects not only the future economic potential of countries but the development of every individual and every society in general. On the other hand, the issues of climate change and rising temperatures are particularly important in terms of shaping knowledge about the environment.

What are the ways to respond to climate change in education? The first challenge is to create a climate-resilient education system (adaptation). And the long-term challenge is to acquire the knowledge, the qualifications needed to meet future challenges.

Although research on sustainable development has been carried out since Rio 92, the need for education for sustainable development has never been as urgent as it is today. Environmental concerns dictate the need to transform our mindsets, mentality, habits and lifestyles as a matter of priority. To make this a reality, we need entirely new knowledge, practical skills, life principles, morals and attitudes that will ensure more sustainable, better societies.

Modern geographical education, as part of global education, addresses contemporary challenges such as climate warming and biodiversity loss, marine and terrestrial ecosystems conservation, clean water and sanitation, infrastructure development and innovation, responsible consumption and production, sustainable cities and human settlements, gender inequality, poverty and hunger eradication, partnerships for sustainable development, as well as other political, cultural, social and religious conflicts, ecological and environmental concerns. Global geographic education aims at teaching future generations to live in a global understanding for sustainable development and conservation of planet Earth.

Abai KazNPU is the main scientific and educational centre for training and retraining pedagogical personnel. Abai KazNPU pays particular attention to the achievement of the Sustainable Development Goals (SDGs). The university's achievement in the Times Higher Education (THE) Impact Rankings is a painstaking, daily and systematic effort of the entire university team. By participating in these rankings, Abai KazNPU demonstrates its commitment to achieving the SDGs and integrates its activities with these goals.

The 2022 ranking clearly demonstrated the university's efforts in achieving the SDGs and taking certain steps to both alleviate poverty and build human capital to address issues in education, social protection and employment, as well as climate change and environmental protection. For example, Abai KazNPU ranked 601-800 in the Times Higher Education (THE) Impact Rankings-2022, improving its last year's result by 200 points and becoming the absolute leader among national universities. A total of 1,406 universities from 106

countries/regions, including 10 universities from Kazakhstan, were included in the rankings. Abai KazNPU took 1st place in the Kazakhstani academic segment, as noted.

According to the results of the ranking, Abai KazNPU was ranked 401-600 on SDG 13 – Take urgent action to combat climate change and its impacts. The university's efforts to contribute to the global fight against climate change are rated at an average of 37.43%. Unfortunately, the level of research on this global issue is low at 1.2%. Overall, efforts for sustainable development show a relatively even trend in the shares of the constituent indicators: above-average publication of SDG reports – 60.8%, education for the SDGs – 55.6%, relationships to support the goals – 43.3%, research in this area below average – 38.9%.

Many of the scientific and methodological studies carried out by our specialists can be implemented in the whole educational system of Kazakhstan. Our research team has made these very issues its goal and main objectives. The preliminary results of the school teachers and pedagogical university academic staff survey were analyzed; the structure of new discipline "Climate change and its consequences" introduced in the curriculum of geography teacher training was proposed; activities to promote pedagogical education in the field of climate change education at Kazakh National Pedagogical University named after Abay were presented.

School teachers and pedagogical university academic staff survey was conducted in Almaty city and Almaty agglomeration to determine their awareness of international agreements on climate change and decisions made within their framework. The survey used a questionnaire developed by Okayama University, which was adapted to local conditions and national peculiarities. The survey involved students who had completed an undergraduate degree at Abai KazNPU and who had completed their studies in the last 5 years. The respondents demonstrated a high level of awareness of the causes and consequences of the greenhouse effect, knowledge of the negative effects of climate change, but insufficient awareness of the international agreements on climate change (COP 21, held in Paris in 2015, etc.) and the decisions made within their framework.

An analysis of the preliminary results of the survey showed the willingness of teachers at the school level and lecturers at the university level to adapt their consciousness, as well as the mismatch between behavioural and environmental skills and theoretical knowledge within the framework of climate change adaptation. For example, 53% of the respondents believe that the use of bicycles and other environmentally friendly modes of transport helps to reduce air pollution, yet only 1% of them use such modes of transport.

The survey revealed a strong and correct understanding of the economic and social impacts of climate change by the respondents, as well as the priority given to addressing environmental issues related to pollution. Geography teachers generally believe that the catastrophic effects of climate change can be prevented or mitigated. An important finding is that, compared to other activities, student teaching has an exceptional advantage in tackling climate change (around 61% of respondents considered it very important and 38% considered it important).

Taking this into account, the research team of Abai KazNPU initiated the introduction of a

new course "Climate change and its consequences" in the educational programme for teachers of geography. The aim of the discipline is to explore the essence and analyze the causes and consequences of modern climate change on Earth. The course of 4 credits will be included in the module "Interaction of Society and Nature" and is planned to be taught in the 4th semester.

In order to promote climate change education, Abai KazNPU organized a number of events at university, national and international levels: exhibitions, project competitions, international Olympiads and conferences. These events aim to develop theoretical knowledge and environmental skills in students within the framework of adaptation to climate change, as well as to popularize knowledge about climate change among students, school teachers and university staff.

For example, on November 17, 2021 the Institute for Natural Sciences and Geography of Abai KazNPU organized a city competition of research projects of students in grades 7-9 on the theme "Young Researcher and Sustainable Development" on the ZOOM platform.

School children's research projects were accepted to the competition in the following sections:

- Section 1 – measures to combat climate change and its consequences;
- Section 2 – conservation and efficient use of biological resources towards sustainable development; and
- Section 3 – effective use of achievements in environmental chemistry towards sustainable development.

More than 50 students from secondary schools in Almaty presented and defended their project research papers in Kazakh, Russian and English.

On November 25, 2021 Abai KazNPU held the International Scientific and Practical Conference "Green Universities: Experience, Perspectives in the Context of Sustainable Development." A Memorandum of Cooperation between Abai KazNPU and NJSC "International Centre for Green Technologies and Investment Projects" was signed at the conference. Within the framework of this document, the university students and faculty will be able to exchange experiences and participate in investment projects based on international green technologies. Obviously, this opportunity will serve as motivation for mastering modern technologies and enhancing the research potential of our university in the future.

From 4 to 10 April 2022 an exhibition on the theme "Nature is our common home" was held, the aim of which was to shape the environmental culture and environmental awareness of the students. The winners and leaders of the best projects were awarded letters of thanks, special prizes, and Abai KazNPU diplomas of I, II and III degrees. All participants and project leaders were awarded certificates. On 4 April 2022, Abai University held an exhibition of drawings "All about Birds" and creative works "Bird on the Nest" in the framework of the International Project "Year of the Bird."

A competition on the theme "Ecologization of Biological Education for Sustainable Development of the Republic of Kazakhstan" was held on April 11, 2022. 1st-year master's

degree students of the programme "7M01513-Biology" were the participants. The aim of the competition is to work on the achievement of the SDGs and to give students the skills to conduct project research.

Graduate students of programme "7M01513-Biology" of Abai University participated in the online international student conference "Development of Collaborative Research in Education: from a Global and Interdisciplinary Perspective" organized by the University of Tsukuba (Japan) on 17-18 March 2022.

On 28-29 April 2022 the II International Student Olympiad on Natural Sciences among students of pedagogical specialties, organized by the Institute for Natural Sciences and Geography, was held in the Republican Training and Recreation Centre "Baldauren" in Kapshagay city. Students from the universities in Russia, Uzbekistan, Kyrgyzstan, and Kazakhstan (10 teams in total) took part in the Olympiad. The third round of the Olympiad was dedicated to defending a case study on "Climate Change and Sustainable Development." Thus, Abai KazNPU is doing significant work in the field of Education for Sustainable Development, namely SDG 13 – Combating Climate Change. Because Education for Sustainable Development (ESD) contributes to equipping learners of all ages with the knowledge and skills, values and attitudes to address the interrelated global challenges the world faces, including climate change. We must ensure that what we learn, where and how we learn, prepares us for today's and tomorrow's challenges, that education is a transformative force, and that it enables us to make informed decisions and take individual and collective action at local, national and international levels.

6.4 NEXT STEPS

6.4.1 Detailed Plans from July 2022

- July – August, 2022 – preparation of publications in ranking journals on the results of the study "Promoting Teacher Education for Climate Change Education in Abai KazNPU;"
- September, 2022 – preparation of conceptual proposals on the results of study on the content of the educational programmes on Geography, Biology, Natural Sciences for secondary schools in Kazakhstan for the implementation of sustainable development;
- October, 2022 – to organize and conduct an international round-table meeting of young scientists "Education and climate change" with the participation of countries participating in the project;
- November, 2022 – to organize and conduct activities (project competitions for pupils of secondary schools in Kazakhstan, scientific seminars, meetings) aimed at dissemination of the project in universities and schools of Kazakhstan; and
- December, 2022 – development and preparation of course "Climate and Life, environmental changes for sustainable schools" methodical assistance to schools' teachers in practical application, for introducing climate change and its impacts into the curriculum of school subjects, extracurricular activities and supplementary education.

6.4.2 Upcoming Timeline and Deliverables

- January, 2023 – organization of events (meetings, trainings, seminars, etc.) to introduce the course "Climate and Life" in higher and secondary educational institutions of Kazakhstan;
- February – March, 2023 – implementation of courses "Climate and Life;"
- April – May, 2023 – organization and carrying out of a number of activities (subject olympiads, scientific seminars, meetings, round tables, international conferences) aimed at popularizing the project theme in high schools and Universities of the Republic of Kazakhstan;
- June, 2023 – preparation of the analysis on implementation of courses "Climate and Life" in Universities and Secondary Educational Institutions of the Republic of Kazakhstan;
- July – August, 2023 – preparation of publications in ranking journals on results of research "Promoting Teacher Education for Climate Change Education in Abai KazNPU;
- September, 2023 – preparation of "Guidance on development of Teacher Training Strategy on Climate Change;"
- October, 2023 – to organize events (meetings, trainings, workshops, etc.) to disseminate the "Teacher Strategy Development Guide on Climate Change;"
- November, 2023 – to organize and conduct a series of activities using the project approach as a means of involving pupils and young people in practical activities, developing their capacity for creative thinking in planning and taking social measures to contribute to solving the problem of "climate change;" and
- December, 2023 – preparation of the annual report.

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Report from Malaysia

7. The Effect of the Lechadiss Technique on Climate Change Content Knowledge among Preservice Teachers

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ABSTRACT

This study investigates the Lechadiss technique's effect on climate change content knowledge among preservice teachers. A total of 24 preservice teachers were selected for this study. Their selection was based on the intact group since they were the only group registered in the Elementary Science course. This study adopted the quantitative approach using one group design test. Data was collected by using an essay question. It was distributed at week 10 and week 15. The intervention for this study, known as the Lechadiss technique, consisted of lectures, hands-on activities and discussion. They also need to produce a participatory video (PV). Their answer will be evaluated using a rubric with three categories: science content, level of understanding and reasoning with four-level: 4- excellent, 3-good, 2-fair and 1-poor. The total score will be used to determine the knowledge mastery about climate change by using the range: 10-12 (excellent), 7-9 (good), 4-6 (fair) and 1-3 (poor). The findings showed that the Lechadiss technique improved their content knowledge about climate change in terms of content, level of understanding and reasoning. Their PV developed showed that the students mastered the climate change content knowledge. It is a hope that these preservice teachers will be able to gain more knowledge about climate change and implement the climate change activities in nearer community, especially school children.

Keywords: preeservice teachers, climate change, content knowledge, lecture, hands-on and discussion

7.1 INTRODUCTION

7.1.1 Background

Climate change is a 21st-century challenge that needs to be addressed. Climate change can disrupt the world's life since it is growing rapidly beyond natural boundaries. It affected the natural and societal system. Human activities, especially for economic reasons that are not environmentally friendly, have been identified as a contributor factor to climate change. Because of the tremendous negative impact of climate change, we need to reduce or minimize the level of climate change through Sustainability Development Goals (SDGs) 13.

SDGs were set up by United Nations in 2015 to meet the economic, environmental and social balance for all members of the UN – to transform our world in a sustainable way.

SDG 13 is about climate change. The purpose of this SDG is to combat climate change and its impact. Based on the UN, the targets are:

(a) Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.
(b) Integrate climate change measures into national policies, strategies and planning.
(c) Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.
(d) Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible.
(e) Promote mechanisms for raising capacity for effective climate change-related planning and management in the least developed countries and small island developing States, including focusing on women, youth, and local and marginalized communities.

