Development of Contextualized STEM Module on Biodiversity for Grade 10 Students

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Abstract

One common problem faced by science students is their low mastery of content knowledge in Biology specifically explaining how species diversity increases the probability of adaptation and survival of organisms in changing environments. With this, the researcher developed a contextualized STEM module that explained the impact of contextualized teaching aids and localized teaching resources on enhancing students' performance in learning Biodiversity. The researcher adapted and modified the Borg and Gall Model (1983) as part of the research and development process for developing the contextualized STEM module in Biodiversity. Before the development of the contextualized STEM module, a need assessment was done for the school administrators/coordinators and Science teachers of the target schools. The results served as the bases for the development of the contextualized STEM module in Biodiversity, which underwent face validation by the thesis adviser and panel members and expert validation by five (5) In-service Science teachers. The developed contextualized STEM module was rated Very Satisfactory with a mean of 3.90.

Keywords: STEM module, biodiversity, contextualized

1. Introduction

The Program for International Student Assessment (PISA) report in 2018 showed that Filipino students performed the lowest among 79 nations in reading, mathematics, and science. In addition, these international results coincide with the results of our National Achievement Tests (NAT) in recent years. In 2018, the national mean percentage score among Grade 6 pupils was the lowest in NAT history and the Grade 10 scores suffered a similar downward trend.

One common problem faced by science students is their low mastery of content knowledge in Biology specifically explaining how species diversity increases the probability of adaptation and survival of organisms in changing environments. This is

supported by the study of Großschedl et al. (2014) which stated that the most challenging part for educators is to assist learners to develop their knowledge in subject matter such as in biology. They cited that these difficulties are affected by different factors such as students' background knowledge, intelligence, and motivation.

The education system, upon a series of investigations, looked at the use of the contextualized module in the teaching-learning process in the literature as a potential solution to the issue. The K–12 program's delivery of teachings through contextualization and localization is one of its key components. Section 10.2 of the Implementing Rules and Regulations (IRR) of Republic Act (RA) 10533 states that "Curriculum shall be contextualized and be flexible enough to enable and allow schools to localize and enhance the curriculum based on their respective educational and social contexts" (Bhowmik et al., 2013).

According to Tomlinson and Masahura (2004), the advantages of localizing and contextualizing the curriculum are cultural sensitivity, the potential for personalization, easy availability of resources, direct relevance of materials to learners, and ownership of the development process. STEM education engages students to learn from practicing knowledge to develop solutions through problem-solving (Sutaphan and Yuenyong, 2019). The local issues should be brought to the STEM education learning activities. Sutaphan and Yuenyong (2019) suggested the STEM teaching approach that could start by bringing the local issues to engage students to practice integrate STEM knowledge for developing the prototypes. The literatures suggested some issues to provide STEM education learning activities from local issues (Fachrunnisa et.al., 2021; Koes-H et.al., 2021; Ebal Jr et.al., 2019; Guarin et.al., 2019; Villaruz et.al., 2019).

With this, the researcher developed a contextualized STEM module that explains the impact of contextualized teaching aids and localized teaching resources on enhancing students' performance in learning Biodiversity. The STEM module was focused on the mangrove ecosystem as part of the researcher's environmental advocacy as an Environment Online (ENO)— Philippines student ambassador in the year 2013 which aims to help rehabilitate and restore Bayug Island which was greatly devastated by typhoon Sendong in 2011.

The general objective of this study was to develop a contextualized STEM module in Biodiversity. Specifically, the following objectives were aimed; (1) Determine the point of view of the principal/coordinators and teachers through needs assessment., (2) Develop contextualized STEM module in Biodiversity., and (3) Validate the developed contextualized STEM module in Biodiversity.

The study was conducted on administrators/coordinators and Science teachers from private and public schools in Iligan City namely, St. Peter's College— Basic Education Department and Hinaplanon National High School for the School Year 2022-2023 for the needs assessment survey. The design and content of the contextualized STEM module were anchored on the Most Essential Learning Competencies (MELCs) in Grade 10 Science for the 3rd Quarter that focused on Biodiversity in Unit 3: Module 4. The competency explains how species diversity increases the probability of adaptation and survival of organisms in changing environments.

