INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY: APPLIED BUSINESS AND EDUCATION RESEARCH
2025, Vol. 6, No. 11, 5550 – 5561
http://dx.doi.org/10.11594/ijmaber.06.11.16

Research Article

STS Curriculum Development via Citizen Science on Coastal Plastic Waste

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Article history:
Submission 02 October 2025
Revised 30 October 2025
Accepted 23 November 2025

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ABSTRACT

In times of rapid change and persistent learner challenges, continuously updating curriculum materials is essential. The growing problem of plastic pollution stresses the need to integrate citizen science into education to ensure relevance, engagement, and contextual application. This study developed and evaluated a module-based curriculum material that embeds citizen science into the Science, Technology, and Society (STS) curriculum, focusing on the assessment of coastal plastic waste. An initial needs-assessment among STS instructors revealed strong agreement on developing localized, citizen-science-based materials to enhance environmental awareness. Quantitative findings demonstrated high acceptability from both experts and students. Expert evaluation yielded "Fully Acceptable" ratings in all categories, with visuals rated "Very Good (Acceptable)" (Mean = 3.67), indicating strong quality and minor areas for improvement. The Students' Involvement Index (SII) of 1.07 reflected effective learner engagement, while the Fry Readability Graph placed the module at the college reading level. The Communication Index (CI) ranged from 0 to 0.01, with a CI of 0.01 indicating fair comprehensibility—acceptable but suggesting refinement of scientific terms. Qualitative feedback from students showed that the module was engaging, meaningful, and applicable to real-world issues. Overall, integrating citizen science into the STS curriculum proved to be a viable and impactful strategy for promoting environmental literacy, fostering active participation, and strengthening contextual understanding of coastal pollution

How to cite:
Quiao, M. A. D., Balangiao, M. V. O., Dala, K. M. C., Won, M. E. Q., & Barquilla, M. B. (2025). STS Curriculum Development via Citizen Science on Coastal Plastic Waste. *International Journal of Multidisciplinary: Applied Business and Education Research*. *6*(11), 5550 – 5561. doi: 10.11594/ijmaber.06.11.16

among undergraduate learners. Future work should focus on improving visuals and clarity, expanding instructional resources, enhancing teacher training, and conducting broader and long-term implementations to strengthen its educational impact.

Keywords: *Curriculum, Citizen science, Module, STS, Plastic waste, Coastal pollution*

Background

In facing today's environmental challenges, connecting scientific activities with public involvement has become more crucial than ever. Among these challenges, the growing issue of plastic waste in coastal areas requires both scientific understanding and active community participation. Addressing this problem effectively depends on developing locale-centric environmental awareness—recognizing how one's immediate environment relates to broader global concerns (Brondízio, 2021; Kibria et al., 2023; Mihai, 2022). This awareness can be fostered through citizen science, a rapidly evolving interdisciplinary approach that bridges formal science and public engagement. According to the National Geographic Encyclopedia (Haklay et al., 2021), citizen science involves the public in collaborative scientific research to expand knowledge, where individuals without formal training contribute meaningfully to data collection, analysis, and interpretation. This approach has proven particularly relevant to environmental monitoring and assessment, including the management of coastal plastic pollution.

Several studies (Fraisl et al., 2022; Sanabria-Z et al., 2022; Wichmann et al., 2022) emphasize the transformative role of citizen science in fostering environmental awareness, pro-environmental behaviors, and civic responsibility, especially among younger learners. Citizen science democratizes scientific inquiry (Allf et al., 2022) and strengthens public engagement in addressing Sustainable Development Goals (SDGs). Empirical works (Somerwill & Wehn, 2022; Hsu et al., 2023; Aristeidou et al., 2022; Lüsse et al., 2022; Godfrey et al., 2022; Araújo et al., 2021; Gönner et al., 2023) further highlight how integrating citizen science into formal education enhances critical thinking, problem-solving, and ecological understanding. For instance, De Veer et al. (2022) found that citizen-science activities help students develop awareness of environmental issues by engaging directly with real-world litter and pollution data.

The dynamic and evolving nature of environmental problems like plastic pollution underscores the need to continuously update curriculum materials so that learning remains relevant, hands-on, and socially responsive. In this context, integrating citizen science into formal instruction presents a timely innovation. The present study specifically focuses on the development and formative evaluation of a module that integrates citizen science through a coastal plastic waste inventory activity. This activity connects Science, Technology, and Society (STS) concepts—such as social responsibility, technological tools in environmental monitoring, and policy implications—with authentic, community-based environmental action. The ultimate goal is the integration of this citizen-science module into the STS course at the undergraduate level, thereby enriching curriculum content and strengthening students' contextual understanding of science in society. The module development process followed established stages, including baseline assessment, objective formulation, writing, formative evaluation, and revision (University of the Philippines Open University, 1999). This paper presents the outcomes of the formative evaluation phase.