(https://www.un.org/development/desa/disabilities/envision2030-goal13.html)

7.1.2 Operational Definition of Climate Change

As for preservice teachers, they need to understand the meaning of climate change. If they have a misunderstanding about climate change concept, then it will be inherited by their students in the future. Thus, knowledge about climate change is fundamental. They need to have an excellent understanding of the climate change concept. Based on Le Treut et al. (2007), the climate system is a complex, interactive system consisting of the atmosphere, land surface, snow and ice, oceans and other bodies of water and living things. They also stated that the atmospheric component of the climate system most obviously characterizes climate. Singh (1995) defined that atmospheric component consisted of nitrogen, oxygen, carbon dioxide and traces of the noble gases (argon, krypton, xenon, neon and helium) plus water vapor, traces of ammonia, organic matter, ozone, various salts and suspended solid particles. Climate is defined as 'average weather' since it is statistic weather for an extended period (NASA, 2005). Climate change is a change in the pattern of weather, and related changes in oceans, land surfaces and ice sheets, occurring over time scales of decades or longer (Australia Academy of Science, n.d). Climate change is any change in average weather that lasts for an extended period of time, like warming temperatures (EPA, 2016). Thus, it can be concluded that climate change is a change of weather that does not happen in one day but happens in the long run – for more than one year.

Besides climate change definition, preservice teachers also need to know the causes of climate change. They must understand that the main reason for climate change is greenhouse gaseous. Greenhouse gaseous (GHG) can be divided into two types (Yue & Goa, 2018).

Natural Greenhouse Gaseous

Natural greenhouse gaseous such as carbon dioxide, methane, water vapour and nitrous oxide naturally exist in our atmosphere. Its purpose is to retain heat to maintain the earth temperature to ensure all living things can survive. If we do not have natural greenhouse gaseous, the earth's temperature will drop to freezing temperature. Thus, all living things will freeze!

Man-made Greenhouse Gaseous

While man-made greenhouse gaseous are synthetic greenhouse gaseous. For example:

- burning coal, oil and gas for energy, transport and heat produced more carbon dioxide (CO_2) to the atmosphere;
- decomposition of waste in landfills, use of commercial and inorganic and organic fertilizers produce methane (CH_4) and nitrogen dioxide (NO_2); and
- used of the fridge and air-condition produced chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

Human activities include fossil fuel burning, deforestation, decomposition of waste in the "pumping" more 'greenhouse gases' into the atmosphere, and changing the level of natural greenhouse gases (Darkwah et al., 2018). These greenhouse gases will act as a "blanket" to the earth's atmosphere, which traps heat from the sunlight. As a result, the earth's temperature will increase. This process takes a long period. Because of this, our earth's temperature will increase year by year. As reported by UNFC (2007), the main characteristics of climate change are:

- increases in average global temperature (global warming);
- changes in cloud cover and precipitation, particularly over land;
- melting of ice caps and glaciers and reduced snow cover; and
- increases in ocean temperatures and ocean acidity – due to seawater absorbing heat and carbon dioxide from the atmosphere.

Preservice teachers must know and understand this information. Once they have a good grasp of climate change content knowledge, it could be easier for them to explain why we need to be bothered about climate change. Thus, the purpose of the study is to investigate preservice teachers' content knowledge about climate change and the reasons for the effect of climate change.

7.2 METHODOLOGY

This study uses a quantitative approach with a single group design. A total of 24 preservice teachers involved in this study from Albukhary International University. They were from Malaysia (10), Indonesia (7), Thailand (3), Liberia (3) and Ghana (1). Their age is between 19-23 years old. They were high school graduates. This sample selected was based on intact group since this is the only group registered in this course, Elementary Science. In this course, they learned about the ecosystem, including climate change. They learned about climate change thru Lachesis (lecture,

hands-on activity and discussion) technique as an intervention. This technique consisted of 2 hours of lecture, 1-hour hands-on activity and 1-hour discussion.

To measure their content knowledge about climate change, they were given an essay question at week 10 (before the intervention) and week 15 (after the intervention). Their answer will be evaluated using a rubric with three categories: science content, level of understanding and reasoning with four levels: 4- excellent, 3-good, 2-fair and 1-poor. The total score will be used to determine the knowledge mastery about climate change by using range: 10-12 (excellent), 7-9 (good), 4-6 (fair) and 1-3 (poor). The data also will be analysed using percentage and paired-sample t-test. Besides, they also need to produce a participatory video (PV) where students develop their own video about climate change. With this video, they need to explain about climate and need to explore any activities related to climate change.

7.3 RESULTS AND DISCUSSIONS

By using total score, majority of preservice teachers (37.5%) did not have a good knowledge of climate change. Their knowledge of climate change was poor and fair. After having lecture, hands-on activity and discussion, their knowledge about climate change was improved. About 25.0% of them has fair knowledge about climate change. About 50.0% have good knowledge about climate change, and 25.0% have excellent knowledge about climate change (**Table 7.1**). It is important to ensure that the data was normally distributed, before running the paired sample t-test. The result showed that the data was normally distributed since the value of kurtosis and skewness was between -2 to +2 for all categories: science content, level of understanding and reasoning. **Table 7.2** showed the mean score for each category.

Table 7.1 Overall score

	Pre	Post	%(Pre)	%(Post)
Poor	9	0	37.5	0.00
Fair	9	6	37.5	25.00
Good	6	12	25	50.00
Excellent	0	6	0	25.00

Table 7.2 Mean score

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PreContent	1.8333	24	.63702	.13003
	PostCont	3.0000	24	.72232	.14744
Pair 2	PreUnderstanding	1.8333	24	.63702	.13003
	PostUnder	2.9167	24	.77553	.15830
Pair 3	PreReasoning	1.5417	24	.50898	.10389
	PostRea	2.5417	24	.50898	.10389
Pair 4	TotalPre	5.2083	24	1.66757	.34039
	Totalpost	8.4583	24	1.88770	.38532

It can be concluded that there was an increasing score between before and after LecHaDiss intervention for content, level of understanding, reason and for overall score. To determine whether LecHaDiss intervention influence the preservice teachers' content knowledge about climate change, paired sample t-test will be used. The result showed that LecHaDiss intervention was effective on preservice teachers' content knowledge about climate change. Refer to **Table 7.3**.

The result showed that for climate change content, level of understanding and reasoning, there was a significant difference in mean score before and after LecHaDiss intervention. Thus, it can be concluded that LecHaDiss intervention able to give positive effect on preservice teachers' content knowledge about climate change. For the PV, unfortunately only one group submitted. This PV was done by 3 preservice teachers who were in the category of excellent and good content knowledge about climate change. In their video, they explain what climate change is and how their campus support to mitigate the effect of climate change. Their PV showed that they understand about content knowledge and they can relate what they have learned in a classroom can be related to their campus living.

LecHaDiss intervention consisted of lecture, hands-on activity and discussion. These three techniques help the preservice teachers improve their content knowledge about climate change. The lecture method was the most appropriate technique for preservice teachers have knowledge about climate change since it involved lots of abstract concepts. As mentioned by Zakirman et al. (2019), with this technique, information can be clearly explained by a lecturer and accommodate all students with various level of ability. In addition, a lecture could promote long-term retention of information (McKeachie et al., 2006).

After having a lecture, a discussion is needed since Nystrand (2006) claimed that having discussion during lecture will facilitate students' learning. According to Sybing (2015), discussion provide students with a platform to participate in their learning process. Thus, by having a discussion at the end of lecture help these preservice teachers exchange ideas and information about climate change. Their learning process towards climate change would be more fun and interesting. As mentioned by Khalid et al. (2018), with discussion, students will not rely on rate learning. Thus, with the discussion, they talk more about the climate change. Because of this, their knowledge and understanding about climate change has been improved.

Table 7.3 Paired sample test on content, understanding and reasoning about climate change

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	PreContent - PostCont	-1.16667	.48154	.09829	-1.37000	-.96333	-11.869	23	<.001
Pair 2	PreUnderstanding - PostUnder	-1.08333	.58359	.11913	-1.32976	-.83690	-9.094	23	<.001
Pair 3	PreReasoning - PostRea	-1.00000	.51075	.10426	-1.21567	-.78433	-9.592	23	<.001
Pair 4	TotalPre - Totalpost	-3.25000	1.35935	.27748	-3.82400	-2.67600	-11.713	23	<.001

While for the hands-on activities, it gives preservice teachers direct experience in doing the activities. This type of activities gives students educational experience since they are actively involved in manipulating the objects to gain knowledge and understanding since it gave them opportunities to do the activities. (Haury & Rillero, 1994). Thus, the climate change activities help the preservice teachers build their own new understandings about climate change through learning by doing. With the content knowledge and experience from the activities, their knowledge about climate change was increase. As mention by Mageswary et al. (2015), students' knowledge can be enhanced through climate change activities. The hands-on activities also gave preservice teachers opportunities to have social interaction where they can have discussion.

Climate change is a global issue. Everybody needs to take part to mitigate the effect of climate. LecHaDiss is one of the techniques that could help these preservice teachers enhance their knowledge about climate change. Thus, as preservice teachers, they need to master the climate change content knowledge. It is very important since they will be future teachers that disseminate the content of climate change and helping future generations for sustainability.

7.4 NEXT STEPS

7.4.1 Detailed Working Plan from July 2022

- A study on non-science preservice teachers' knowledge and awareness on climate change.
- Training non-science preservice teachers' knowledge and awareness on climate change.
- Designing and planning activities on climate change by preservice teachers.
- Compilation of activities on climate change by preservice teachers.
- Implementation of climate change activities with school children.
- Field trip to Okayama University.

7.4.2 Upcoming Timeline and Deliverables

- **July 2022:** Development and distribution of questionnaire on non-science preservice teachers' knowledge and awareness on climate change (pre-training).
- **August – September 2022:** Trainings and workshops to non-science preservice teachers on climate change education.
- **October 2022:** Development and distribution of questionnaire on non-science preservice teachers' knowledge and awareness on climate change (post training).
- **November 2022:** Analysis data of questionnaire on non-science preservice teachers' knowledge and awareness on climate change.
- **December 2022:** Reporting of the study on non-science preservice teachers' knowledge and awareness on climate change.
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- **Jun – August 2023:** Implementation of climate change activities with school children by preservice teachers.
- **September – October 2023:** Field trip to Okayama University with the preservice teachers.
- **November – December 2023:** Reporting and documentation.

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Report from Malaysia

8. The Effect of STEM-PBL on Students' Knowledge and Awareness on Climate Change

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ABSTRACT

Climate change is not a new issue, as it has been occurring since the 1970s. The world requires a society that is knowledgeable and aware of the issue of climate change to ensure a sustainable planet is inherited to the future generations. This study uses STEM-PBL as one of the interventions to raise students' knowledge and awareness of global concerns awareness as well as their ability to solve problems concerning such issues. This study employed a pre-experimental design with pre- and post-testing of a single group (one group, pre-test and post-test design). In this study, there was only one group, which is the experimental group, which received STEM-PBL intervention. The population of this study were form four students who undergone the KSSM Form Four Science syllabus containing topic 4: "Green Technology in Preserving Nature" and this topic can be linked to climate change. Respondents of this study were 30 form four students from selected schools. One adopted questionnaire was used to measure the effects of STEM-PBL on students' knowledge and awareness as well as the correlation between students' knowledge and awareness of climate change. This study reveals that students' knowledge and awareness of climate change has improved because of the strength of STEM-PBL learning strategies. It increases students' knowledge more visually by conducting structured activities and focusing on product creation that requires students to think using their knowledge content. Without high awareness these mitigation and adaptation measures cannot be done because they require not only individual support, but also cooperation and collaborative efforts among many agencies and parties.

Keywords: secondary students, knowledge, awareness, STEM-PBL learning

8.1 INTRODUCTION

The UNESCO climate change initiative 2013 was launched by Director-General Irina Bokova at the 15th UN Framework Convention on Climate Change (UNFCCC COP15) in its programme "Climate Change Education for Sustainable Development." This programme aims to make climate change education one of the most important agenda items in the international response to climate change. The initiative aims to develop "climate literacy" among young people and increase awareness of the implications of global warming.

Strengthening the capacity of member states to provide quality climate change education, promoting innovative teaching approaches to integrate climate change education in schools, raising awareness of climate change and enhancing non-formal education programmes through media, networks and partnerships are all methods of intensifying efforts.

Malaysia, particularly in the context of accountability on climate change issues, has formulated a national climate change policy that serves as a framework to organise and assist government agencies, industry, communities and stakeholders in a comprehensive and integrated manner in addressing the challenges of climate change (NRE, 2010). According to the policy (NRE, 2010), key action will be taken to implement formal and informal systematic learning to raise awareness on climate change. Multiple approaches will be used with the involvement of various parties, including non-governmental organisations (NGOs) and local community organisations (CBOs), as well as the media (NRE, 2010). Other strategy is by enhancing cooperation between the government and the private sector, including corporate responsibility, and targeting special groups (UNESCO, 2009).