2. Methods

The researcher adapted and modified the Borg and Gall Model (1983) as part of the research and development process for developing the contextualized STEM module in Biodiversity. In addition, the subjects of this study were the school administrators/coordinators and Science teachers of the target private and public schools in Iligan City namely, St. Peter's College— Basic Education Department and Hinaplanon National High School.

2.1 Development of the Needs Assessment Questionnaire

The researcher designed and developed a needs assessment questionnaire to determine the needs of the key informants. The key topics covered by the questions are the use of supplementary resources, placing the curriculum in perspective, and STEM. After the design, the needs assessment questionnaire went through face validation by the adviser and panel members. Then, it was validated by three (3) Ph.D. professors who are experts in the field. A revision was done after the validation to include all comments and suggestions given by the experts. Lastly, the needs assessment survey was administered to the target schools' school administrators/coordinators and Science teachers.

2.2 Development of the Contextualized STEM Module on Biodiversity

In developing the contextualized STEM module on Biodiversity, several steps have been carried out to align it with the K-12 curriculum. It was adapted from the study of Tecson (2019). To combine the contextualization of the lecture and activities, a collection of species information was taken from the mangrove forest of Bayug Island, Barangay Hinaplanon, Iligan City. To complete this process, approval was first obtained from the Barangay Captain and the City Mayor. To integrate the species collected in the contextualized STEM module on Biodiversity, only the photographs and videos of the species were taken to insure that no harm was done to the species.

The needs assessment findings from the responses of the school administrators/coordinators and the Science instructors served as the basis for the lesson's focus. In addition, the researcher developed a STEM lesson that followed the recommended 7 stages of the context-based STEM education learning approach by Sutaphan and Yuenyong (2019). The mapped learning competencies and activities from the DepEd were also included in the development of the STEM module.

Furthermore, the STEM lesson was reviewed and checked by three (3) Science teachers, who were familiar with STEM and have attended seminars regarding on STEM education, using the adapted rubric for the developed STEM Lesson. On the other hand, the contextualized STEM module on Biodiversity was evaluated by five (5) in-service Science teachers, who developed a self-learning module during the pandemic in their respective regions, using an adapted assessment rating sheet from the DepED (2008) regional handbook.

Moreover, the researcher adapted the seven (7) components when creating a DepEd learning module. The next items on the list are the title page, table of contents, introduction, learning objectives, learning activities, assessment/evaluation, and references. The objectives of this module are to help students identify species in the local environment, help them gain 21st-century skills, and explain how species variety occurs in dynamic environments.

After the development and evaluation of the contextualized STEM module, an approval letter from the DepEd— Division of Iligan City was secured and presented to the principal of the target schools and asked for their permission to conduct the research study on their respective teachers.

2.3 Data Gathering: Needs Assessment

The respondents for the needs assessment were two (2) school administrators/coordinators and five (5) Science teachers from the target private and public schools in Iligan City namely, St. Peter's College— Basic Education Department and Hinaplanon National High School. A survey was administered to them using the developed and evaluated needs assessment questionnaires. But before the survey,

permission, and consent from the school principal were obtained. They agreed to submit themselves as voluntary respondents. Afterward, results were gathered, tabulated, and subject to thematic analysis.

2.4 Data Analysis

Mean was used for the analysis of ratings in the needs assessment questionnaire, the developed contextualized STEM lesson, and the contextualized STEM module. While for the qualitative part, the responses of the school administrators/coordinators and teachers in the needs assessment questionnaire were collected and subjected to content and thematic analysis. In addition, to secure the privacy of their answers and the confidentiality of their identities, this study assigned codes to each responder. Ethical standards were met to provide security for all the data and documents gathered by the researcher in the study.

