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EL-STEAM

**Environmental Education at the
Secondary Level in Bangladesh
Using STEAM to Develop an
Environmentally Literate Generation**

by

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**Project Title: EL-STEAM: Environmental Education at the Secondary Level in Bangladesh
Using STEAM to Develop an Environmentally Literate Generation.
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Introduction

The objective of this project is to improve the environmental literacy of Bangladeshi secondary school students by implementing a proposed Personalized Project-Based Learning (PPBL) that utilizes local wetland habitats, such as lakes and ponds, as real-world subjects. The initiative aims to address the inadequacies of traditional environmental education approaches in Bangladesh and promote a thorough understanding of ecological systems by involving students in collaborative, hands-on projects using the STEAM approach. By motivating students to look into and resolve environmental problems in local communities with the Gradual Immersion Method (Sanabria-Z, 2015), the project places a strong emphasis on using xAPI statements to measure learners' achievements throughout the experiential learning journey and raises student participation and a sense of ownership over their work.

Context

Environmental education in Bangladesh has traditionally focused on theoretical knowledge delivered in classroom settings, proving inadequate for fostering a deep understanding of ecological systems. In response to environmental crises and the limitations of traditional methods, the educational frameworks of Bangladesh have shifted towards interactive and experiential learning after the COVID-19 pandemic. Many students still lack a comprehensive understanding of environmental issues. To address this, the education ministry has begun implementing experiential and project-based learning, yet there remains a need for more personalized approaches that incorporate real-world topics. Local wetland areas, such as ponds and lakes, provide tangible examples that can significantly enhance students' learning experiences and environmental awareness, making education more relevant and engaging. Therefore, this project aims to provide a framework to engage secondary-level students of Bangladesh in Personalized Project-based environmental education where the learners will get the opportunity to collaboratively analyze and solve real-world environmental issues through the STEAM approach.

Description of the Project

Learning about local wetland areas—ponds, lakes, etc.—as a real-world subject has a big impact on the students' lives (*Codesigning Schools Toolkit*, n.d.). Because they will feel more a part of their local community, this inclusion is expected to increase student engagement and foster a sense of ownership over their work.