Climate change is not a new issue, as it has been occurring since the 1970s. The world requires a society that is knowledgeable and aware of the issue of climate change to ensure a sustainable planet is inherited to the future generations. However, more efforts in this area is needed since previous research has revealed low percentage of community's awareness across the country. It is difficult to obtain an analysis in Malaysia that is relevant to the community's knowledge or understanding of climate change due to the paucity of research conducted on the topic. In Malaysia, the implementation of such studies is found to be very subpar. The majority of climate change research is limited in scope, focusing on a single component. These studies do not address all elements that contribute to climate change. Examples include research on global warming and the greenhouse effect, among others. Nonetheless, several studies examine the extent of climate change misconceptions, such as a study conducted by Mohamad and Zurida (2010) entitled "Views and understanding of trainee teachers on climate change," which found that approximately three-quarters of pre-science services teachers (77.2%) believe that trapped sunlight contributes to climate change. 27.5% of pre-service science teachers believe that atmospheric surface ozone can operate as a greenhouse gas. This is likely because ozone is typically characterised as a protective gas rather than a pollutant. This demonstrates that pre-science services teachers have a fundamental misunderstanding of the elements that lead to climate change.

This study will use STEM-PBL as one of the interventions to raise students' knowledge and awareness of global concerns awareness as well as their ability to solve problems concerning such issues. Specifically, the objectives of this study are as follows:

- To examine the effects of STEM-PBL on students' knowledge of climate change.
- To examine the effect of STEM-PBL on students' climate change awareness.
- To examine the correlation between students' climate change knowledge and awareness.

The following is a list of the null hypotheses tested at a significance level of 0.05 in this study.

Ho1 There were no significant differences between students' climate change knowledge before and after STEM-PBL interventions.

Ho2 Before and after receiving STEM-PBL interventions, students' awareness of climate change did not differ significantly.

Ho3 There is no significant correlation between students' climate change knowledge and awareness.

8.2 METHODOLOGY

8.2.1 Research Design

This study applied a quantitative methodology. This study employed a pre-experimental design with pre- and post-testing of a single group (one group, pre-test and post-test design). In this study, there was only one group, which is the experimental group, which received STEM-PBL intervention. Experimental study design can be used to evaluate the effectiveness of teaching methods (Creswell, 2005). Data were collected using questionnaires and the analysis of this study used SPSS version 24.

8.2.2 Population and Sampling

The population of this study were form four students who undergone the KSSM Form Four Science syllabus containing topic 4: "Green Technology in Preserving Nature" and this topic can be linked to climate change. Respondents of this study were 30 form four students from the schools that have been selected, where the students were given STEM-PBL learning technique interventions on climate change topics as part of their study. The diagram (**Fig. 8.1**) shows an overview of the pre-test and post-test design of a single group.

After the pre-test is conducted, the STEM-PBL learning approach were implemented in this experimental group. The first post-test was conducted soon after the students have completed the STEM-PBL learning approach, and the second post-test was conducted five weeks after the intervention has been implemented. In this study, differences between pre and post-test scores for each variable were compared. These differences were evaluated to determine the effect of STEM-PBL learning on students' climate change knowledge and awareness.

8.2.3 Research Instrument

The instrument for this study were questionnaire. One adopted questionnaire was used to measure the effects of STEM-PBL on students' knowledge and awareness as well as the

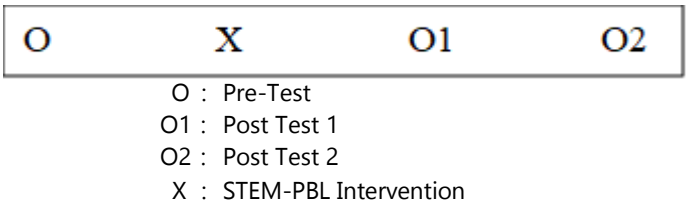

Fig. 8.1 Design of one group's pre-test and post-test

correlation between students' knowledge and awareness of climate change. Section A for the questionnaire includes the demographic part while section B for the knowledge and section C for awareness of climate change.

8.3 RESULTS AND DISCUSSIONS

8.3.1 Results

The quantitative data analysis used statistical analysis of SPSS software version 24. Overall, the reliability value obtained with the Cronbach's Alpha value score is at $\propto$ => 0.7 which indicates the items are at a good and acceptable level and can produce consistent and reliable results.

In this study, a paired t-test (Paired sample t-Test) was used to compare the mean scores of the same group of people in two different situations. This test was applied to determine the difference between a student's pre-test and post-test scores. The two tests of mean scores will be compared to see whether there are differences in students' knowledge and awareness of climate change. According to Chua (2011), this t-test is typically used to evaluate studies that apply the pre-post-test procedure.

The Pearson-r correlation test was utilized to examine the relationship between climate change knowledge and awareness. In addition, the value of the correlation coefficient (r) was utilised to determine the strength of the relationship between students' climate change knowledge and awareness.

8.3.2 Data Analysis

The analysis included the gender and race of the respondents. Female students dominate male students by 60 % (18 students). While the percentage of male students were 40%, the percentage of female students were 60% (12 students). There were just two races of the respondents in this study, the Malay, and the Chinese. The Malays dominate the other races by 96.7% (29 people). While followed by the Chinese which was 3.3% (1 person) only, the data are normally distributed.

The Shapiro-Wilk test is applied because all the data in this study had a normal distribution. The selection was because there were 30 samples in this study. If the p-value for the Shapiro-Wilk test is greater than 0.05, then the data are normally distributed. If p is less than 0.05, however, the data distribution is not normal.

8.3.3 Findings

Table 8.1 showed that the p-value for pre-test and post-test is p> .05, then it can be concluded that the data for pre-test and post-test are normally distributed. **Table 8.2** showed that the pre-test and post-test p values were .059 and .368 respectively, indicating a p-value >.05. Therefore, it may be concluded that both the pre-test and post-test data are normally distributed.

The paired t-test was applied to answer the research question of whether there is a difference in the students' knowledge before and after undergoing the treatment. The results

Table 8.1 Pre- and post-knowledge normality tests on climate change

	Shapiro Wilk		
Test	Statistic	df	sig
Pre	.192	30	.017
Post	.921	30	.029

Table 8.2 Pre- and post-awareness normality tests on climate change

	Shapiro Wilk		
Test	Statistic	df	sig
Pre	.933	30	.059
Post	.963	30	.368

Table 8.3 Table shows mean scores for knowledge constructs

Element	Test	Mean	N	Standard Deviation	Standard Error Mean
Knowledge	Pre	33.90	30	9.55	1.74
	Post	39.10	30	13.08	2.39

of **Table 8.3** showed that the mean value for the pre-test was 33.90 (S.D = 9.55) and that for the post-test, it was 39.10 (S.P = 13.08). The results showed an increase in mean scores between the pre-test and post-test when the intervention was conducted.

Table 8.4 showed that there was a significant difference in mean scores for students' knowledge before (M = 33.90, S.P = 9.55) and after the STEM -PBL intervention (M = 39.10, S.D = 13.08) with a value of t (29) = -2.114, p = 0.043, p <.05. The findings showed that there was an increase in the mean score of -5.200 with a 95% confidence interval. The size effect is 0.13 which indicates a small size effect. Based on the value of p <.05, the null hypothesis is rejected. It can be concluded that STEM-PBL interventions are effective in improving students' knowledge of climate change.

The paired t-test was applied to answer the research question of whether there is an awareness of students towards climate change before and after undergoing the treatment. As shown in **Table 8.5**, Pre-test mean value was 32.37 (S.D = 5.32) for Table 7, whereas post-test mean value was 33.0 (S.D = 5.04).

Table 8.6 showed the result of students' awareness after undergoing the intervention STEM -PBL (M = 33.00, S.D = 5.038) with t = 2.102, p = 0.044, and p .05. The findings indicated an increase in the mean score of 0.633 with a confidence interval of 95%. The size effect value of 0.13 represents a small size effect. The null hypothesis is rejected based on the value that p <.05. It can be concluded that STEM-PBL programmes increase students' awareness of climate change effectively. After students underwent the STEM-PBL intervention, there was a moderate and significant positive relationship. The results of **Table 8.7** indicated a significant connection between students' knowledge and awareness of climate change after the STEM-PBL intervention, with a p = .016, p <.05. The null hypothesis is therefore rejected. The Pearson-r coefficient is 0.436, indicating a moderately positive relationship between students' climate change knowledge and awareness.

Table 8.4 Paired t-test for knowledge

		Difference paired				
		Mean	Standard Deviation	t	df	sig
Knowledge	Pre-post	-5.200	13.47	-2.114	29	.043

Table 8.5 Means score for students' awareness

Element	Test	Mean	N	Standard Deviation	Standard Error Mean
Awareness	Pre	32.37	30	5.321	.971
	Post	33.00	30	5.038	.920

Table 8.6 Paired t-test for awareness

		Difference Paired				
		Mean	Standard Deviation	t	df	sig
Awareness	Pre-post	-.633	1.65	-2.102	29	.044

Table 8.7 The correlation between knowledge and awareness in climate change

Variable		Knowledge	Awareness
Knowledge	Pearson-r	1	.436
	sig		.016
	N	30	30

8.3.4 Discussions

This study reveals that students' knowledge of climate change has improved because of the strength of STEM-PBL learning strategies. It increases students' knowledge more visually by conducting structured activities and focusing on product creation that requires students to think using their knowledge content. STEM-PBL treatments are recommended as a medium that provides a real and practical learning experience so that students could feel and address real challenges with the provided knowledge (Capraro et al, 2016).

Among the factors that can improve students' awareness of climate change is engaging them in practical or hands-on activities, so that they can obtain personal experience in dealing with challenges such as climate change, in STEM-PBL learning. As mentioned by Kolb (1984) experiential-based activities centred on students will encourage students to ask questions, do experiments, make analogies, hypothesis and as such.

This study indicated that despite in small size of awareness, students' awareness still has increased. It was believed that since the STEM-PBL method's design of activities has adopted the 5E learning cycle for the organisation of STEM-PBL activities, students were exposed to concrete problems and effects/consequences of the issue of climate change through this project subsequently develop adaptation or mitigation strategies. Indirectly, students' awareness will increase after studying the implications and finding solutions to this climate change issue. Furthermore, the study also found out that there is a relationship

between students' knowledge and awareness, although the correlation between knowledge and awareness in this study is relatively moderate.

8.3.5 Conclusions

High awareness of climate change is very important as the world is undergoing drastic change and thus, there is needs for immediate mitigation and adaptation measures. Without high awareness these mitigation and adaptation measures cannot be done because they require not only individual support, but also cooperation and collaborative efforts among many agencies and parties. In fact, it is also the main objectives of the national climate change policy strengthen institutional and implementation capacity reducing the negative impacts of climate change (NRE, 2010). However, prior to awareness, sufficient knowledge related to climate is needed. With this regard, researchers strongly emphasize that activities such as STEM-PBP are carried out to increase students' knowledge and awareness.

8.4 NEXT STEPS

8.4.1 Detailed Working Plan from July 2022

- A study on non-science preservice teachers' knowledge and awareness on climate change.
- Training non-science preservice teachers' knowledge and awareness on climate change.
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8.4.2 Upcoming Timeline and Deliverables

- **July 2022:** Development and distribution of questionnaire on non-science preservice teachers' knowledge and awareness on climate change (pre-training).
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Report from Mongolia

9. Analysis for Climate Change Education into Teacher Education Curricula

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ABSTRACT

Education for Sustainable Development (ESD) is an integral component of the SDG Target 4.7 and is recognized as an enabler of all other Sustainable Development Goals. UNESCO has been assisting countries in integrating sustainability issues into education through ESD. While information of teacher education (TE) programmes' development on ESD and associated educational techniques has grown, there is still a huge need for a deeper understanding of the extent to which programmes address sustainability issues in programmes and curricula. This study satisfies that demand. It presents the findings of a study that looked at how ESD issues, particularly climate change and biodiversity, were integrated into undergraduate courses at the Mongolian National University of Education (MNUE). MNUE is a national teacher training institution, which has been carrying a leading role in preparing teachers and professionals in the education sector. There are about 52 academic programmes for preparing them.

The goal of this study is to look at how ESD and Climate Change Education (CCE) are integrated into teacher education programmes and even course curricula at MNUE. In order to fulfill the goal, 24 programmes/course curricula has been chosen based on the mastery of core subjects in a 21st century, such as natural science programmes (geography, biology, chemistry, physics, mathematics and informatics), primary education programmes (natural science and social science), preschool programme, social science programmes (English, Japanese and Chinese). In the frame of the study, we used systematic analysis methodology. We anticipate that the findings will show that biology, chemistry, physics and geography curricula are the most likely to include environmental content, with the perception of inclusion in other curricula being fairly low.