3. Result

The development of the contextualized STEM module on Biodiversity adapted and modified the Research and Development (R&D) model of Borg and Gall (1983).
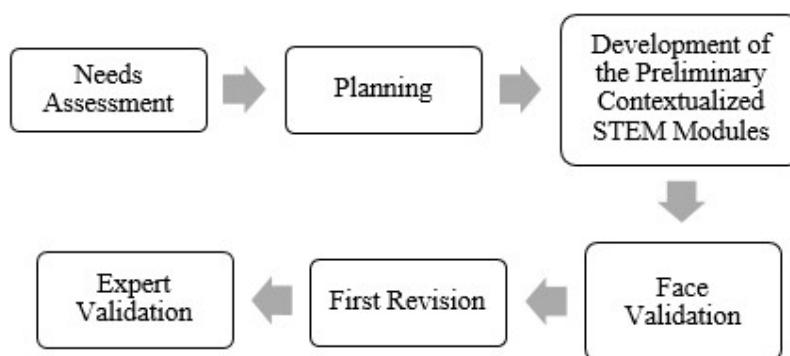
Figure 1. Steps in the Development of Contextualized STEM Module on Biodiversity

3.1 Needs Assessment

In this part of the study, the researcher developed a needs assessment questionnaire for the school administrator/coordinator and Science teachers in the target schools. This part followed five (5) steps namely: (1) designing the needs assessment questionnaires; (2) face validation; (3) teacher's validation; (4) revision of the questionnaires where comments and suggestions were considered; and (5) implementation.

3.1.1 Expert's Rating on the Developed Needs Assessment Survey
Before the utilization of the needs assessment questionnaires, these were evaluated by a panel of experts composed of three (3) Ph.D. professors who had been in the education field for more than ten (10) years. These experts evaluated the needs assessment questionnaire using the adapted rubric from Bontilao et al., (2021).

Table 1. Expert's Rating on the Developed Needs Assessment Questionnaires

Components		Mean	Description
Content and Development		2.78	Satisfactory
Format, Organization, and Structure		2.88	Satisfactory
Grammar		3	Satisfactory
Over-all Average		2.89	Satisfactory
1.00-1.79	Needs Improvement	3.20-4.19	Very Satisfactory
1.80-2.39	Fair	4.20-5.00	Outstanding
2.40-3.19	Satisfactory		

Table 1 shows the summary of ratings by the three (3) teacher evaluators. The rubric for evaluating the needs assessment questionnaires has three (3) components, which are: (1) content and development; (2) format, organization, and structure; and (3) grammar. The needs assessment questionnaires were rated satisfactory with a mean of 2.78 in terms of content and development, which means that the questions are clear and precise and are based on the needed information. Format, organization, and structure have a mean of 2.88 and were rated as satisfactory which means that the questions were appropriate to the target audience. Lastly, grammar was rated satisfactory with a mean of 3 and is well-built and clear.

3.1.2 Implementation of Needs Assessment Survey

The needs assessment questionnaires were administered to the key informants from the target private and public schools consisting of five (5) Science teachers and two (2) administrators/coordinators. They all voluntarily participated in the study and were presented first with an approval letter from the DepEd— Division of Iligan City and the school principal. Safety and health protocols were observed and their respective responses were treated with utmost confidentiality.

3.1.3 Summary of the Responses for the Administrators and Science Teachers

During the implementation of the needs assessment questionnaire, it was found that there was a need to develop a contextualized STEM module on Biodiversity. This was an offshoot of the results. One of the common challenges encountered by teachers when it comes to STEM education is the limited or insufficient learning resources that would help provide students with relevant and authentic learning experiences through the integration of STEM skills, real-world application, student engagement, and motivational lessons and activities.

In terms of familiarity, their idea of STEM education is that it enables learners to develop skills such as problem-solving, critical analysis, etc. The key informants also shared that the common challenges teachers have were limited resources and lack of training when it comes to its implementation. With this, it can be observed from their responses that the solution or the intervention that they think could help overcome these challenges is to provide STEM modules that would help deepen their understanding of the topic to be presented to the students and provide students with relevant and authentic experiences, promoting hands-on and inquiry-based learning, and fostering cross-curricular connections.

3.2 Planning

In planning the learning module, the researcher anchored the contextualized STEM module on the Most Essential Learning Competencies (MELCs) from the Department of Education. In addition, the researcher developed a contextualized STEM lesson to ensure

that the module's contents followed the 7 stages of the context-based STEM education learning approach by Sutaphan and Yuenyong (2019).