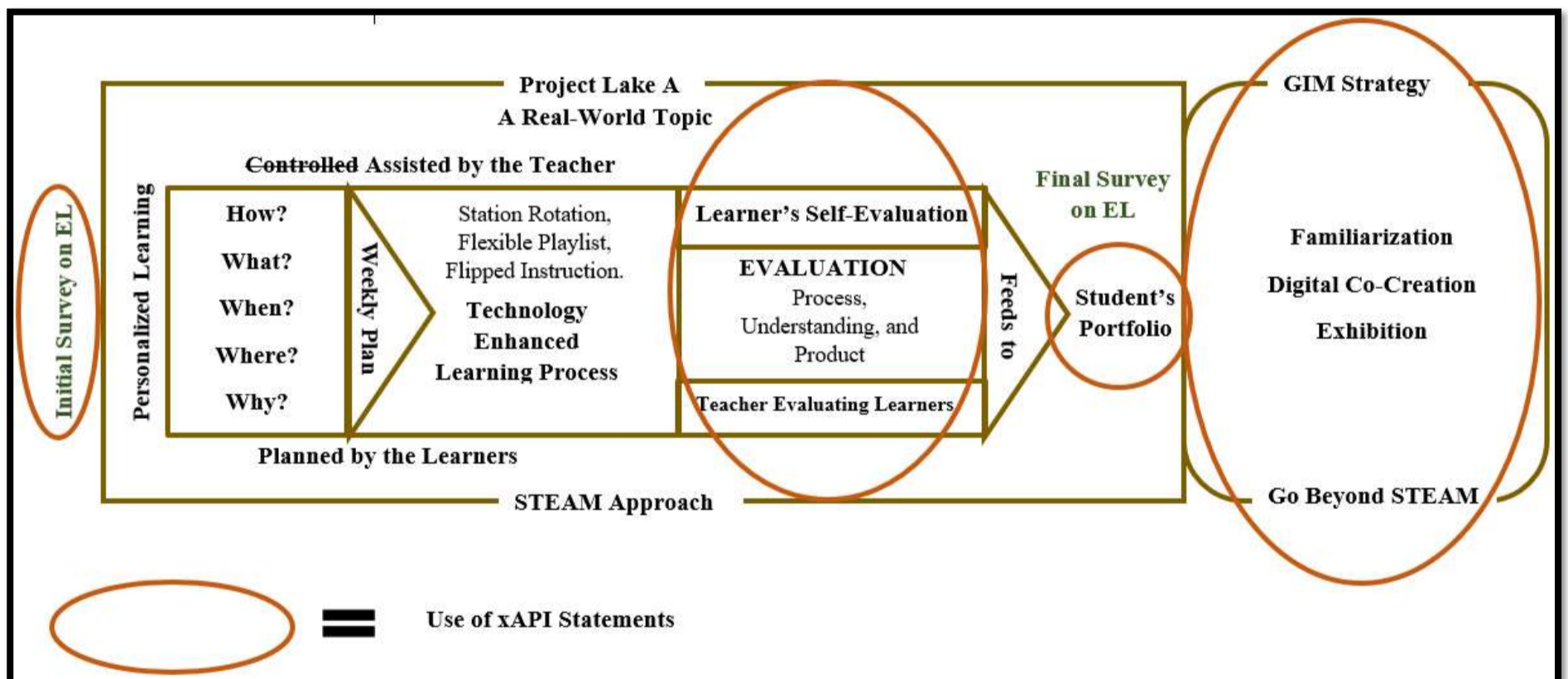


Figure 01: Visual Representation of the EL-STEAM Project

The teacher will begin by inquiring as to which lake is closest to our school. How is the lake used? Do you know if the fish and plants in the water are safe for consumption or not? Then, let's investigate. After being split up into groups, the students planned what water quality meant. How can safety be determined? To organize their experimentation with the water quality and to study the plants and animals that live there, they will research terminologies such as BOD, DO, COD, TDS, and others. Learners will decide on the technologies they need for the experiments and the school authority will provide them accordingly with the teacher's instructions. The instructor will assist in their preparation to ensure that it does not significantly deviate from the intended objective. After that, the students plan to go to a nearby pond, where they will observe and gather samples for the experiment. Through a variety of online resources and the equipment's user manuals, students will learn how to operate the equipment. Ultimately, they will create posters and showcase their entire project plan, the rationale for selecting that particular plan, and potential explanations for its success or shortcomings. In the assessment stage, students will have the opportunity to demonstrate their comprehension of the project, what works and what doesn't, what they will do something different the next time, etc. The teacher's assessment and their reflections will be combined to create the final portfolio. xAPI-Statements will be essential for tracking learner progress and teacher self-evaluation for personal improvement purposes.

Giving students the freedom to determine their future encourages innovative problem-solving techniques. This can be accomplished by using Sanabria-Z's (2015) Gradual Immersion Method (GIM), which gives students an understanding of smart cities as well as the ability to envision

and create smart city infrastructure. For example, learners will identify environmental issues within and around the local lake/pond after investigating its state. Learners will create a smart city pond by designing it based on that study. They can conceptualize their community pond from the perspectives of socio-cultural values, social business, and environmental sustainability because of this method. After that, they can practice making both 2D and 3D models with inexpensive materials and/or interactive software. Additionally, learners will get the opportunity to show their work to stakeholders to get insightful comments through science fairs or on similar occasions.

A weekly plan for this project will provide the learners with guided authority to grow personal responsibility and authority of the learning within the learners. The teacher will assist with necessary resources and help in planning where necessary so that the learners' actions don't divert too much from the actual goal. However, learner's creativity and tendency to do things in their way will always be welcomed. Here is a sample weekly plan for the project progression. The plan can help educators plan their lessons incorporating the idea of promoting environmental literacy through the STEAM approach.

Lesson No.	Contents	Instructional Purposes (from the teacher's point)	Learning Objectives (from the student's standing point)	Teaching-Learning Strategies	Materials Needed	Expected Products (Deliverables at the end of the activity)	Evaluation Strategy	Special Directions
01	- Quality of water - Component Responsible for the quality of water. - Possible living things and non-living things present in the water ecosystem.	-learners will research digital media and books to learn the concept beforehand. -learners will identify the components responsible for the quality of the water. -learners will identify the equipment needed for determining the quality of the water.	Learners will be able to -identify the components responsible for the quality of a water source. -identify the tools needed for their experimentation. -identify possible living organisms within and around the local lake/pond	Station Rotation/ Flexible Playlist/ Flipped Instruction	-Digital media accessing resources (e.g., laptop, tablet, etc.). -Relevant Books.	-Students' project plans for visiting the local lake and collecting samples.	-Assessment Rubrics: consisting of student engagement, research, and group planning.	Students should be asked to do pre-research and bring low-cost available materials
02								
03	-Filed (e.g., lake) visit. -Use of equipment. -Collection of necessary samples/data.	-learners will manipulate the equipment and collect data using the tools. -learners will use the equipment to collect their planned samples/data.	Learners will be able to -manipulate the tools necessary to determine DO, BOD, COD, TDS, etc. water quality components. -collect precise and planned samples/data from the local lake.	Guided Filed Visit	-laboratory equipment for collecting water samples.	-adequate data for doing the measurements.	-Assessment rubrics: student engagement, students respecting the equipment, following the process, etc.	Students should undergo preparation for using the laboratory equipment.
04	-Student presentations of their works.	-Students will construct posters of their research, their chosen process, why they chose, what issues were found, what went wrong, how they overcame them, etc.	Learners will be able to -identify environmental issues found within and around the lake. -present the whole activity using poster-presentation. -identify the difficulty of their process. -evaluate the learner's process.	Poster Presentation	-Posters. -Makers. -Stickers (for quick poster design)	-Poster showing the process each group of students undergo.	-Assessment Rubrics: consisting of oral presentation, identifications of the environmental issue, student's ability to evaluate their p	Students should be asked to bring materials (e.g., posters) in groups for the presentation.
05		-Students will design a sketch for a smart city lake design consisting of features that address the environmental issues the learners identified. -Students will develop 2D and 3D designs of their sketches using AR software. -If not interested in software, learners will make 3D models using low-cost materials (e.g., papers, cork sheets, etc.) to make the model of a smart city lake. -Student will present their projects (3D models) at school fairs or other occasions where stakeholders are invited.	Learners will be able to -co-design a smart city lake consisting of features that address the environmental issues the students identified. -co-create a 2D/3D model using software or low-cost materials of a smart city lake.	Gradual Immersion Method (GIM)	-Software -Low-cost materials (e.g., cork sheets, papers, etc.)	-2D/3D design using AR software. -3D models using low-cost materials.	-Assessment Rubrics: Student engagement, student design, and students' creation.	Students should be asked their preferences and let the students research on how they will approach their design challenge.
06	-Going beyond STEAM (using GIM-framework)							
07								