Keywords: climate change education, teacher education curricula, integration of ESD, sustainability issues, course curricula

9.1 INTRODUCTION

ESD, at the core of the SDG 4 Target 4.7, aims to ensure that all learners acquire the

Table 9.1 ESD/CCE-related terms that we have collected

General environment cluster	Ecosystem, environment, ecology, habitat, atmosphere, weather, water
Biodiversity cluster	Biodiversity
Climate change cluster	Greenhouse gases, global warming, climate change, climate crisis, carbon, methane, greenhouse effect, carbon footprint, pollution, emissions
Sustainability cluster	Sustainable development, ESD, adaptation, mitigation, renewable resource, energy

knowledge and skills needed to promote sustainable development. In addition, the strengthening of teachers' capacities is one of the key themes to be reflected in the ESD policies of countries when countries are taking a holistic approach to advance the SDG Target 4.7, which is one of the key targets in the SDGs that addresses the purpose and quality of education. Recognizing the significance of education in promoting sustainable development, Mongolia has developed a number of policies and initiatives relating to ESD and CCE. Furthermore, many kinds of projects and campaigns have been implemented by international and national organizations such as UN, UNESCO and UNDF to raise public awareness and increase education initiatives about ESD and CCE. Raising public awareness and increasing education initiatives is one of the most important ways to adapt and mitigate climate change. Teachers are the key to achieving all of the SDG 4 targets and preparing students to become responsible citizens capable of working towards an environmentally sustainable, globally interconnected, equitable and diverse society.

Keyword searching was used to identify environment related text in the documents, in clusters of words related to 'environment', 'biodiversity', 'climate change' and 'sustainability'. Steps were taken to reduce the likelihood of identifying more general references to terms such as 'environment' and 'climate' which can have more than one meaning. For example, terms searched included 'environmental' not 'environment' and 'climate change' not 'climate' (**Table 1**). This was undertaken using the specialized data information management software NVivo11 for documents in Mongolian. A series of matrix queries enabled analysis of keyword results by document type, programme and curricula. Results on keyword frequencies were standardized per million words to take into account the respective length of documents.

9.2 METHODOLOGY

This study discusses how climate change issues and related concepts are dealt with in the current curricula of MNUE. Within the curricula, both standards and curricula of undergraduate level have been analyzed in terms of extent and scope. This provides an insight into how CCE is integrated into the different disciplines of the natural sciences, social studies, humanities and civic and moral education. In total, we have chosen 20 curricula.

MNUE is one of the largest universities in Mongolia and it has 8 schools such as School of Social Sciences and Humanities, School of Mathematics and Natural Sciences, Teacher's School, School of Fine Arts and Technology, School of Physical Education, School of Pre-School Education, School of Educational Studies and Teachers School Arkhangai Province.

Our university is a national teacher training institution, which has been carrying a leading role in preparing teachers and professionals in the education sector. Today the University boasts more than 15,000 students of postgraduates and undergraduates. Moreover, there are about 29 academic programmes for preparing teacher and 12 academic programmes for preparing professionals in the education sector. In other words, the University recommends over 30 kinds of teacher profession such as math teacher, foreign language teacher, chemistry teacher, history teacher and so on.

Content capacity of undergraduate programmes has to be more than 120 credits and its content consists of general foundation courses, teacher education courses and professional courses. In total, 120 credits are as follows:

I. General foundation courses – 25 credits
  1. Compulsory courses – 21 credits
  2. Elective courses – 4 credits
II. Teacher education courses – 21 credits
  1. Compulsory courses – 14 credits
  2. Teacher education practicum – 3 credits
  3. Elective courses – 4 credits
III. Professional courses – 78 credits
  1. Compulsory courses – 70 credits /It includes 5 credits experiment teaching practicum and 5 credits teaching practicum/
  2. Elective courses – 8 credits

In this research work, we have chosen 24 course curricula for undergraduate students of MNUE who are majoring as a teacher. The study was carried out from 2021 to 2022.

9.3 CONCLUSION

The conclusion related to the research objectives shows that there is a diverse point that implementation of the course curricula, we have chosen, in teacher training.

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Report from the Philippines

10. Climate Change Disasters and Education for Sustainable Development: Modules for the Teachers

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ABSTRACT

The most important Action Plan component prepared by Team Mindanao is the module preparation on Climate Change Disasters and Education for Sustainable Development for Teacher Education. These modules have the following objectives:

1. Understand multi-disciplinary issues (related to environment, society, economy, well being) associated with climate change, disasters and Education for Sustainable Development (ESD).
2. Facilitate school wide disaster preparedness education programme (Using MOVE Philippines Disaster Preparedness Education Model).
3. Design contextualized community action learning activities that promote knowledge, practices, values, skills, issues, motivation and commitments on ESD, Disaster Readiness, Climate Change Adaptation and Climate Change Mitigation.

Three (3) modules were developed on the following themes:

1. Disaster Readiness and Risk Reduction that focuses on The Science of Typhoons/Cyclones/Hurricanes its development and effects;
2. Climate Change Adaptations and Mitigations that focuses on Philippines game based disaster preparedness education; and
3. Climate Change Action that focuses on Creative Action o n Climate Change. Each of the modules has 3 sessions: Buy in, Inquiry and Culminating Activity.

The modules were done on time and completed with a presentation during the Third Meeting of ATECCE held in Mongolia last May 3-5, 2022. Forewords were provided by Professor Hiroki Fujii, PhD, UNESCO Chair in Research and Education for Sustainable Development, Director, Okayama University ESD Promotion Centre, Japan and Professor Ichinose Tomonori, PhD of the National University Corporation Miyagi University of Education.

Keywords: modules, climate change education, teacher education

10.1 INTRODUCTION

The Philippines is at the top of the list of countries prone to natural disasters due to its geographical position. It is the country most exposed to tropical storms and earthquakes, and being a developing country, the vulnerability to natural disasters is also most felt especially by the marginalized communities. It is therefore imperative that Climate Change

Education be provided. A module on CLIMATE CHANGE DISASTERS AND EDUCATION FOR SUSTAINABLE DEVELOPMENT was prepared aimed for the Teacher Education faculty and students. We believe that the teachers would be the key to bring about consciousness and sense of responsibility towards the environment and beyond.

10.2 BACKGROUND

The materials on ESD had been part of the Teacher Education curriculum in the Philippines; however, it was focused on Disaster Risk Management due to the very many natural calamities brought about typhoons particularly here in Mindanao. The programmes were more reactive than proactive. We believe that the current modules on Climate Change Disaster and Education for Sustainable Development are more comprehensive and proactive. Since this is a report on the modules developed, allow me to do away with some sub-headings such as previous studies, methodology, purpose, originality, creativity and results and discussion as they are not applicable to this report of mine.

10.3 THE MODULE

CLIMATE CHANGE DISASTERS AND EDUCATION FOR SUSTAINABLE DEVELOPMENT Modules for the TEACHERS is a compilation for three modules developed with the following objectives:

(a) Understand multi-disciplinary issues (related to environment, society, economy, well-being) associated with climate change, disasters, and ESD.
(b) Facilitate school-wide disaster preparedness education programme (Using MOVE Philippines Disaster Preparedness Education Model).
(c) Design contextualized community action learning activities that promote knowledge, practices, values, skills, issues, motivation and commitments on ESD, Disaster Readiness, Climate Change Adaptation and Climate Change Mitigation.

As envisioned, the modules are for the faculty of the Teacher Education Institutions and their Student Teachers.

The foreword from Professor Hiroki Fujii, PhD, the UNESCO Chair in Research and Education for Sustainable Development, Director, Okayama University ESD Promotion Centre, Japan is very encouraging as he acknowledged the contribution of these modules. He wrote: *These modules provide concrete strategies for teachers in the Philippines to engage in CCE in their schools, and will guide subsequent countries in developing their own modules in their own contexts. We will learn a lot from these modules and will make further progress in the project.*

Likewise, Professor Tomonori Ichinose of Miyagi University of Education, Japan, noted the following: *This book noticed numerical simulations and observational data show that the presence of the warm-core eddy combined with Sea Surface Temperate (SST) increases due to climate change led to the rapid intensification of Super Typhoon. It is no longer possible to speak about disasters, and climate change, either adaptation or mitigation, in isolation of each other. This book contains the scientific knowledge about typhoons, knowledge and*

attitude about Disaster risk reduction, understating for environmental activism and the methods for promoting sustainability lifestyles.

Thank you to these two giants of ESD for their inspiring and encouraging statements on the modules.

The three modules follow the same format as illustrated in abbreviated form:

Disaster Readiness and Risk Reduction

Module 1	**THE SCIENCE OF TYPHOONS/CYCLONES/HURRICANES- Its Development and Effects**
Core theme/s	**:** 1,2,3 **Time/duration** : 9.0 H
Core Themes of Education for Sustainability	
1. Lifelong learning 2. Interdisciplinary education	3. Partnerships 4. Multicultural education 5. Empowerment
Module Specific Learning Objectives (K-knowledge, I-issues, S- skills, P-perspectives, and V-values)	
Context	**Anchor**
Philippine Secondary Education	One of DepEd's 10 point-agenda (2.C) Special emphasis on environmental awareness, disaster preparedness and climate change adaptation and mitigation
Session 1: Buy-In	**Climate Change, Sea Surface Temperature (SST) and Typhoons**
Domain	**Facilitate Learning**

Formative Assessment

To what extent do you agree or disagree with the following statements (Strongly agree, agree, disagree, strongly disagree)? Describe your thinking why you made such statement.

1. Climate change is directly associated with human activities.
2. Global warming increases the probability of more frequent and intense storms.
3. Sea Surface Temperature (SST) can cause an increase in sea level pressure at the typhoon center which led to intensification of typhoon.

Review

You learned that human activities particularly burning fossil fuels used in transportation and agriculture contribute to increasing greenhouse gases like carbon dioxide, nitrous oxide, and methane in the atmosphere. These gases trapped solar heat radiation which led to global warming. Its effects are already felt as we experience rising sea level as glaciers are melting causing island states in the Pacific and low-lying cities to be at high risk of inundation. There are more intense typhoons, floods, drought and desertification, heat related diseases and death since global warming drastically changed earths' climate. However, Global efforts to reduce greenhouse gases has been made toward a more sustainable and resilient society in the future that is also carbon neutral.

Introduction

One of the most important factors that affect the strength of the typhoon is sea surface temperature (SST). In November 2013 the average SST in the Warm Pool Region was the highest observed during the 1981 to 2014 period while that of the West Pacific Region was among the highest. The SST is shown to be well-correlated with wind strength of historically strong typhoons in the Philippines and the observed trends in SST suggest that extremely destructive typhoons like Haiyan (TS Yolanda) are likely to occur in the future (Comiso, J., et.al. 2015). As cited by Guansuo, W. (2018), a 2oC increase in SST can cause 19-hPa drop in the sea level pressure at the typhoon center, demonstrating that typhoon intensity is very sensitive to SST (Xue et.al.2007). However, based on well-established evidence published in peer-reviewed journals, about 97% of climate scientist have concluded that human-caused climate change is happening (AAAS 2014). 11 international science academies issued a joint statement about climate change in 2005- "Climate change is real. There will always be uncertainty in understanding a system as complex as the world's climate. However, there is now strong evidence that significant global warming is occurring. The evidence

comes from direct measurements of rising surface air temperatures and subsurface ocean temperatures and from phenomena such as increases in average global sea levels, retreating glaciers, and changes to many physical and biological systems.

It is likely that most of the warming in recent decades can be attributed to human activities" (IPCC 2001).

Whats's New

Climate change is one of the key issues that our world is facing nowadays; greenhouse-induced warming, loss of biodiversity and deforestation are some of the consequences of this. The ocean plays a crucial role in the Earth's climate system because of its large heat storage capacity. With this, the ocean takes up 90% of the world energy imbalance and its internal variability circulation intervene in the global climate. This study discussed the relationship between selected greenhouse gases and the trend and variability of the Philippine Sea Surface Temperature (PSST). It focused on gases like carbon dioxide, methane, and nitrous oxide because they are more sensitive in terrestrial radiation rather than solar radiation. The greenhouse gas modeled data from Mauna Loa in Hawaii and archived data of the PSST both dating back from 1948-2016 covering a period of 69 years in investigating the relationship of the two. It was found out that the PSST was significantly increasing with an average temperature of 0.0093 °C/ year. A much rapid trend was observed over the southeastern part of the Philippine Area of Responsibility (PAR) which is also a part of the Western Pacific Warm Pool. Moreover, it reveals a significant correlation between the selected greenhouse gases and the PSST. Regional differences were observed in PAR as greenhouse gases dominated the area. A significant relationship was shown and the increase of trend in the PSST. Through this, it is expected a frequent formation of tropical cyclones within the region (Hiyastro, Jeroh & Guido, Ryan Manuel, 2019).

