Annex - X

Teaching Module on Climate Change Education based on Inquiry Based Science Education (IBSE) pedagogy for Capacity Development of Science Teachers in Pakistan

1st DRAFT

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Background

With a population of over 210 million, Pakistan is one of the most vulnerable countries to the impacts of climate change in the world. The country is expected to face severe extreme climate events, such as increased variability of monsoons, receding glacial caps, heatwaves, floods, and droughts. To address this mammoth challenge, there is an urgent need for the adaptive capacity of communities through adequate science education and enabling citizens to make informed decisions in the context of climate change.

Science education plays a vital role to prepare societies for the future global challenges, including the climate change. Climate science education can be one of the essential components and a catalyst in deescalating the rate of climate change by raising awareness, promoting evidence-based research and knowledge. The climate change issues can be effectively dealt with a policy framework and political determination only if the decisions are based on scientific research data and rational judgment.

Equipping citizens and professionals with the knowledge and skills to understand and respond to climate change is an essential part of adaptation and mitigation efforts. The integration of climate change into school education that contributes to professional development of young Pakistani students to address the climate change issues. In addition, through their learning, students transfer knowledge into the home, the community and into professional spheres as they enter the work force.

With this objective in mind, ECOSF in collaboration with InterAcademy Partnership on Science Education Program (IAP SEP) has developed this teacher training module on Climate Change Education for science teachers that employs Inquiry Based Science Education (IBSE) pedagogy. This training module aimed at delivering effective content on climate change to students of grade 5 through 10. Another objective of this assignment is developing an assessment or evaluation methodology for this training to measure the depth of learning with IBSE pedagogy. This is to demonstrate that inquiry-based approach could offer greater degree of learning and understanding of science concepts and processes in comparison to traditional science teaching methods.

Employing Inquiry Based Science Education to teach Climate Change education

Inquiry-Based Science Education (IBSE) is a form of science education that unlike the traditional model where the teacher provides facts and the students learn them, gives children the opportunity to explore “hands on”, to experiment, to ask questions and to develop responses based on reasoning.

IBSE takes a more student-centered approach to teaching and puts focus on questions and problem-solving.

- **Develop their own questions**
- **Collect Evidence**
- **Form a decision**
- **Construct Explanations**
- **Communicate Logically**

Inquiry Based Science Education (IBSE) - Learning Cycle

Inquiry based learning provides an opportunity to Students to learn problem-solving skills using methods like the ones scientists employ that should lead them through parallel stages of discovery. The teaching modules on climate change have been developed based on the framework of IBSE learning that follows each one of the following steps:

- **Engage:** Teachers create interest and generate curiosity in the topic of study; raise questions and elicit responses from students that will give you an idea of what they already know.

- **Explore:** At this stage students are given opportunities to work together without direct instruction from the teacher. Teachers act as facilitators, helping students to frame questions by asking questions and observing.

- **Explain:** Teachers encourage students to explain concepts in their own words, ask for evidence and clarification of their explanation, and listen critically to one another's explanation and those of the teacher. Students use observations and recordings in their explanations.

- **Elaborate:** Apply concepts and skills in new (but similar) situations and use formal labels and definitions.

- **Evaluation:** Evaluation takes place throughout the learning experience. Teachers observe students' knowledge and/or skills, application of new concepts and a change in thinking. Students assess their own learning progress. Teachers ask questions that would encourage future investigations.

Potential Benefits of employing Inquiry Based Science Education as a teaching methodology for STEM subjects.

- An inquiry-based science education paves the way for effective learning of science and boost critical thinking.
- Majority of businesses and leaders are primarily interested in job candidate’s demonstrated capacity to think critically, communicate clearly, and solve complex problems.
- Recent survey by Human Resource professionals ranked critical thinking as one of the most important skills that employees will need in the next five years.
- Being scientifically literate helps students to be thoughtful global citizens.

Unit 1 - Introduction to climate and weather concepts

How weather and climate are different from one and other?

Learning objectives

- Be able to understand the difference between the weather and climate
- Assess the factors that influence weather and climates.
- Demonstrate how to measure various weather parameters through experimentation

Engage Duration: 10 mins

- Start off with your usual warm up and try to get students talking about seasons.
- Ask students what season they like best and see if anyone can explain why.
- Or ask them, have you ever left your house without a jacket on what turned out to be a freezing cold day?
- Have you ever been caught in the rain without an umbrella because you thought it was going to be a nice, sunny day?
  (This could elicit much of the vocabulary you plan to practice during the lesson so if certain vocabulary words come up, write them on the board.)
- You can also talk about different activities students like to do during seasons and why some of them, such as skiing, cannot be done year-round.

Explore Duration: 30 mins

- Teacher would ask the students to think about different atmospheric variables that create the weather we experience.
- Instructor would ask them to predict about the weather conditions for tomorrow. And display a weather forecast for complete day or week on multimedia.
- Students would be asked to think about the instruments which were probably used to determine the weather conditions.
- Design a working weather station that records several variables. Divide the class into small design teams, giving each team a different variable to measure. The task should follow a design and technology style workflow. Encourage students to carry out research to identify and understand needs, and then design an instrument that will record their variables.