Methods

In the development and evaluation of the curriculum material, both qualitative and quantitative methods were employed. In the initial stage, a needs assessment survey to determine the importance of adding citizen science to the Science, Technology, and Society (STS) curriculum. This is followed by the outline and writing stage where in a particular module was created for STS, focusing on Environmental

Awareness. This module incorporated citizen science, particularly in the context of coastal plastic waste inventory, and was designed with the educational goal of applying STS concepts to address social and environmental issues. For evaluation purposes, the module was reviewed by three experts.

The formative evaluation phase of the module employed a multi-faceted approach, incorporating three key analytical methods. First, the Student Involvement Index (SII) (Romey, 1965) was calculated to measure student engagement, with an optimal or acceptable range set between 0.4 and 1.5. Second, the effectiveness of communication, particularly concerning ambiguous terms, was assessed using a Feedback-based Communication Index (CI) (Talisayon, 1983), where an acceptable range was defined as $0 < CI < 0.01$. Finally, the module's textual difficulty was determined using the Fry Readability Graph (Fry, 1968) to ensure the content's reading level was appropriate for the intended users (undergraduate students). Based on the feedback and results from this assessment, the module underwent revisions before being implemented with undergraduate students. The implementation involved initial classroom discussions, followed by practical field survey activities. These were succeeded by post-activity group discussions, and the data collected during these activities were subsequently uploaded to *plasticount.ph*. An adapted evaluation rating (Olipas, 2023) of the module by the students was then followed.

Participants

Utilizing a convenience sampling method, this study effectively engaged thirteen (13) Science, Technology, and Society (STS) instructors from State University who participated in the preliminary needs assessment survey. These instructors were specifically chosen for their active teaching experience in general STS courses, ensuring perspectives that represent typical instruction within the discipline.

For the evaluation of the module's content and relevance, three (3) subject-matter experts were selected based on their specialization areas: one expert in STS, one in Science Pedagogy, and one in Coastal Plastic Research. This combination of expertise ensured that the module was thoroughly reviewed for pedagogical soundness, content accuracy, and scientific validity, particularly in relation to citizen-science activities on coastal pollution.

For the module's implementation phase, twenty-eight (28) third-year Bachelor of Science in Environmental Science students from Mindanao State University at Naawan were purposively selected. The selection criteria mandated prior completion of the STS course, ensuring participants could apply established principles to the citizen-science activity. These students provided module evaluation ratings and assessed its practical application and educational impact.

Instruments

At the onset of determining the need of a curriculum material development, an initial needs assessment survey was pooled from specific group of teacher-respondents from various Universities. The survey employed a 5-point response scale, where each response was assigned a numerical value and accompanied by qualitative descriptions indicating rejection or endorsement of developing a curriculum material in STS. The following presents the scale values and corresponding qualitative descriptions.

Table 1. Needs-assessment survey scale and qualitative descriptions

Scale	Range	Response	Qualitative Description
1	1.00 – 1.80	Strongly Disagree	Complete rejection
2	1.81 – 2.60	Disagree	Mild opposition
3	2.61 – 3.40	Neutral	Implies indecision
4	3.41 – 4.20	Agree	General agreement
5	4.21 – 5.00	Strongly Agree	Total endorsement

This resulted to the crafting of the STS module on citizen science with the title "Environmental Awareness Through Citizen Science: Coastal Plastic Waste Assessment". The module comes in two version, the teacher's guide and student guide. An evaluation rating sheets for the module intended to be rated by the experts as well as the students were also used. The 5-point response scale for experts and a 4-point response scale for students, with corresponding qualitative descriptions are shown below.

Table 2. Experts' evaluation rating scale of the module and its qualitative descriptions

Scale	Range	Response	Qualitative Description
1	1.00 – 1.80	Poor	Unacceptable
2	1.81 – 2.60	Fair	Marginally Acceptable
3	2.61 – 3.40	Good	Average
4	3.41 – 4.20	Very Good	Acceptable
5	4.21 – 5.00	Excellent	Fully Acceptable

Data Analysis

In analyzing the data collected, descriptive statistical techniques were applied to the survey responses and rating sheets provided by participants. This included using frequency counts and calculating mean values to determine the occurrence and average of the responses. The Student Involvement Index (SII) values were then compared against the benchmark of approximately 1.0 or higher, to gauge their adequacy. For assessing the module's readability, it was crucial to ensure that it matched the level appropriate for its target end users, as indicated by the intersection value on the Fry Readability Graph. Additionally, the Communication Index (CI) calculated for unclear words was evaluated against the established acceptable range, which is between 0 and 0.01, to ensure clarity and comprehension in the module's language.