Table1: Significant Relationship of Selected Greenhouse Gases to the Philippine Sea Surface Temperature

	Variables	Pearson's r	Correlation	P-Value	Decision	Remarks
SEA SURFACE TEMPERATURE	CO_2 (Carbon dioxide)	0.6812	Moderate Positive Correlation	0.00000565	Reject Null	Significant
	N_2O (Nitrous Oxide)	0.6806	Moderate Positive Correlation	0.0000208	Reject Null	Significant
	CH_4(Methane)	0.6358	Moderate Positive Correlation	0.0000208	Reject Null	Significant
Test of Significance α=0.05						

What is it?

Based on the research abstract and table above, answer the following questions:

1. What is the objective of this study?
2. What are the findings?
3. Based on the table, what does Test of Significance (alpha=0.05) mean to the relationship between PSST and the 3 greenhouse gases when the null hypothesis is rejected?

Enrichment Activities

Super Typhoon Haiyan devastated portions of Southeast Asia, particularly the Philippines, on November 8, 2013. In this paper, observational data are used to analyze the intensification process of Super Typhoon Haiyan. Observational data showed that Typhoon Haiyan intensified, and the maximum sustained winds increased to 59 ms−1 after it encountered a double warm-core ocean eddy, while the central pressure of the typhoon dropped from 970 hPa to 920 hPa.

Based on the research abstract and figure above, answer the following questions.

1. What are the main findings of the study?
2. How do you relate SST to intensification of typhoon Haiyan?
3. How does warm-core ocean eddy influence the SST and typhoons?

Generalization

What I have learned

Complete the sentence stem below

1. I understand that sea surface temperature (SST) and warm-core ocean eddy will _____ the strength of the typhoon.
2. Climate change will likely _____
3. Misinformation about the science of climate change will _____ (Note: Read Task 2)

Application

What can I do

1. Download Earth Now App from Google Play. Use the link below.
   https://play.google.com/store/apps/details?id=gov.nasa.jpl.earthnow.activity&hl=en&gl=US
   Earth Now is an application that visualizes recent global climate data from Earth Science satellites. The visualized data include surface air temperature, carbon dioxide, carbon monoxide, ozone, and water vapor, as well as gravity and sea-level variations.
2. "Click" Vital Signs. Then "click" Air Temperature
   Purple and blue areas indicate cooler temperature while yellow and red denote warm region.

Question

What do you think is/are the reasons why the average 7-day temperature is cooler in Africa and middle east compared to other countries of the same latitude?

Additional Activities

Visit your municipal/city/provincial/barangay Disaster Risk Reduction Management Office personnel and ask about their capacity to respond to various emergencies. Complete the table/checklist/question below. Also, ask permission to take photographs of their equipment/facilities.

Name of office	Contact number	
Number of personnel	Number of families/population	
Location/place		
List of equipment		
Title of trainings attended by personnel to increase their capacity	1.	2.
Q1 How do you track storms?	Ans	
Q2 How do you communicate this information to the people especially when it is imminent or likely to affect your community?	Ans	
Q3 Other question/s you may have:	Ans	

Task 2

Read one of two articles below and answer the questions using the REE-AP format found after this

Point of view: A skeptic's view of climate change

To many of us, global warming or climate change as a serious concern is just more fake news, initiated and propagated by leftists, for the purposes of obtaining wealth for the few and the redistribution of wealth for many. There has been too much political deceit going on to trust the claims, and there is also ample scientific proof to question these assertions. Those of us on the other side of the climate change argument are not saying man is not changing climate at all, we just do not believe the extremely slight

change is a danger to the world. We know there is politics involved and we also know there is data tampering that exaggerates this need to put a strain on our economy for the sake of the so-called dangerous climate change.

PCC WARNS ANEW OF MORE FREQUENT, MORE SEVERE CLIMATE IMPACTS IN NEW LANDMARK REPORT

Climate Change Commission PH August 10, 2021 @ 6:43PM·

The Climate Change Commission (CCC) cites a new report by the UN Intergovernmental Panel on Climate Change (IPCC) yesterday as a wakeup call for countries to urgently scale up mitigation efforts to keep average global warming at 1.5 degrees Celsius and to adapt to more frequent and more severe climate impacts, some of which are irreversible. The "Climate Change 2021: The Physical Science Basis" report is the contribution of the IPCC's Working Group I to the Sixth Assessment Report, which stressed that "it is unequivocal that human influence has warmed the atmosphere, ocean and land" and that "widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred.

R	*read*	assigned text on your own/pair/group
E	*elaborate*	through teacher-student interaction
E	*encode*	the text by writing the idea of what you read in <u>your own words</u>
A	*annotate*	*annotate* the text by writing down the main ideas (notes, significant words, quotes) and the authors' message
P	*ponder*	what you read by thinking and talking with others in order to make personal connections, develop questions about the topic, and/or connect this reading to other reading you have done.

Writing Rubric				
Scoring	**Content Focus**	**Content Organization**	**Content Support**	**Content Style (Vocabulary)**
4	Topic/subject is clear, though it may/may not be explicitly stated.	Organizational structure establishes relationship between/among ideas/events.	Support information is related to and supportive of the topic/subject.	Exhibits skillful use of vocabulary that is precise and purposeful.
3	Topic/subject is generally clear though it may not be explicitly stated.	Organizational structure establishes relationships between ideas/events, although minor lapses may be present.	Support information has minor weaknesses in relatedness to and/or support of the topic/subject.	Exhibits reasonable use of vocabulary that is precise and purposeful.
2	Topic/subject may be vague.	Organizational structure establishes some relationship between/among some of the ideas/events. The structure is minimally complete.	Support information has major weaknesses in relatedness to and/or support of the topic/subject.	Exhibits minimal use of vocabulary that is precise and purposeful.
1	Topic/subject is unclear or confusing.	Organizational structure does not establish connection between/ among ideas/events. The overall stucture is incomplete or confusing.	An attempt has been made to add support information, but it was unrelated or confusing.	Lacks use of vocabulary that is precise and purposeful.
0	This code may be used for compositions that are entirely illegible orotherwise unscorable: blank responses, responses written in a foreign language, restatement of the prompt, responses that	This code may be used for compositions that are entirely illegible or otherwise unscorable: blank responses, responses written in a foreign language, restatement of the prompt, responses that are off-topic or incoherent.	This code may be Used for compositions that are entirely illegible or otherwise unscorable: blank responses, responses written in a foreign language, restatement of the prompt, responses that	This code may be Used for compositio ns that are entirely illegible or otherwise unscorable: blank responses, responses written in a foreign language, restatement of the prompt,

	are off-topic or incoherent.		are off-topic or incoherent. This code may be used for compositions that are entirely illegible or otherwise	responses that are off-topic or incoherent.
				http://rubistar.4teachers.org/

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Comiso, Josefino & Perez, Gay & Stock, Larry. (2015). Enhanced Pacific Ocean Sea Surface Temperature and Its Relation to Typhoon Haiyan. Journal of Environmental Science and Management. 18. 1-10.

DePetris, L. (2017, Feb 14). Point of view: A skeptic's view of climate change. Florida Times Union Retrieved from https://www.proquest.com/newspapers/point-view/docview/1874920932/se-2?accountid

The other modules on **Disaster Readiness and Risk Reduction**

- Climate Change Mitigation and Adaptation focuses on game-based disaster preparedness education, something that students would appreciate and could be try their creativity.
- Creative Action on Climate Change – focuses on environmental activism starting with their families and immediate communities.

Sample activities were also provided in the modules.

Currently preparations are underway for the pilot implementation that will start in September 2022, to coincide with the First semester for SY 2022-2023. The target participants are the Student Teachers and the Faculty members of the College of Education.

10.4 NEXT STEPS

10.4.1 Detailed Working Plan from July 2022

Training of Champions for Climate Change Education refers to the Students Teachers who will undergo training based on the Modules prepared. Training will incorporate application in the Student Teaching component their planned action on the training they receive. This Action Plan will consist on leaving in their Practice Teaching Schools a programme on CLIMATE CHANGE DISASTERS AND EDUCATION FOR SUSTAINABLE DEVELOPMENT for the school to keep and sustain. It's a contextualized project or action research participated in by the teachers and the students which the Student Teacher will nurture for the next five years. It will be a joint project between the school and the Local Government Unit to ensure continuity.

10.4.2 Upcoming Timeline and Deliverables

Evaluation which will oversee the application of the modules through Action Plans of the Students Teachers will constitute the third and last portion of this project. This will look into the effects of the contextualized projects or Action Research each of the Student Teachers will work on as a result of the training. By November 2022, the Evaluation phase would have been

finished. This consists in following up the programmes on Climate Change Education set up by students in the various schools where they had Practice Teaching. What follows next will be re-doing the Modules based on the Evaluation. Then the final copy of the Modules will be ready for Mindanao wide use in the Teacher Training Institutions.

Report from the Philippines

11. Climate Change Education in the Cordillera Administrative Region

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ABSTRACT

Promoting Education for Sustainable Development (ESD) particularly Climate Change Education in Teacher Education Institutions results to the awareness and application of sustainable development actions among teachers and students both in the tertiary level and basic education level. This paper aims to present the progress of Saint Louis University's (SLU) efforts regarding Promoting Teacher Education for Climate Change Education in Asia (ATECCE). Saint Louis University is one of the Centres of Excellence in Teacher Education in the Cordillera Administrative Region, Philippines. From the documentary analysis and curriculum audit that was conducted, it was found out that ESD is clearly captured by the vision-mission of the university and is clearly translated in its strategic directions. This is cascaded in the strategic plans of the schools and one of these is the School of Teacher Education and Liberal Arts that ensures that ESD particularly climate change education is translated as one of the course contents of the teacher education curriculum. From the curriculum audit that was conducted, some climate change education contents and activities are covered in the general education courses, professional education courses and internship programme with the basic education level. With the alignment of climate change education in the University's vision-mission and goals down to the course learning outcomes, it denotes that the pre-service teachers of the teacher education programme together with the students in the laboratory schools are empowered with the essential knowledge, skills, values and attitudes needed to address climate change problems. To sustain and enhance the pre-service teachers' engagements in climate change education, climate change education workshop is highly recommended to be implemented.

Keywords: curriculum quality audit, climate change education, pre-service and in-service teachers, Laudato Si

11.1 INTRODUCTION

The Philippines is ranked third among the four countries in the world that is most vulnerable to climate change (The Philippine Star, 2018). In a research done by Bollettino et al. (2020), it stated that the Philippines is highly susceptible to both geophysical and climate-related disasters as it is sitted in the Pacific Ring of Fire which is subject to routine seismic and volcanic activity. Moreover, its position in the Pacific puts it in direct path of multiple typhoons each

year. This Philippine context makes climate change education a very important and priority concern by the Philippine Government in general and by the education sectors in particular. The role of the education sectors in sending the message to a lot of learners and other stakeholders in promoting sustainable development is undeniably beneficial. The education sectors have been recognized in playing a big role in helping the government and non-government organizations in promoting sustainable development goals such as combating climate change.

In the Philippines, one of the key players in the educational system are the Teacher Education Institutions (TEIs) offering education degree programmes for pre-service teaching. The TEIs are one of the key players in the entire educational system because they are the ones preparing and training the would-be-teachers who will be employed as in-service teachers in the various schools locally and internationally. Currently, there are 1,603 TEIs in the country and 18 TEIs in the Cordillera Administrative Region (CHED, 2022). The role of the TEIs is critical as its main goal is to prepare the pre-service teachers to become professional teachers and educators. The way they will educate and train their pre-service teachers is crucial as whatever contents and skills they were able to let their students acquire and achieve is what they will bring with them to the community and to the schools where they will be teaching. Their graduates are important bearers of essential information and tools that are necessary in educating people for social change as they can be equipped with the right knowledge and skills to help combat climate change. As Anderson (2010) puts it, there is a clear education agenda in climate change adaptation and mitigation strategies and these require learning new knowledge and skills and changing behaviors in order to reduce the vulnerability and manage the risks of climate change.

To understand the initiatives of schools in promoting climate change education and to know how climate change is introduced in the Philippine schools, some researches on sustainable development and climate change were conducted and published. One of the research agenda on climate change that was looked into in the Philippine researches is on climate change awareness. Barreda (2018) for instance investigated the level of awareness on climate change of some selected students studying in Partido State University in Caramines Sur. The research also determined the factors that influenced their awareness. The results of the research say that the level of awareness of the students is generally high and the factors identified that determine their awareness are personal experience, education, government actions and channels of information. Another study on climate change awareness was conducted by Magulod (2018) that assessed the climate change awareness and the environmental attitude of undergraduate students of Cagayan State University. The results of the study revealed that the respondents have high level of climate change awareness and environmental attitude. The study confirmed too that the awareness of the students on climate change differs because of gender, age, birth order and parents' educational attainment. Meanwhile, attitude of the respondents towards the environment is influenced by their age and college departments.