Explain Duration: 20 mins

- Run this video on Weather versus Climate or What's the difference between weather and climate?
- Discuss following questions
  - What is weather?
  - What is climate?
  - How weather and climate are different?
  - What instruments can be used to collect data for weather prediction?
  - What is job of a meteorologist?

Elaborate Duration: 20 mins

- Now ask students to make a prediction about what the weather will be like on their birthday or a festive day (or choose random dates throughout the year). Ask them to explain how they know.

  Do they know for sure what the weather will be like that day?

  What evidence are they basing their prediction on?

  If they are traveling on their birthday, will their prediction still hold true?
- Facilitate a discussion about the difference between weather (what the weather is like from day to day) and climate (the weather conditions prevailing in an area in general or over a long period).
- Introduce monthly temperature and precipitation data into the conversation. Show examples for your region and others for comparison.

Evaluate Duration: 10 mins

- Wrap up the class by asking the students to write about the scenario given below and submit their answers.

  You are packing for a long trip to a new place. You are packing a suitcase with clothes to wear now and shipping a box with clothes you will need later. How do you know what to pack in which box? What information do you need?

  (To plan what you will need for both now and later you need to know something about both the weather and the climate where you are going. To determine what the weather will be like in the next few days, so you can pack your suitcase, you can look at local forecasts for the area. It's too early to know exactly what the weather will be like each day months from now, but you can look at patterns of weather over longer periods of time to figure out what to pack. Monthly

temperature and precipitation graphs for your destination will provide the information you need to pack your box.)

Suggested Activities for Unit 1

Barometer

What you'll need: Jam jar, balloon, lollipop stick, cardboard, sticky tape, base board
What to do:

- Remove the lid of the jam jar and attach the jar to the base board.
- Use the balloon to seal the top of the jar and tape the lollipop stick to the center of the balloon.
- Draw a measuring scale on a piece of cardboard and position it so that one end of the lollipop stick points to the scale on the cardboard.

How it works: As air pressure increases, it pushes down the balloon, causing the tip of the stick to rise on the scale. When it decreases, the air in the jar expands, pushing the tip down on the scale.

Anemometer and wind vane

What you'll need: Balsa wood, thick dowel rod, thin dowel rod cardboard, a yoghurt pot sticky tape, map pins, and Compass

What to do:

- Make a stand from balsa wood and cardboard, with a central hole for the thick piece of dowel rod to sit in. Slot in the piece of dowel so that it stands vertically but ensure that the rod can rotate freely.
- Make a cardboard vane that will turn the device to face into the wind. Attach this to the thick piece of dowel with sticky tape.
- Make a measuring arm from a yoghurt pot attached to a length of thin dowel rod. Attach this arm to the top of the thick dowel rod using a map pin, so that it pivots at the top of the vane. As the wind speed increases, the measuring arm will be pushed higher. Draw a scale on the vane so that you can accurately measure this movement.
- Add a direction indicator to the stand, at the bottom of the thick dowel, to show which way the vane is pointing. Make sure you line it up with a compass when you position your device.

How it works: As the wind changes direction, the vane will turn the device into the wind. The strength of the wind is measured by observing the pivoting movement of the measuring arm.

Rain Gauge

What you'll need: Plastic pop bottle (two-litre size) Sticky tape Marker pens A pair of scissors or a craft knife

What to do:

- Carefully cut the top off a two-litre pop bottle using a craft knife so that you are left with a straight edge and the neck of the bottle.
- Turn the neck upside down and push it back into the bottle. Use sticky tape to cover sharp edges if needed.
- Use a marker pen to add a scale to the side, making it easy to tell how much rainfall has been collected.

How it works: As rain falls, the open bottle will collect the water and channel it into the storage area at the bottom. Using the top as a funnel helps to stop too much of the stored water evaporating away.

Windvane activity:

Material to use: 1 Plastic straw**,** 2 Paper plates, 1 Marker, 1 Pencil with a new eraser, 1 Pair of scissors, 1 Roll of tape, 1 Poster board**,** 1 Straight pin (for use by adults only!), 1 Ruler, 1 Tube of modeling clay, and 1 Table fan.

Procedure:

- On the bottom of a paper plate, use a marker to write N, E, S, W (clockwise).
- Cut an arrow point and tail from the poster board. The tail should be much larger than the point.
- Cut 1-inch-long slits lengthwise on both ends of the straw.
- Slide the arrow tip and tail into the slits.
- Separately, squish a big ball of clay in between the two plates.
- Push the pencil through the plate you wrote N, E, S, W on so it stands straight up and is sturdy.
- Ask an adult to loosely push the pin through the center of the straw and into the pencil's eraser.
- Test the wind vane using the fan to represent wind.
- If you go outside, use a compass to align North on your plate for accuracy.