Table 01: Sample Weekly Plan for the Project.

xAPI-Statements, Data Analysis, and Use of Data

Activity	Actor	Action	Object	Context	Result	Sample xAPI Statements	Collection of Data	Analyzing Data	Use of Data
Initial Environmental Literacy Survey	Learners	Completed, Scored	MCQs Quiz	Initial Environmental Literacy Assessment	Score, Submission Time	Learner A completed the initial environmental literacy assessment MCQs in 15 minutes and scored 6/10.	Score Recording through Kobo Toolbox	Mean, Standard Deviation	-Assessing individuals. -Assessing group. -Assessing an individual's situation in the group. -Comparing the results with the final survey result.
Final Environmental Literacy Survey	Learners	Completed, Scored	MCQs Quiz	Final Environmental Literacy Assessment	Score, Submission Time	Learner A completed the final environmental literacy assessment MCQs in 10 minutes and scored 8/10.	Score Recording through Kobo Toolbox	Mean, Standard Deviation	-Assessing individuals. -Assessing group. -Assessing an individual's situation in the group. -Comparing the results with the initial survey result.
Learners' Self-Assessment	Learners	Engaged, Prepared	Group Discussion, Sample collection	Learner's Self-Assessment through Rubrics	Score, Task completion, Engagement, Precision	-Learner A completed a self-assessment survey and scored 5/6. -Learner A admitted to being engaged in group discussion. -Learner A completed data collection precisely. -Learner A came prepared with research and materials before class.	Score Recording through Kobo Toolbox	Self-Assessment Score	-Comparing the score with the teacher's assessment of the learner. -Forming Learner's Portfolio.
Teacher Assessing Learners	Learners	Presented, Respected	Process Presentation, Tool manipulation	Teacher's Assessment of the Learners through Rubrics	Score, Tools manipulation, Presentation	(Almost similar statements as the learners. Here are some additional) -Learner A presented ideas, and reasons why he/she chose the methods and the materials properly. -Learner A manipulated and used the tools respectfully.	Score Recording through Kobo Toolbox	Assessment Score	-Comparing the score with the teacher's assessment of the learner. -Forming Learner's Portfolio.
GIM-Activity Assessment	Learners	Designed, Constructed, Used	3D model	Learner's Design, Product/Model concerning smart city pond addressing a local environmental issue.	Addressing Environmental Issues, Addressing Smart City's characteristic	- Learner A designed a 3D model of a smart city pond using AR software addressing a local environmental issue. -Learner A constructed a 3D model of a smart city pond addressing a local environmental issue with low-cost materials.	Teacher and audience observational comments and rating.	Learner's score	Measuring Learner's Creativity
Teacher's Self-Assessment	Teacher	Gave	Resources, Authority	Teacher's self-assessment through rubrics	Score	-The teacher gave the learners the necessary resources during activity 1/2/3... -The teacher gave the learners authority to plan and design their problem-solving strategy	Score Recording through Kobo Toolbox or paper questionnaire	Assessment Score based on the rubrics	Assessing teacher's 21st-century attributes (for self-improvement)

Table 2: Sample xAPI-Statements, Data Analysis, and Use of Data for the EI-STEAM Project.

Conclusion

The project hopes to develop environmentally literate students who are motivated, knowledgeable, and able to handle ecological difficulties in the real world by using this innovative approach. The program not only improves learning results but also fosters a culture of sustainability and environmental care by incorporating local environmental issues into the curriculum and giving students the freedom to investigate, experiment,

and report their discoveries. This project serves as a reminder of the value of individualized, hands-on learning in educating the next generation of people to be aware and proactive in the face of environmental emergencies.

References

Codesigning schools toolkit. (n.d.). <https://www.codesigningschools.com/toolkit-phase-one>

Sanabria, J. C. (2015). The Gradual Immersion Method (GIM): Pedagogical Transformation into Mixed Reality. *Procedia Computer Science*, 75, 369–374. <https://doi.org/10.1016/j.procs.2015.12.259>