It is also interesting to note that climate change level of awareness was also explored in the

basic education level. One research on climate change awareness and attitude was among selected senior high students in Cavite, the Philippines. This was conducted by Lopez and Malay (2019). The research revealed that the level of awareness of the student-respondents is moderate to high. The senior high school students also moderately strongly agree that on their roles in addressing problems about climate change. Their awareness on climate change were results of various sources such as internet, television and from school. As noted by the respondents, one of their sources of information is the school and this may probably be charged to one of their core subjects that focused on disaster risk reduction management. Having a good level of awareness and the right attitude towards climate change is very important especially among young learners. It must be noted that children and young people are commonly treated in the climate change and disasters literature as victims of natural events requiring protection by adults (Tanner, 2010).

Aside from the data taken from the basic education and tertiary level, another study was conducted post-undergraduate level and this is a study that was conducted by Domantay et al. (2021) in one of the medical schools in the Philippines. In particular, it was conducted at Saint Louis University, Baguio City, Philippines, having the future physicians in this medical school the respondents. The study determined the knowledge and attitudes of future physicians towards climate change. The results of the study revealed that the respondents had fair to good knowledge of climate change. The results further revealed that the respondents generally showed favourable attitudes towards the issue, indicating that they may be more likely to express willingness to take climate change action.

By studying the awareness and attitude of learners across all levels of the educational ladder, climate change education initiatives can be enhanced, refocused and re-aligned. The results of these research topics are very helpful to identify the areas that will need reinforcements and the areas that needs strengthening especially when all the factors and variables that were found out to be affecting or influencing students' awareness and attitudes towards climate change are looked into or are taken into consideration when planning and implementing programmes on climate change education. These data are necessary to serve as springboard and baseline data.

Some other school related studies were also conducted not focusing on awareness and attitude but on some climate change related school projects and programmes. One of the recently conducted research focused on the implementation of the Department of Education programmes, projects and activities on mitigating the impact of climate change in the Philippines (Tosino et al., 2022). The research participants are represented by various stakeholders because they have school heads, teachers, parents, schools' division personnel, Punong Barangays and Sangguniang Bayan members. The results of the study revealed that a very great extent of implementation of the Department of Education initiatives mitigate climate change within the learning conditions and environments of the schools. Another climate change research was conducted focusing on the pro-environmental actions of schools. The research entitled, "Greening Through Schooling: Understanding the Link between Education and Pro-environmental Behavior in the Philippines." This was conducted

by Hoffmann and Muttarak (2020). The research found out that an additional year of schooling increases the probability of pro-environmental actions like tree planting, recycling and proper waste management. One of the essential results of the study is its findings saying that education influences behavior mainly by increasing awareness about the anthropogenic causes of climate change, which may consequently affect the perception of self-efficacy in reducing human impacts on environment.

Considering all of the above cited researches, it indicates that there are researches on climate change in the Philippines but are with limited number. Moreover, it is significant to note that most of the published studies so far in the Philippine context focused on awareness and attitude on climate change. Hence, this study aimed to explore the integration of climate change education in the curricular programmes of one on the CHED recognized Centre of Excellence in Teacher Education institution in the Philippines. This research specifically aims to explore how climate change education content standards are integrated in the development of the curricular programmes of some selected Teacher Education Institutions in the Cordillera Administrative Region, Philippines.

11.2 METHODOLOGY

11.2.1 Research Design

Qualitative research design was used for this study. Specifically, it applied the qualitative descriptive research design (Lambert & Lambert, 2006) using documentary analysis. This design provides a detailed summary of specific descriptions of how climate change education is integrated in the curricular programmes of the teacher education programmes of the target teacher education institutions.

This design is the least "theoretical" as compared to the other qualitative designs for it leans towards bringing out naturalistic inquiry. It implies a dedication to studying something in its natural state to the extent possible within the research field. As a result, there is no prior commitment to any one theoretical perspective of a target phenomenon, no pre-selection of research factors, no manipulation of variables and no prior commitment to any one theoretical view of a target phenomenon (Lambert & Lambert, 2006).

11.2.2 Scope and Delimitation

The study was limited to the analysis of the general education and professional education course syllabi of the Bachelor of Elementary Education and Bachelor of Secondary Education Programmes for the AY 2021-2022 of the selected Teacher Education Institutions in the Cordillera Administrative Region. The scope will have two phases. The first phase focused on the curricular programmes of the School of Teacher Education and Liberal Arts of Saint Louis University, Baguio City, Philippines. The first phase included the analysis of the various learning outcomes of the programmes as these are necessary in the development of the different course syllabi. The second phase of the scope will include other selected TEIs of the region who will be willing to participate in the research as respondents.

11.2.3 Data Collection

Since curricular programme covers the institutional outcomes, programme learning outcomes, course learning outcomes and the entire learning plan and implementation, the documents that were collected to have the data needed are the course syllabi and the course learning modules and materials of the general education and professional education courses of the Bachelor of Elementary Education and Bachelor of Secondary Education Programmes. The same data will be collected from the other participating TEIs during the second phase of the data collection.

11.2.4 Data Analysis

The documentary analysis was done through using some of the essential processes of conducting Curriculum Quality Audit (CQA) introduced by the Philippine National Research Center for Teacher Quality. The content standards of climate change education were used as a basis to audit if these are covered and are integrated in the curricular programmes of the school-respondent. Guided by the Outcomes-Based Education (OBE) framework that was used by the institution in developing its curricular programmes, the analysis of the data followed the following steps (**Fig. 11.1**).

To have a clear direction in the identification of the climate change education contents from among the various documents, the documents were analyzed hand-in-hand with the climate change topics identified by the Department of Education (DepEd) in their official website. These topics with their identified activities are expected to be introduced in the integration of climate change in the basic education level. The DepEd's identified topics were used as a basis as the pre-service teachers as would-be-teachers are expected to be knowledgeable about these in preparation for their application in the future as in-service teachers. Hence, the collected documents from the TEI during the first phase of the data gathering were audited based on the Climate Change Education topics of DepEd.

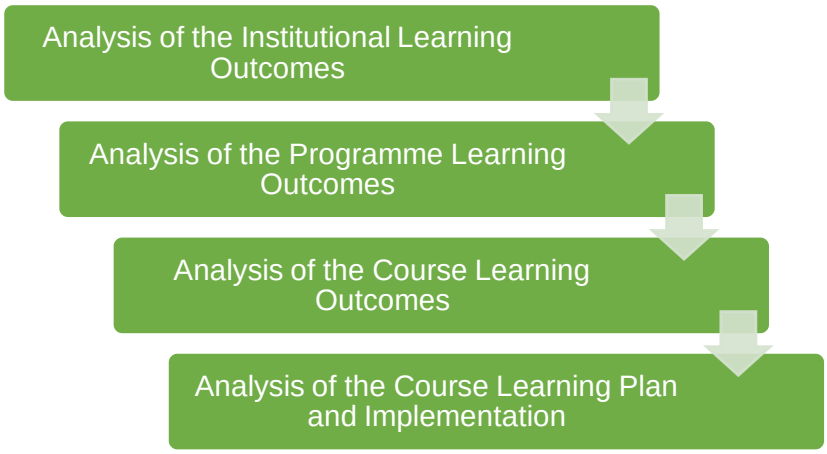

Fig. 11.1 Data analysis steps

Table 11.1 Elapsed timeline and deliverables

Objectives	Output	Outcome	Timeline
Identifying the climate change research gap	Research gap	Clear research objectives	First Sem AY 2021-2022
Reading of published researches on climate change education in the Philippines	Rationale of the research and embedded literature review in the research introduction	Comprehensive research introduction	First Sem AY 2021-2022
Crafting the research introduction and the research methodology	Research methodology	Complete information of the research methodology	First Sem AY 2021-2022
Gathering the documents needed for the audit	Complete documents for the documentary analysis	Ready for the documentary analysis	Second Sem AY 2021-2022
Started the curriculum quality audit of the documents using some selected steps introduced by the RCTQ on doing CQA	Interim results of the research results and discussion	There is an interim data that will serve as springboard for the succeeding data collection.	Second Sem AY 2021-2022

The same content standards will be used to audit the curricular programme offerings of the other TEIs who will be participating during the second phase of the data gathering.

11.2.5 Elapsed Timeline and Deliverables

Table 11.1 presents the activities that were initially done for this research.

11.3 RESULTS AND DISCUSSIONS

As a result of the conducted documentary analysis from the first phase of the data collection, the following interim results are presented and discussed.

11.3.1 Institutional Learning Outcomes

Saint Louis University is a Catholic University founded by the Congregatio Immaculati Cordis Mariae (CICM). As a Catholic learning institution, its mandates are anchored on the Catholic Social Teachings that apply in a particular way to the Church's concern for the environment. First, concern for the environment calls us to respect human life and dignity. Second, as the world becomes increasingly interdependent, we have a call to promote the common good and the virtue of solidarity. Finally, in caring for the environment, we have a special responsibility to the poor and vulnerable, who are most affected and least heard (United State Conference of Catholic Bishops, 2022). It is no wonder why in the institutional learning outcomes of the University, many of the goals in the Sustainable Development Goals (SDGs) are covered. In particular, environmental concerns that are directly covered in Climate Change

Table 11.2 SLU's institutional learning outcomes

Graduate Attributes	Institutional Learning Outcomes (ILO) At a result of their educational experiences at the University, LOUSIAN graduates will:
Christian Spirited	1. Lead others in encountering God as a mission oriented Louisian; 2. Live Christian values in their personal and professional endeavors; 3. Manifest compassion in human relations with emphasis for the marginalized and the poor; and 4. Practice ethical behavior in a globalized, multi-cultural and technology driven world with the end in view of perpetuating life in all its forms and the conservation of the environment;
Socially Involved	5. Advocate the promotion of social justice and nationalism; 6. Foster a life-long commitment and discerning attitude towards addressing global, religious, political, societal issues and environmental concerns; 7. Promote unique and diverse cultural heritage vital to development, inclusiveness, and nationhood; and 8. Engage in community-based programmes to improve quality of life;
Creative and Critical Thinker	9. Generate new knowledge through research and develop innovative projects; 10. Devise creative solutions to discipline-related problems and issues; 11. Develop products, creative output and services through the use of appropriate tools, techniques and technologies in the discipline; and 12. Exhibit innovativeness and aesthetics in knowledge building and problem-solving in their field of expertise.

Education are one of the Institution's targets in its institutional learning outcomes. This is clearly shown in the following institutional learning outcomes articulations (**Table 11.2**).

Out of the twelve learning outcomes, it is notable to point that institutional learning outcome number 4, "*practice ethical behavior in a globalized, multi-cultural, and technology driven world with the end in view of perpetuating life in all its forms and the conservation of the environment*," directly covers one of the major reasons why Climate Change Education is promoted. This is to make sure that the environment is conserve. Another institutional learning outcome that is directly covering a Climate Change Education topic is item number 6, *"foster a life-long commitment and discerning attitude towards addressing global, religious, political, societal issues, and environmental concerns,"* that ensures that a life-long commitment and discerning attitude towards environmental concerns among others is demonstrated by all the Institution's students.

Institutional learning outcomes are framed that will serve as a guide to the developers of an institution's curricular programmes. Hence, in the development of the all the curricular programmes of the University, it is expected that they will anchor their learning plans and activities aligned with these learning outcomes. In doing so, curricular offerings are reviewed and enhanced guided by the Institution's learning outcomes.

From the above-cited learning outcomes, it expresses that the programme learning outcomes of all the degree programmes of the University are with aligned outcomes that also target topics on the preservation of the environment.

Table 11.3 Programme learning outcomes of BEED and BSED

Programme Learning Outcomes
At the end of the programme, the students are expected to be able to: 1. apply the latest developments in the specific field of practice; 2. participate in the generation, dissemination and utilization of new knowledge and developmental projects; 3. communicate effectively in oral and written forms using both English and Filipino; 4. work effectively and independently in multi-disciplinary and multi-cultural teams; 5. act in accordance to professional, social and ethical responsibility; 6. preserve and promote "*Filipino historical and cultural heritage*;" 7. practice Christian values in their personal and professional endeavors as Louisians in the service of the CICM mission; 8. demonstrate high level literacy, communication, numeracy, critical thinking, learning skills; 9. facilitate learning in the secondary education level guided by principles and methods of facilitating learning; 10. integrate meaningfully and comprehensively the knowledge of the subject matter to real life situations of learners; 11. apply a wide range of teaching and facilitating process skills including curriculum development, lesson planning, materials development, educational assessment and teaching approaches; 12. innovate on effective alternative teaching and learning approaches, methodologies and strategies to improve student learning; 13. innovate on effective alternative teaching and learning approaches, methodologies and strategies to improve student learning; 14. collaborate with colleagues and other experts in their own fields for continuous professional development and a better fulfillment of their mission as teachers; and 15. create an inclusive learning friendly environment that promotes the potential of all learners.