Table 3. Students' evaluation rating scale of the module and its qualitative descriptions

Scale	Range	Response	Description for Level of Satisfaction
1	1.00 – 1.74	Strongly Disagree	Unacceptable
2	1.75 – 2.49	Disagree	Marginally Acceptable
3	2.50 – 3.24	Agree	Acceptable
4	3.24 – 4.00	Strongly Agree	Fully Acceptable

Result and Discussion

The thirteen (13) participating STS instructors were mostly female (69.2%) and aged 30–39 years (61.5%), with the majority holding a master's degree (69.2%) and coming from state universities (92.3%). Nearly half (46.2%) had 6–10 years of university experience, and 53.8% had been teaching STS for 1–2 years, indicating relative newness to the course. Most were under fixed-term contracts (46.2%), while 30.8% held permanent positions. Overall, the participants were academically qualified and professionally diverse, representing a credible profile of current STS instructors in state universities.

The initial needs assessment survey comes with eleven (11) statements that lean into the determination of their endorsement of a curriculum material in Science, Technology, and Society (STS). The summary of this survey is shown on Table 4.

The results revealed generally positive perceptions toward enhancing the STS curriculum. Instructors strongly agreed on the need for new curriculum materials (Mean = 4.23) and the integration of localized environmental awareness (Mean = 4.38), showing a clear demand for more context-based and engaging learning resources. They also expressed strong endorsement of citizen-science approaches (Mean = 4.23) and a high level of interest in professional development related to environmental integration (Mean = 4.62). Most instructors agreed that they practice student-centered and contextualized teaching strategies (Means

= 3.62–3.92), though they showed neutral responses regarding prior training (Mean = 2.69) and available resources for environmental activities (Mean = 2.92). These findings align with studies showing that citizen-science projects enhance engagement, critical thinking, and environmental awareness but require sustained teacher training and institutional support (Araújo et al., 2022). Therefore, while there is a solid foundation in STS education among the respondents, there remains a need for enhanced resources, professional development, and innovative teaching approaches that connect with students' experiences and foster a greater appreciation for the subject. Developing citizen-oriented materials and strategies can make STS instruction more practical and meaningful by linking learning to real-life community issues and applications (Magwilang, 2019).

Table 4. Summary of the result from the initial needs-assessment survey

Statements	Mean (N=13)	Response	Qualitative Description
1. I had a professional training in STS curriculum prior to my teaching the course.	2.69	Neutral	Implies indecision
2. I am confident and contented in my implementation of STS curriculum in my class.	3.62	Agree	General agreement
3. The current STS curriculum effectively meets teaching and learning experience.	3.77	Agree	General agreement
4. I have presented new teaching strategy in STS this semester, different from what the syllabus suggested.	3.69	Agree	General agreement
5. New curriculum materials is needed to enhance students' interest and appreciation in STS.	4.23	Strongly Agree	Total endorsement
6. I believe it is important to integrate localized environmental awareness in STS lessons.	4.38	Strongly Agree	Total endorsement
7. I feel adequately equipped with resources to successfully integrate environmental awareness activities into my STS lessons.	2.92	Neutral	Implies indecision
8. Citizen Science approach can be used in the STS particularly in localized environmental issues.	4.23	Strongly Agree	Total endorsement
9. I practice students' active involvement in real-world activities and applications related to STS concepts.	4.15	Agree	General agreement
10. I actively seek to connect STS concepts with the cultural and social contexts of my students.	3.92	Agree	General agreement
11. I am interested in professional development or training sessions related to incorporating localized environmental awareness in my STS curriculum.	4.62	Strongly Agree	Total endorsement

Guided by the concept and principles of writing a curriculum material (Doll, 1989), writing stage comes up with a Students' Guide Module. As shown in Table 5, the STS citizen science module received excellent evaluations across various criteria, indicating its effectiveness in content quality, learner-centered development, cultural and contextual relevance, educational methodology, and use of visuals. The high mean scores and consistent "Fully Acceptable" qualitative descriptions suggest that the module is highly effective and well-received by experts in the field. Nevertheless, the experts rated the module's visuals (Category 5, item 6) in terms of motivation and appeal as merely "acceptable." Consequently, there is an opportunity for improvement by incorporating more elements of visual learning into the module.