3.2.1 Selection of Topics in MELCS from DepEd

Table 2 shows the quarter, content standard, performance standard, and most essential learning competency used in the study.

Table 2. Selection of Topics in Most Essential Learning Competencies from DepEd

Quarter	Content Standard	Performance Standard	Most Essential Learning Competencies	Duration	K to 12 CG Code
4th	1. The influence of biodiversity on the stability of ecosystems	Write an essay on the importance of adaptation as a mechanism for the survival of species	Explain how species diversity increases the probability of adaptation and survival of organisms in changing environments	Week 7	S10LT-IIIh-41

The design and content of the contextualized STEM module were anchored on the Most Essential Learning Competencies (MELCs) which explains how species diversity increases the probability of adaptation and survival of organisms in changing environments.

3.2.2 Development of Contextualized STEM Lesson on Biodiversity

The researcher designed a STEM lesson on Biodiversity before developing a contextualized STEM module to ensure that the module's contents followed the 7 stages of the context-based STEM education learning approach by Sutaphan and Yuenyong (2019). This includes (1) Identification of social issues, (2) Identification of potential solution, (3) Need for knowledge, (4) Decision-making, (5) Development of prototype or product, (6) Test and evaluation of the solution, and (7) Socialization and completion decision stage.

Table 3. Expert's Rating on the Developed Contextualized STEM Lesson on Biodiversity

Components	Mean	Description
Learning Objectives	3.78	Excellent
Learning Content	3.67	Excellent
Degree of Contextualization	4	Excellent
STEM Lesson Stages	3.95	Excellent
Overall Average	3.96	Excellent

Note.   1.00-1.79   Needs Improvement   2.50-3.24   Very Good
         1.75-2.49   Good   3.25-4.00   Excellent

Table 3 shows the summary of ratings by the three (3) teacher evaluators. The evaluators were the three (3) Science teachers, who were familiar with STEM, attended seminars regarding STEM education, and have been teaching for more than five (5) years. The rubric for evaluating the contextualized STEM lesson has four (4) components, which are: (1) learning objectives; (2) learning content; (3) degree of contextualization; and (4) STEM lesson stages.

3.3 Development of Contextualized STEM Module on Biodiversity

The researcher designed a contextualized STEM module that was focused on the mangrove ecosystem of Bayug Island, which was greatly devastated by typhoon Sendong in 2011. In addition, the researcher adapted and modified the seven (7) elements used in developing a learning module from the DepEd (2020).

1	Title Page
2	Table of Contents
3	Pre-test
4	Introduction
5	Learning Activities
6	Assessment/Evaluation
7	References

Figure 2. Seven Elements in Developing a Learning Module from DepEd (2020)

Figure 2 shows the elements of developing a learning module. The first element was the title page, which integrates the biodiversity that was focused on the mangrove forest. The second element was the Table of Contents where specific lessons and tasks on how to learn this module were presented. The third was the Pre-Test to be conducted on the students to test their prior knowledge of the topic. Another was the introduction where an overview of each lesson of the module was presented including the learning objectives. It explained how species diversity increases the probability of adaptation and survival of organisms in changing environments (S10LT - IIIh -41); analyze how biodiversity in the mangrove forest affects the stability of an ecosystem; and identify the threats and suggest ways on how mangrove biodiversity can be protected and conserved in the community.

After the introduction, were the learning activities that were mainly focused on the species found in the mangrove forest of Bayug Island. After answering all the activities in the learning module, the learners were evaluated using the researcher-made test found in the assessment/evaluation section. Lastly, the references were also presented where ownership of some of the contents in the learning module was cited.

3.4 Face Validation

The developed contextualized STEM module used in the study has undergone face validation by the thesis adviser and panel members before its validation. During this step, there were proposed changes to the contents and grammar of the module.