11.3.2 Programme Learning Outcomes

Among all the degree programmes offered in Saint Louis University, the teacher education programmes are one of the oldest programmes it offers. In the analysis of the programme learning outcomes of the teacher education programmes particularly the degree Bachelor of Elementary Education (BEED) and Bachelor of Secondary Education (BSED), it can be deduced that the curriculum developers were conscious in aligning its programme outcomes with the institutional learning outcomes. From among the following programme learning outcomes, there are four specific programme learning outcomes that support ESD particularly on addressing some environmental and social issues that are aligned in climate change education. The programme learning outcomes are shown in **Table 11.3**.

11.3.3 Course Learning Outcome

In the analysis of the different courses of the two identified degree programmes included in this study, it was found out that the courses that targeted the said climate change education related outcomes are mapped in the following two general courses (**Table 11.4**).

Table 11.4 **Courses integrating climate change education topics**

Course Code	**Descriptive Title**
CFE 105A	CICM in ACTION: Justice, Peace and Integrity of Creation, IRD and Indigenous Peoples.
CFE 105B	CICM in ACTION: Environmental Planning and Management and Disaster Risk Reduction.
NSTP-CWTS 2	National Service Training Programme-Civic Welfare Training Service Course 2 (NSTP-CWTS)

The above-cited courses are Christian Formation Education courses and National Service Training Programme – Civic Training Welfare Training Service with the following course learning outcomes of each of the said courses:

At the end of the CFE 105 courses, the students should be able to:

- articulate and align yourself to the new venue and direction of the CICM mission;
- profess their willingness to contribute to relevant and responsive missionary programmes for the marginalized and vulnerable that are organized by their local church or community;
- participate actively in government and church programmes that promote justice, peace, integrity of creation, Indigenous Peoples and Interfaith Dialogue;
- promote peace unity among Churches through daily prayers and respectful conscious dialogues with people of different faith; and
- sustain their relationship with God through regular participation in the various religious activities of their own church/religion.

At the end of NSTP-CWTS 2, the students should be able to:

- demonstrate understanding of community welfare involvement though actual social activities;
- demonstrate competency of the basic skills required by community immersion, project identification, planning and implementing while exhibiting Christian values;
- design a project in line with their programme that will uphold their commitment in promoting community welfare and service to one's academic and workplace as professional or to the community; and
- execute a well-planned community welfare project with evaluation for its sustainability.

Below are some samples of activities in the NSTP-CWTS 2 course aligned with climate change education activities:

a. recycling;
b. gardening;
c. plant nursery;
d. composting;
e. solid waste management;
f. cultural learning documentation of local values that promotes service and bayanihan;
g. landscaping;
h. entrepreneurship projects – home-based business;
i. academic tutorials;
j. making of dishwashing liquid, soap making and others;
k. catechetical work, church work; and
l. others

The NSTP-CWST 2 project apostolates are usually done off campus and in campus or the ad-extra and ad-intra projects. Example of ad-intra projects is the following: re-greening projects, blood donation, reforestation, recycling, tutorials, inclusion choir, fitness programme, crowd control management, school of living tradition documentations, organizing and planning of campus forums, planning and facilitating talent beyond borders shows.

11.4 NEXT STEPS

Objectives	Output	Outcome	Timeline
Communication with the Commission on Higher Education for the Workshop Data Gathering with the Selected TEIs	Official documents provided in the conduct of the research with the selected TEIs	Authorized to conduct data gathering with the selected TEIs	1st Sem AY 2022-2023
Data Gathering with the selected TEIs	Data gathered	Ready for data analysis	1st Sem AY 2022-2023
Analysis of the Data	Data coded and analyzed	Completed results and discussion	2nd Sem AY 2022-2023
Finalization of the Research Paper	Full paper completed	Ready for submission	2nd Sem AY 2022-2023

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Report from the Philippines

12. Promotion of Climate Change Education among Centres of Excellence and Development in Teacher Education in the Visayas Region: Challenges and Enablers

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ABSTRACT

Learners with the necessary competencies will be able to contribute to environmental sustainability, integrity and climate change education. This study assesses the level of Climate Change Education (CCE) integration in the DepEd schools and HEIs in the Visayas Region. The three UNESCO ESD domains served as the foundation for this study's concept. As a baseline data, a total of 109 Department of Education (DepEd) teachers and from Higher Education Institutions (HEIs) voiced their opinions on how CCE was being integrated in their own practice in the areas of (1) School Competency – Curriculum, Co-Curricular and Curricular Activities; and (2) Competency for Teachers – Research, Community Extensions and Training and Development. According to the selected respondents' perceptions of the Centers of Excellence and Development schools, the integration of CCE competencies in HEIs is at a moderate level (3.31 on average), while the integration of CCE competencies in teachers' scholarship programmes according to the DepEd is at a low level (1.99 on average). These results demonstrate further improvements to achieve a high level of integration of CCE. The 25 representatives from different HEIs in the Visayas and in the Philippines shared their best practices, lived experiences, and expertise in implementing the CCE Programmes during the workshop on CCE organized by the University of San Jose-Recoletos ESD Centre in the Visayas region. The challenges and enabling factors were comprehensively identified during this process. After which, the means of verification served as a procedure of evidence gathered through dynamic assessment and evaluation founded on the valued judgment to authenticate the explicit outcomes for CCE based on the respondents' perspectives. The study recommends programmes for CCE in the Visayas region that will eventually incorporate CCE Concepts into all aspects of facilitating learning, connecting, collaborating and engaging, as well as continuing to learn how to create.

Keywords: teacher education, climate change education, facilitating learning, connecting, collaborating and engaging, continuing to learn how to create

12.1 INTRODUCTION

12.1.1 Background

Schools and teachers with principled knowledge, attitudes and skills will achieve

sustainability (UNESCO, 2015; UN, 2018). It empowers them to contribute to environmental sustainability and integrity (UNESCO, ESD Workshop in South East Asia, 2018; Babia et al, 2021). Therefore, Climate Change Education principles and programmes should be promulgated in the Philippines. Henceforth, it creates economic viability and a humane society for posterity. This report aims to integrate CCE into the Philippine education system.

Since then, various organizations have pushed for CCE institutionalization in the country. For instance, the Philippine Rural Reconstruction Movement (PRRM) was established to improve the capacity of rural areas in carrying out sustainability through an integrated programme of education and livelihood. The Philippines' Department of Environment and Natural Resources (DENR), initiated the programme called the Philippine Strategy for Sustainable Development in 1989 to achieve and maintain economic growth without depleting the country's natural resources. Later in 1996, the Philippine Agenda 21 – which is the country's blueprint – was adopted which was later updated in 2009 as the Enhanced Philippine Agenda 21. Such a goal of eradicating poverty through good governance was then reflected in the provisions found in the Millennium Development Goals to the current 2030 Sustainable Development Goals. The Philippine government managing the education landscape of the country also conducted its huge efforts in achieving the sustainability goals through curriculum integration and mainstreaming. Commission on Higher Education (CHED) articulated ESD integration in its Strategic Plan 2011-2016 to streamline efforts and resources towards ESD implementation and integration. The Department of Education (DepEd) as a response to the Hyogo Framework for Action in 2007, issued DO No. 55 on "Prioritizing the Mainstreaming of Disaster Risk Reduction Management in the School System" and DO No. 175 s. 2007 on a technical working group on an operation manual on DRR.

Previous studies in the Philippines have shown that academic institutions play a significant role in promoting CCE (Lopez & Malay, 2019; Linawag & Lee, 2021). However, there are no teacher education programmes shown. A recent study by Genizera and Tosino (2022) shows the implementation of CCE programmes in basic education. The result further recommends enhancements throughout other DepEd schools in the Philippines. With that, there must be assessments of Higher Education Institutions (HEIs) and DepEd schools for integrating CCE in curriculum, co-curricular and curricular activities. Hence, the teachers' capability to contribute to research, community extensions and training and leadership programmes for CCE must also be assessed to create enhancements.

The results of this study will serve as baseline data as to what competency should be enhanced for school programmes and teachers' capabilities. Moreover, this study will gather the schools' initiatives for implementing systematic education programmes. The existing school initiatives for CCE will be verified and aligned to the pillars of ESD to serve as a basis and recommendations for the ways forward. This study is an attempt to enhance CCE integration in HEIs and DepEd schools through the collaboration between Asian centres of excellence on ESD. Hence, it also intends to derive some solutions from Asia.

12.1.2 Conceptual Framework

The concept of this study was derived from the UNESCO Japan and Okayama University's roadmap for implementing the Global Action Programme on ESD based on the three futures of learning: Facilitating Learning; Connect, Collaborate and Engage; and Continue to Learn and Create (Okayama University ESD Promotion Centre, 2020). The three futures of learning guide the school in integrating the CCE in the school and teachers' competencies. Through this, best practices based on the future of learning will be shared.

CCE competencies in Philippine schools are curriculum, co-curricular and curricular activities. The curriculum explicitly and implicitly identifies the schools' capabilities to incorporate CCE principles into the lesson plans, curriculum and instruction, physical environment and policies and processes. The co-curricular activities are the integration of CCE principles in field trips, science fairs, student activities, studies and literature, forums and other presentations. Extracurricular activities are the integration of CCE principles in girl and boy scouts, student leaders, student programmes and student community outreach programmes.

Meanwhile, CCE competencies among teachers are based on the pertinent provision of CHED Order Number 52, Series of 2016 to integrate CCE principles into research, community extensions, and leadership and training which constitute the integration of scholarship for basic and higher education teachers in the Philippines. Integration of scholarship among teachers will help in economic, social, environmental, political and cultural sustainability.

12.2 METHODOLOGY

This study utilizes a sequential explanatory mixed-method research design. It starts with

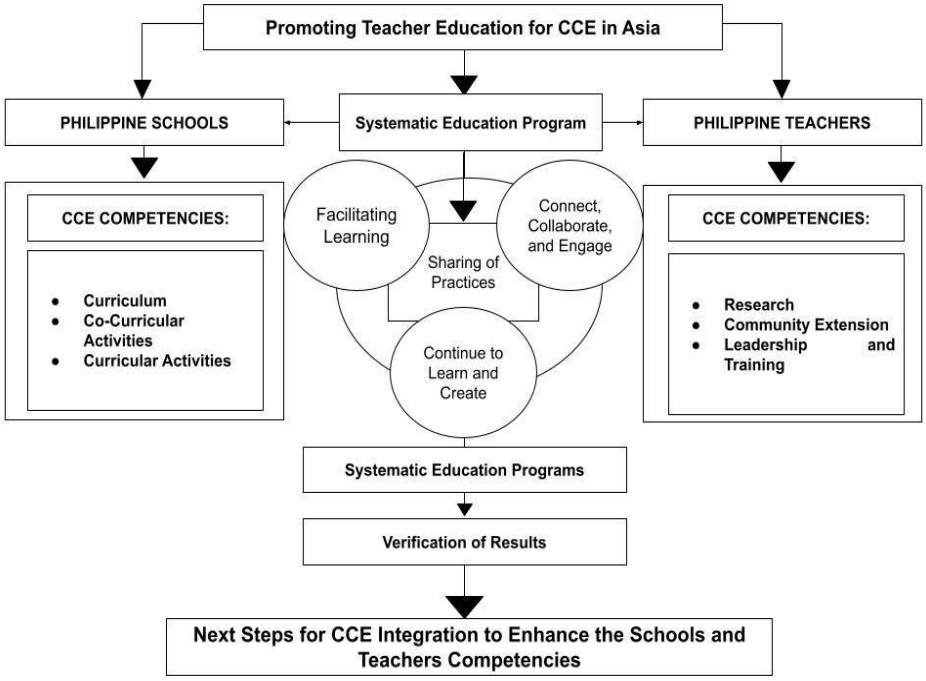

Fig. 12.1 Schematic diagram of implementing the conceptual framework of this study

Table 12.1 Cross-tabulation of respondents

USJ-R	**10**	**9.2%**
CTU	3	2.8%
CNU	1	0.9%
USC	3	2.8%
SU	2	1.8%
HNU	3	2.8%
BSU	2	1.8%
NORSU	1	0.9%
DepEd School A	27	24.8%
Dep Ed School B	27	24.8%
DepEd School C	30	27.5%
Total	**109**	

collecting and analyzing the quantitative data to measure the integration of CCE in school curriculum, co-curricular and curricular activities and teachers' capability to contribute to research, community extensions and leadership and training for CCE. This study utilizes two types of a research-made survey questionnaires. As part of the qualitative method, the researcher uses a semi-structured interview tool through open-ended questions. In addition, the verification of the competencies was analyzed using thematic analysis. Inputs were also taken during the Climate Change Education workshop among Centres of Excellence and Development organized by University of San Jose- Recoletos ESD Center for Research, Training and Development. Participants were from University of San Jose - Recoletos (USJ-R), Cebu Technological University (CTU), Philippine Normal University (PNU), Cebu Normal University (CNU), University of San Carlos, Silliman University (SU), Holy Name University (HNU), Bukidnon State University (BSU) and Negros Oriental State University (NORSU) were the participants of the focus-group discussion. There are 109 respondents from a random sampling (**Table 12.1**).