Table 5. Expert's evaluation rating of the STS citizen science module

	Mean	SD	Qualitative Description
Category 1: Content Quality			
1. The concepts developed significantly contribute to the enrichment, reinforcement, and mastery of the identified learning objectives.	5.00	0.00	Fully Acceptable
2. The content is thoroughly up-to-date, reflecting the latest information and developments.	4.67	0.58	Fully Acceptable
3. The content is logically developed and organized, providing a clear and coherent structure.	5.00	0.00	Fully Acceptable
4. Content is free from cultural, gender, racial, ethnic and other biases.	4.67	0.58	Fully Acceptable
5. The content actively promotes and stimulates critical thinking.	4.33	0.58	Fully Acceptable
6. The content is highly relevant to real-life situations, providing practical applications.	5.00	0.00	Fully Acceptable
Category 2: Learner-Centered Development			
1. The material reflects the holistic development of the learner effectively.	4.33	1.15	Fully Acceptable
2. The material promotes development of 21st century skills (ie., learning and innovation skills, communication skills, information and technology skills, life and career skills, etc.) and higher order thinking skills (critical thinking, learning by doing, problem solving and other similar skills).	5.00	0.00	Fully Acceptable
3. The material can be effectively used independently or collaboratively, with or without teacher supervision.	4.67	0.58	Fully Acceptable
4. The vocabulary level is highly suitable for the target users.	5.00	0.00	Fully Acceptable
5. Length of sentences is suitable to the target users.	4.33	0.58	Fully Acceptable
6. Sentence and paragraph structures are highly appropriate and varied.	4.33	0.58	Fully Acceptable
7. The material effectively utilizes both individual and group tasks, fostering independent learning and building self-esteem.	4.67	0.58	Fully Acceptable
Category 3: Relevance and Responsiveness			
1. Text and visuals reflect sensitivity to gender and sexual orientation, people with disabilities, the gifted and talented in terms of roles, occupations and contribution.	4.67	0.58	Fully Acceptable
2. The material is highly mindful of the health and safety of the target learners.	4.33	0.58	Fully Acceptable
3. The material provides rich examples and illustrations of the local and global context, where applicable.	5.00	0.00	Fully Acceptable
4. The material represents and respects the diversity of cultural, religious, socio-economic, and family backgrounds of Filipino learners.	5.00	0.00	Fully Acceptable

Category 4: Use of Constructivist Pedagogy			
1. There is logical flow and seamless integration of ideas and activities within a lesson.	5.00	0.00	Fully Acceptable
2. Content provides ample opportunities for meaning-making and active construction of knowledge.	5.00	0.00	Fully Acceptable
3. Development of lessons allows for a thorough review, comparison, and integration with previous lessons.	4.33	1.15	Fully Acceptable
4. Activities involved are highly meaningful, engaging, challenging, and collaborative.	5.00	0.00	Fully Acceptable
Category 5: Visuals and Illustrations			
1. Visuals (illustrations, photographs, maps, charts, graphs, diagrams, etc.) are highly relevant to the text.	4.67	0.58	Fully Acceptable
2. Visuals are effectively used to facilitate comprehension.	5.00	0.00	Fully Acceptable
3. Visuals provide accurate representation of the concepts discussed.	4.67	0.58	Fully Acceptable
4. Visuals are consistently clear in content and detail.	4.67	0.58	Fully Acceptable
5. Visuals sustain interest and do not distract the attention of the learner.	4.67	0.58	Fully Acceptable
6. Visuals are motivating and appealing.	3.67	0.58	Acceptable
7. Visuals are well-organized, contributing to a coherent presentation.	4.67	0.58	Fully Acceptable
8. Graphics and colors are used for appropriate instructional purposes.	4.33	0.58	Fully Acceptable
9. Visuals are free from objectionable biases or advertising.	5.00	0.00	Fully Acceptable

An important piece of feedback from an evaluator in this study underlined the critical need for a student-oriented version of the educational module. In response to this valuable insight, the STS Citizen science module was thoughtfully developed in two distinct formats: a teacher's guide and a student's guide. This bifurcation ensures that both educators and learners have access to resources specifically tailored to their unique needs and perspectives, thereby enhancing the overall learning experience.