Table 4. Summary of the Comments/Suggestions from the Adviser and Panel Members

Adviser/Panel	Comments/Suggestions
Adviser	Revise the content of the module. Make an activity that is problem-solving. Increase the number of items in the pretest and posttest questionnaire, from 15 to 30.
Panel 1	List the basic characteristics of the mangrove ecosystem using its acronym. Add mangrove ecosystem function and services. Add threats in mangrove forest/ecosystem Add adaptation, mitigation, and conservation

Adviser/Panel	Comments/Suggestions
	Revise Table 2 (Species Found in the Mangrove Forest of Bayug Island)
	Revise activity 3 in Richness and Evenness
	Revise activity 1 in making species maps
Panel 2	Please consider the minor grammatical errors in the module.
	Consider the improvement of the contextualized STEM module.
	Supplement the introduction of the parts of the module.
Panel 3	Additional questions about the 15 items will be incorporated into the standardized questionnaire for the pretest and posttest.

Table 4 presents the comments and suggestions of the adviser and panel members on the developed contextualized STEM module on Biodiversity. Most of the suggestions were mainly on the contents of the module in which there was a need for several revisions on the activities found in the module. In addition, there were some suggestions on the important contents and information that must be added to provide a wider knowledge of the mangrove forest. Lastly, there were minor grammatical errors that need to be considered as commented by the panels.

3.5 First Revision

After the face validation, the next step was the first revision, which included the comments and suggestions of the adviser and panel members during the face validation. The comments and suggestions were considered in developing the contextualized STEM module.

Table 5. Comments and Suggestions of the Contextualized STEM Module on Biodiversity

Comment/s	Before	After
1. Increase the number of items in the pretest and posttest questionnaire, from 15 to 30.		

It was suggested that the number of items in the pretest and post-test questionnaires were increased from 15 items to 30 items and include a list of the basic characteristics of the mangrove ecosystem using its acronym. The test questionnaire was used to evaluate how well the students performed throughout the research and following exposure to the new learning strategy, which was the contextualized STEM Biodiversity module. There were also minor grammatical errors on page 22, removing the 'bold' in the word 'best and including problem-solving in the said questionnaire.

3.6 Expert Validation

Prior to the pilot testing, the developed contextualized STEM module underwent an evaluation by five (5) in-service Science teachers, who developed a self-learning module during the pandemic in their respective regions. The evaluators utilized the Evaluation Rating Sheet and related Descriptors for Print Materials, which was a standardized rubric from the Department of Education (2015) to determine whether materials are appropriate for use in public schools and guarantee their accuracy. It has several criteria, which include (a) content, (b) format, (c) presentation and organization, and (d) accuracy and up-to-datedness of information.

Table 6. Expert's Rating on the Developed Contextualized STEM Module on Biodiversity

Factors	Mean	Description
Content	3.86	Very Satisfactory
Format	3.88	Very Satisfactory
Presentation and Organization	3.92	Very Satisfactory
Accuracy and Up-to-datedness of Information	3.93	Very Satisfactory
Overall Average	3.90	Very Satisfactory

Note.   1.00-1.74   Not Satisfactory   2.50-3.24   Satisfactory
        1.75-2.49   Poor   3.25-4.00   Very Satisfactory

Table 5 shows the summary of ratings by the five (5) in-service Science teachers. The rubric for evaluating the contextualized STEM module has four (4) components, which are: (1) content; (2) format; (3) presentation and organization; and (4) accuracy and up-to-datedness of information. The contextualized STEM module was rated very satisfactory with a mean of 3.86 in terms of the content, which means that the contents that were presented in the module are accurate and precise. The format has a mean of 3.88 and was rated as very satisfactory which means that the module followed the appropriate format proposed by DepEd.

In addition, the presentation and organization were rated very satisfactory with a mean of 3.92, which means that the material was well organized and well planned. Lastly, Accuracy and Up-to-datedness of Information were rated very satisfactory with a mean of 3.93 and were well built and events were timely to the students.