12.3 RESULTS AND DISCUSSIONS

This chapter shows the measurement of CCE integration among the different schools and teachers' capability for CCE.

The Level of Integrating CCE Competencies In The HEIS and DEPED Schools

The result of CCE integration among different schools and universities in the Philippines was measured in terms of Curriculum, Co-Curricular, Curricular, Research, Extensions and Training perceived by the teachers and focal persons during the fora.

Data:Seminar-and-Climate-Change-Education-Integration-Evaluation-Responses (1).xlsx

Data:https://docs.google.com/spreadsheets/d/1eTzT3_dzbLetSxuMWQQw7tVFK5G5dULU749JmyISPy4/edit?usp=sharing

Statistical Treatment:results.xlsx

Table 12.2 shows that Curriculum, Co-curricular and Curricular Activities have moderate integration of CCE principles. It means that teachers were able to integrate the practices and principles in their respective schools. Furthermore, integration should impact not just the

Table 12.2 Level of CCE integration in HEIs as perceived by the selected focal persons (N=109)

Components	Mean	Sd	Interpretation
Curriculum	3.355	0.55	Moderate Level
Co-Curricular	3.245	0.61	Moderate Level
Curricular	3.32	0.56	Moderate Level
Total	3.306666667	0.573333333	Moderate Level

Table 12.3 Level of CCE integration in HEIs as perceived by DepEd teachers (N=109)

Components	MEAN	SD	Interpretation
Community Extensions	2.05	0.76	Low level
Research on Climate Change	1.82	0.79	Low level
Training and Participation	2.11	0.79	Low level
Total	1.99	0.78	Low Level

focal person but all individuals including parents, teachers and students. Thus, this data is only limited to the perceptions of the leaders and teachers for CCE integration in HEIs. It further suggests that the impact of CCE must be expounded to students, parents, teachers and the community and their perceptions should be considered to support the claim (Genizera & Tosino, 2022). The focal persons play a vital role in promoting CCE awareness in the different schools in the Philippines.

The Level of Integrating CCE Competencies in the Teachers' Integration of Scholarship

The result reveals that CCE is only minimally integrated into DepEd teacher scholarships (**Table 12.3**). This indicates that among the instructors' professional and academic advancements, CCE is not given top priority. The findings also suggest that the CHED and DepEd provisions for CCE integration in the teachers' scholarship be adopted and improved. As a result, the Philippine basic education system needs to further emphasize this concern since it will also have an impact on the path of globalization and internationalization and because it is a key factor in both national and international academic rankings.

The HEIS Initiatives for Implementing Systematic Education Programmes: Facilitating Learning; Connect, Collaborate and Engage; and Continue to Learning and Grow

These are the HEIS Initiatives for Implementing Systematic Education Programmes for Three Domains (**Table 12.4** to **Table 12.6**).

PPT: *https://drive.google.com/drive/folders/1nhWNjyt0ZVngBxzAhpRC9JVTKo_q8SIG*

Table 12.4 Domain 1- Facilitating learning

Theme	Schools	Activities	Formulated Meanings
Designing instructional materials using frameworks for teaching climate change	USJ-R	Crafting of CCE Module	Using the C-L-I-M-A-T-E Framework, University of San Jose- Recoletos developed a climate change education learning module. The following elements make up this framework: ***Competencies, Learning Objectives, Instructional Methodologies, Motivational Activities, Activity Analysis, Teaching Abstraction and Evaluation Measures.*** To establish alignment, the competencies for ESD, CCE and the SDGs were also defined and mapped appropriately. CCE will be promoted more and better with

Table 12.4
(continued)

			the creation of modules for use in classrooms. Given that the majority of the modules may be learned independently and at one's own pace, this allows it to reach a far larger audience. Additionally, the modules will have learning exercises that will direct students to some of the greatest environmental care techniques, techniques that can mitigate the consequences of climate change and a variety of other techniques.
	CTU	Transforming Learning Environments	The CTU provides trifocal functions such as research, instruction and community extensions. The university prioritizes the integration of scholarship among teachers to provide quality education and sustainable learning environments. To facilitate learning inside and outside the academic setting, the CTU conducts workshops to enable educators to integrate ESD and CCE with local communities. Whereas, it provides project-based actions for CCE initiatives.
	PNU	Integration of ESD and CCE Concepts to the syllabus and other learning activities	PNU-Visayas promotes curriculum and instruction, community participation and the creation of instructional materials as its primary duties within the holistic approach to ESD. The SDGs were incorporated into the curricula and modules that were taught using ESD methods with a focus on fostering lifelong learning. Students apply what they have learned in the classroom to their mangrove planting initiatives, looking for sustainability and environmental problems as well as potential solutions.

Table 12.5 Domain 2- Connect, Collaborate and Engage

Theme	Schools	Activities	Formulated Meanings
Collaboration between HEIs on Initiatives for Climate Change Education	All COEs and CODs	Inter TEI Collaborative researches Exchange of Expertise Network building among TEIs Anchor with Environmental Education Network of the Philippines (EENP)	Several Centers of Excellence and Development in Teacher Education including the SEAMEO- ESD Universities collaborated together and shared their CCE Practices and Initiatives during the "Climate Change Education for Sustainable Development among Centers of Excellence and Centers of Development in Teacher Education in the Visayas Region" organized by USJ-R in partnership with the UNESCO National Commission of the Philippines, Teacher Education Council and Okayama University. The project intentions were to: (1) convene the policymakers from COE and COD in the Visayas region and discuss the current trends in Climate Change Education; (2) Showcase effective Climate Change Education policies, guidelines and strategies implemented among COE and COD in the Visayas Region; (3) Develop an understanding of the existing policies, guidelines and strategies in the implementation of the Climate Change Education; (4) Identify points for the seamless inclusion of Climate Change in the Curriculum, Instruction, and Teacher

Table 12.5
(continued)

			Training Programmes; (5) Present short term and long term programmes for the inclusion of Climate Change Education in the curriculum, Instruction and Teacher Training Programmes among COE and COD in the Visayas Region; and (5) Create a community of practice and collaboration, sharing and capacity building in the promotion of Climate Change Education.
	CTU	Building Capabilities of Educators	In its National Service Training Curriculum-Community Welfare Training Services (NSTP-CWTS) college programme, which includes explicit mention of SDG 4 in the course's qualifications, CTU incorporates CCE, ESD, SDGs and GCED. Additionally, CTU creates research-based instructional materials (IMs) for Philippine basic education institutions. These materials were used to incorporate conservation efforts for biodiversity. With this, CTU is honored for excellent community-based practice known as hablon, a hand weaving product in Cebu, Philippines, by receiving the Government Best Practice Recognition, QS Rankings, Philippine GAWAD Edukampyon and SDSN Spotlight Award.
	PNU	Strengthening Environment Education - Local Government Unit Initiatives for Education Scholarship Grant	PNU concentrated on restoring the coastal mangrove area in order to address the marine ecosystem's response to climate change in the coastal area, where it was discovered through this action that the population decline of endemic species due to their habitat being destroyed by typhoons and the prolonged drought season. PNU works with USJ-R, CNU and CTU as well as various Local Government entities and most especially students as partner implementers to further increase lifelong learning and sustainability.

Table 12.6 Domain 3- Continue to Learn and Create

Theme	Schools	Activities	Formulated Meanings
Conduct of Continuing Professional Development Programmes between COEs and CODs	All COEs and CODs including the SEAMEO Schools	• CPDs on CCE • Core Group Mentoring and Monitoring • Capacity Building	The ability of educators to effectively prepare their lessons will be greatly aided by CPD programmes and training that will be provided on how CCE may be strengthened and integrated further in the classrooms. Many educators in various TEIs feel that it is necessary to develop CPD programmes expressly for climate change education in order to increase the framework's implementation and to emphasize the essence of CCE and bring its outcomes to lifelong learning.

Challenges and Enabling Conditions in Integrating CCE In HEIS and DEPED Schools to Enhance the Competencies

Table 12.7 are the challenges and enabling conditions in integrating CCE in HEIs and DepEd

Table 12.7 Challenges and enabling conditions for CCE integration

	Significant Statements	Themes	Keywords
Challenges Experienced	School Curriculum, and Co-curricular and Curricular Activities	Time allotment for the CCE programmes must be provided to the teachers and students.	My school activities need alignment in order that other activities will not occupy too much of the energy of the school, so CCE can be inserted.
	Teachers' Training and developmental programmes, and Research on CCE	Teachers and students must be exposed to CCE programmes.	My education and training and other personnel at CCE are necessary.
	Community Extension programmes	School administrators must create a policy that will engage learners and teachers in the community extension programmes.	There must be policy integration in the school.
Enabling Conditions	Community Extensions	Teachers and students must create programmes that will unite the people in society to contribute to CCE.	I must conceptualize innovative institutional CCE-related activities.
	Research on CCE	Training and support must be provided for the students and teachers in creating research-based CCE projects.	My administrators must support CCE-related projects both for teachers and students.
	Co-Curricular and Curricular activities in Schools	Teachers and students must contribute to innovation, development, and sustainability programmes.	I must conceptualize innovative institutional CCE-related activities.

Schools to Enhance the Competencies:
Participants Output:
https://drive.google.com/drive/folders/1El37hcCD0r5n_gb3hUV916qdApBp0Khq

Means of Verifying the Competencies

A procedure of evidence gathering through assessment and evaluation founded on valued judgment is required to authenticate the outcomes for climate change education based on the respondents' perspectives. The subsequent themes were noted:

Theme 1 *Identification of the relevant areas and levels of specificity is necessary for verification.*

Respondent 1: "*The three areas that should be investigated in relation to area*

assessment are theory, policy and practice. It is necessary to evaluate the levels based on the institution, programme, course and level or subject."

Respondent 2: *"The context of conducting climate change education based on teacher preparation, curriculum planning, instruction and extension must be recognized in order to further deepen the integration process."*

Theme 2 *Policies, theories and practices must be mapped out in accordance with the implementation at the institution, programme or course level.*

Respondent 5: *"The Teacher Education Programme may evaluate the area versus level matrix in terms of institutional outcomes, programme outcomes and course outcomes.*

Respondent 3: *"Basic education assessments can be self-initiated contextualization processes of ESD in basic education schools or they can be measured in terms of partnership with teacher education institutions – linked Applied Higher Education Programmes or Initiatives."*

Theme 3 Along with aims, products or performances, the assessment, verification and evaluation process must engage other people, things and resources.

Respondent 4: *"The institutional foundation of teacher education institutions and basic education schools must be understood in light of the objectives and outcomes of the courses. The Key Result Areas (KRAs) and Key Performance Indicators (KPIs) of the collaborator must be taken into account during planning, implementation and evaluation."*

Respondent 5: *"Basic Education schools need their own institutional focus in addition to TEI-linked activities and initiatives specifically on Climate Change Education."*

12.4 WAYS FORWARD

Programmes for climate change education in the Visayas region will eventually incorporate CCE Concepts into all aspects of *facilitating learning*, *connecting, collaborating and engaging*, as well as *continuing to learn how to create*. The following are specific steps to take going forward: (1) Promote and advocate for sustainable universities and communities by strengthening research collaboration between COEs and CODs on ESD and CCE; (2) Continue to discuss more climate change projects in the Community of Practice (CoP); (3) Strengthen the ability of preservice teachers to include climate change education in a more cross-disciplinary manner; (4) Collaborate with other Teacher Education Institutes to develop teaching and learning resources that highlight the inclusion of climate change education; (5) Monitor and assess CCE programmes in accordance with the framework; and (6) Inform all relevant parties of the outcomes, procedures and effectiveness of CCE.

Further, the programme will also seek to strengthen the following: (1) Ensure continued discussion on the institutional policies, strategies and principles in promoting climate change education; (2) Continued collaboration to strengthen and study various approaches and success indicators in the implementation of climate change education; (3) Plan a strategy for the integration of climate change education in the curriculum, instruction and teacher training programmes; (4) Generate a framework detailing the characteristics of effective integration of climate change education; and (5) Fortify the integration of Climate Change

Education by focusing on the outcome of the needs-based assessment and addressing the deficiencies in priority areas.

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Closing

This interim report represents a significant step forward in the attempt to promote climate change education in teacher education in order to contribute to climate action. Members of the project from nine countiries, shared the outcomes of their ongoing practices and future prospects of CCE in teacher education, such as the creation of modules, training programmes, courses and workshops. These outcomes will be further accumulated and presented at the final project meeting to be held in Okayama and Kyoto, Japan next year, leading to the development of a framework for CCE teacher education programmes to be disseminated throughout Asia.

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