The effectiveness of this dual-format approach is clearly evident in the student evaluations of the module, as detailed in Table 6. These evaluations show a high level of student satisfaction across a variety of critical educational categories. Students rated the module's content, teaching and learning methodologies, support mechanisms, assessment strategies, and overall satisfaction level as "Fully Acceptable." The mean scores in these categories ranged from 3.57 to 4.00, reflecting a strong positive response from the students.

Particularly noteworthy is the students' appreciation for the clarity and relevance of the module's content. This aspect is crucial in ensuring that the material resonates with the students and is applicable to their academic and personal development. Additionally, the effectiveness of the teaching methods used in the module received high marks, underscoring the importance of pedagogical strategies that actively engage and inspire students. The organizational support and clear assessment criteria were also recognized as key factors contributing to the module's success, as these elements provide a structured and understandable framework for learning.

Furthermore, the feedback received was found to be immensely beneficial, aiding students in their educational journey. This aspect of the module highlights the importance of continuous and constructive feedback in the learning process, enabling students to refine and enhance their understanding and skills. The overall satisfaction score of 4.00 is a strong indicator that the module has successfully met the educational needs and expectations of the students, aligning well with contemporary educational standards and practices.

Moreover, the adoption of a discovery learning approach in this module aligns with the findings of Rosa et al. (2021), who emphasize the significance of such methodologies in fostering creativity, critical thinking, and problem-solving skills in science education, including in the realm of STS. This approach encourages students to explore and discover concepts and principles on their own, thereby deepening their understanding and retention of the subject matter. The combination of a student-centric module design and a discovery learning approach represents a powerful pedagogical strategy in modern science education, particularly in the context of STS, where practical application and real-world relevance are paramount.

Table 6. Students' evaluation rating of the STS citizen science module

	Mean	SD	Description for Level of Satisfaction
Category 1: Contents			
1. At the start of the module, I received clear information and guidance on what the module covered and on assessment details.	3.71	0.47	Fully Acceptable
2. My understanding of the subject has increased as a result of taking this module.	3.71	0.47	Fully Acceptable
3. The module allowed me to gain skills that will aid in my employability or career advancement.	3.79	0.43	Fully Acceptable
4. The module contents were up-to-date.	3.79	0.43	Fully Acceptable
5. The module was relevant to my course.	3.92	0.27	Fully Acceptable
Category 2: Teaching and Learning			
1. The instructor has made the subject matter covered in the module interesting.	3.71	0.47	Fully Acceptable
2. The instructor was good at explaining things.	4.00	0.00	Fully Acceptable
3. The module was intellectually stimulating.	3.79	0.43	Fully Acceptable
4. The teaching methods in this module have helped me to learn.	3.71	0.47	Fully Acceptable
5. The quality of teaching in this module has been good.	3.71	0.47	Fully Acceptable
Category 3: Support			
1. The module was well organized.	3.79	0.43	Fully Acceptable
2. The learning resources provided on the module websites/links were helpful to my learning.	3.79	0.43	Fully Acceptable
3. The reading list was helpful.	3.79	0.43	Fully Acceptable
4. I have been able to contact the course instructor when I needed to.	3.57	0.65	Fully Acceptable
5. I have received sufficient advice and guidance concerning my module.	3.71	0.47	Fully Acceptable
Category 4: Assessment and Feedback			
1. The assessment requirements and marking criteria were clear.	3.64	0.50	Fully Acceptable

	Mean	SD	Description for Level of Satisfaction
2. The assessment tasks and associated marking criteria were made available in good time.	3.64	0.50	Fully Acceptable
3. The balance between teaching and independent learning was appropriate.	3.71	0.47	Fully Acceptable
4. The module prepared me well for the assessment tasks.	3.71	0.47	Fully Acceptable
5. Feedback throughout the module has helped me to develop and improve my learning.	3.71	0.47	Fully Acceptable
Category 5: Overall Student Satisfaction			
1. Overall, I am satisfied with the quality of this module.	4.00	0.00	Fully Acceptable

During the debriefing sessions following the field survey, students shared their experiences and the challenges they encountered. A significant challenge highlighted by one of the students related to the physical conditions of the fieldwork: "The extreme heat and strong winds, along with difficulties in using the tape measurement, were challenging, but we overcame them through teamwork." Another student mentioned the specific difficulty in "identifying the different types of plastics," highlighting the complexity of the task. However, despite these challenges, there was a sense of accomplishment and pride, as echoed by a student who remarked, "I feel proud for having another experience of participating in this kind of activity."