3.7 Features of the Developed and Enhanced Contextualized STEM Module

The researcher adapted the seven (7) elements used in developing a learning module from the DepEd (2020) consisting of a Title Page, Table of Contents, Learning Objectives, Introduction, Learning Activities, Assessment/Evaluation, and References.
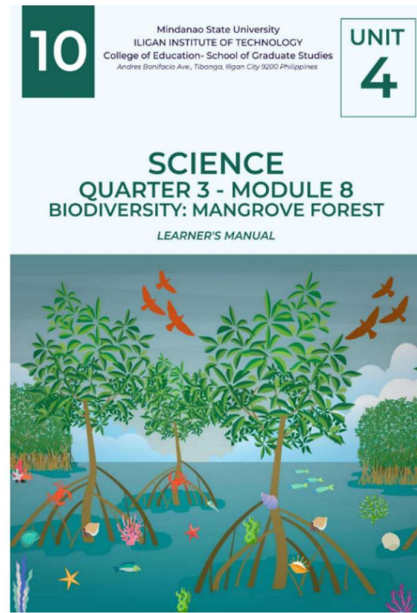
Figure 3. Title Page of the Contextualized STEM Module on Biodiversity

The title page of the contextualized STEM module showed an edited photo of a mangrove forest, which was customized by the researcher to incorporate the species found on Bayug Island. It was also designed to make sure that it was anchored to how species diversity increases the probability of adaptation and survival of organisms in changing environments. After the face validation and expert validation, there have been no proposed changes on the title page of the module.

Table of Contents

Figure 4. Table of Contents of the Contextualized STEM Module on Biodiversity

The table of contents served as a guide on what are the contents of the module with its corresponding page number. It consisted of the cover page, introductory message, table of contents, and a guide on how to learn from this module. It has different elements, too. In addition, it has corresponding labels in English. These were 1) What I Need to Know or the Introduction/Learning Objectives, (2) What I Know or the Pretest, (3) What's In/ Review (4) What's New/ Activity 1, (5) What Is It/ Discussion of Activity 1, (6) What's More/ Enrichment Activities, (7) What I Have Learned or the Generalization, (8) What I Can Do/Application and (9) Assessment or the Post Assessment.

Before you proceed in studying this module, let's check how much you know about the topic by answering the pretest questionnaire.

What I Know

Directions: Read carefully each item. Choose the letter of the correct answer.
1. Which of the following statements BEST describes biodiversity?
   A. It includes a variety of species in a given area.
   B. It pertains to the number of plants throughout the world.
   C. It refers to the number of different animals in the world.
   D. It simply means the study of life.
2. Which of the following ecosystems is MORE DIVERSE?
   A. forest   C. grassland
   B. garden   D. a vacant lot
3. Which of the following is correct about the interrelatedness of biodiversity and sustainability?
   A. Biodiversity has nothing to do with sustainability.
   B. The lower the biodiversity, the greater the sustainability.
   C. The higher the biodiversity, the greater the sustainability.
   D. The higher the biodiversity, the less sustainable the ecosystem.
4. Which of the following is NOT a benefit of biodiversity?
   A. food security   C. ecotourism
   B. deforestation   D. medicine
5. What is an example of an ecosystem with low biodiversity?
   A. Rainforest   C. Marine Ecosystem

Figure 5. Pre-test of the Contextualized STEM Module on Biodiversity

Before the students proceeded on answering the activities in the developed module, they were required to answer the pre-assessment that served as the baseline for assessing the prior knowledge of the students about biodiversity. The results from the pretest were compared with their scores in the posttest after the intervention. This was supported by the study of Shivaraju et al., (2017) which claims that administering pretests before lecture would increase the attentiveness, curiosity, and eagerness to listen to the lecture among the students. There was 96.15% of the students felt that the pretest helped in acquiring new learning as well as important points, which were unknown previously.

What I Need to Know

According to the Convention on Biological Diversity, the Philippines is one of 18 mega-biodiverse countries of the world, containing two-thirds of the earth's biodiversity and between 70% and 80% of the world's plant and animal species. The Philippines is also one of the world's biodiversity hotspots with at least 700 threatened species, thus making it one of the top global conservation areas.

In addition, the Philippines is considered one of the richest diversity of coastal plants in the world. One of the most important components of the coastal ecosystem is the mangrove forest on the landward side of the coastal zone, usually located within the inter-tidal zone.

According to the Department of Environment and Natural Resources (DENR), mangroves are a component of the coral reefs and seagrass ecosystem that is found along the coast and in the ocean. Mangrove is referred to as the "rainforest of the sea," and like the inland rainforest, it benefits the coastlines economically and ecologically. Alcohol, medications, tannin, timber, and building materials can all be found in mangroves.