Several students shared their personal reflections on the experience:

- One mentioned feeling exhausted yet found the activity enjoyable: "I felt very exhausted but it was fun."
- Another student expressed satisfaction and happiness from the new experience and knowledge gained: "I feel good and happy for the new experience and knowledge."
- The excitement of the activity was noted, despite the challenging weather conditions: "It's exciting, although it's very hot there."
- A sense of pride in being part of the assessment was shared by another student: "I feel proud being part of this assessment."
- The experience was described as enlightening and gratifying by another: "It gives me a new experience. Very satisfying."

When asked whether the activity changed or reinforced their perspectives, scientific knowledge, and skills regarding the relationship between science, technology, and society, the majority of students responded affirmatively. One student elaborated, "It gives me courage and more willingness to join advocacies which give insights to STS as it is helpful to the modern technologies." These excerpts collectively demonstrate a positive impact on the students' learning experiences and their awareness of environmental issues.

The activities not only presented them with practical challenges but also offered valuable lessons in teamwork, environmental responsibility, and the real-world application of scientific knowledge. Consistent with the study of Wichmann et al. (2022), this suggests that such field activities are effective in enhancing students' understanding and appreciation of the interconnectedness of science, technology, and society, and in inspiring them to be more actively involved in environmental advocacy.

Quantitative Metrics. The formative evaluation of the module yielded several important insights into its engagement, readability, and clarity. The Student Involvement Index (SII) was 1.07, indicating an adequate level of student participation and suggesting that the module successfully encouraged active engagement throughout the learning process. The Communication Index (CI), calculated using Talisayon's (1983) framework, was 0.01, which falls within the acceptable range of 0.00 to 0.01. This value means that approximately one in every 100 words was identified as ambiguous. Although this meets the minimum threshold for

clarity, it highlights the need for refinement of scientific terms and contextual explanations. This finding aligns with students' qualitative feedback, which indicated occasional difficulty in identifying and distinguishing different types of plastics during the citizen-science activities.

The Fry Readability Graph placed the module at a college-level reading grade, confirming its suitability for tertiary students. However, the presence of specialized scientific vocabulary likely contributed to a higher readability score, suggesting opportunities to simplify technical terms and enhance comprehension without compromising scientific accuracy. Overall, these quantitative results demonstrate that the module is both appropriate and engaging for undergraduate learners, while underscoring the importance of revising ambiguous terminology and improving language clarity. Such refinements will strengthen its role as a citizen-science learning resource that fosters environmental awareness and student participation in addressing coastal pollution.

Conclusion and Recommendation

The results of this study demonstrate that integrating citizen science into the Science, Technology, and Society (STS) curriculum—particularly through a coastal plastic waste inventory activity—effectively bridges classroom learning with environmental action. The developed module was found to be highly acceptable to both experts and students, aligning with the cognitive and contextual needs of undergraduate learners. The Fry Readability Graph placed the module at a Grade 14–15 level, confirming its suitability for the target users. The Student Involvement Index (SII) of 1.07 further indicates that the module successfully engaged students in active, inquiry-based learning. Meanwhile, the Communication Index (CI) of 0.01 revealed fair comprehensibility—an acceptable outcome that nonetheless highlights the need to refine certain scientific and technical vocabulary. Overall, the findings affirm that citizen-science integration in STS instruction promotes environmental literacy, critical thinking, and civic responsibility, positioning students as active contributors to addressing coastal plastic pollution.

To enhance the module, we recommend several steps. First, the visual elements of the module should be improved to increase its appeal and motivational impact. Second, efforts should be made to enhance the clarity of language and presentation, addressing the areas indicated by the CI. Additionally, expanding the resources available in both the teacher's and student guides will provide more comprehensive support. Ongoing professional development for educators is essential to equip them with the latest strategies in integrating citizen science and environmental awareness. Broader implementation of this module across more participants and educational institutions, coupled with continuous feedback collection, will facilitate further improvements. Lastly, conducting long-term studies to assess the impact of this curriculum on students' environmental awareness and behavior is crucial. These steps will refine the curriculum to better meet student needs and effectively contribute to their understanding and engagement with important environmental issues.

Acknowledgement

The researcher extends heartfelt thanks to everyone who contributed to this study, especially acknowledging Professor Floremie B. Apdian for allowing the active participation of the 3rd year BS Environmental Science students of MSU Naawan to the activity. Additionally, the researcher is grateful for the insightful feedback and mentorship received from the professors at Mindanao State University - Iligan Institute of Technology.

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