Mangroves are vital biodiversity hotspots. Because they help filter coastal waters, they provide nutrient-rich habitats for a vast array of species worldwide including birds, fish, and even reptiles, in different stages of their life cycle. Fish and other organisms seeking food and safety from predators are drawn to mangrove forests because of their intricate root systems.

At the end of this module, you are expected to:
1. explain how species diversity increases the probability of adaptation and survival of organisms in changing environments (**S10LT - IIIh -41**).
2. analyze how biodiversity in the mangrove forest affects the stability of an ecosystem; and
3. identify the threats and suggest ways on how mangrove biodiversity can be protected and conserved in the community

Figure 6. Introduction in Each Lesson of the Contextualized STEM Module on Biodiversity

The introduction includes an overview of the lessons in the learning module. The learning objectives are statements that describe what students are expected to achieve after using the developed module as well as the learning objectives. The objectives that the

students were expected to achieve after the utilization were (1) Explain how species diversity increases the probability of adaptation and survival of organisms in changing environments (S10LT - IIIh -41); (2) Analyze how biodiversity in the mangrove forest affects the stability of an ecosystem; and (3) Identify the threats and suggest ways on how mangrove biodiversity can be protected and conserved in the community. These learning objectives were anchored on the Most Essential Learning Competencies (MELCs).
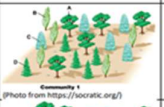

Figure 7. Learning Activities of the Contextualized STEM Module on Biodiversity

The learning activities used in the module were anchored by the developed contextualized STEM lesson on biodiversity. There were activities in every different element of the module. Students were required to answer all the learning activities to assess their understanding and performance on utilizing the developed contextualized STEM module.

Figure 8. Assessment/Evaluation of the Contextualized STEM Module on Biodiversity

At the end of the module, an assessment was given to the students that served as their posttest, which aims to evaluate how well they performed throughout the research and following exposure to the new learning strategy, which was the contextualized STEM Biodiversity module. Posttests demonstrate whether a student has acquired the necessary knowledge and show how much each student's knowledge has increased and how much they have improved because of using the developed module (Hornbuckle, 2022).

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Figure 9. References of the Contextualized STEM Module on Biodiversity

The last part of the developed contextualized STEM module was the references where different sources of the module were presented to acknowledge the other people's work that was used in developing this module.

4. Discussion

The needs assessment questionnaires were rated satisfactory with a mean of 2.78 in terms of content and development, which means that the questions are clear and precise and are based on the needed information. Format, organization, and structure have a mean of 2.88 and were rated as satisfactory which means that the questions were appropriate to the target audience. Lastly, grammar was rated satisfactory with a mean of 3 and is well-built and clear. Overall, the needs assessment questionnaires were rated satisfactory with a mean of 2.89. Hence, the needs assessment questionnaires were valid and can be used as an instrument in the study. Validation of this research instrument is an important process in the study to ensure its quality. The needs assessment was necessary to help identify, understand, and prioritize the needs that must be addressed to improve performance (DepEd, 2020).

Furthermore, STEM lesson stages were rated excellent with a mean of 3.95 and were well-built and clear. Overall, the developed contextualized STEM lesson was rated excellent with a mean of 3.96. Hence, the developed contextualized STEM lesson was valid and can be used as an instrument in designing the contextualized STEM module.

Regarding the seven stages of the context-based STEM education teaching approach; it may provide a referent of STEM education teaching in school setting and STEM project teaching. Teachers may perceive concrete ways of getting started the STEM education learning activities when they are thinking about the identification of social issues. Then, the activities could be started from social issues and/or human needs such as disasters, pollution, environmental issues, biotechnology, health, cosmetics, ecosystem, energy, market, commerce, and designing some technological products. The 7 stages will allow students using applying scientific and other knowledge for designing the solutions and provide the context of instruction that requires solving a real-world problem or task

through teamwork. And, students will also have a chance to apply their scientific and other knowledge for problem-solving (Sutaphan and Yuenyong, 2019).

Moreover, the developed contextualized STEM module was rated very satisfactory with a mean of 3.90. Hence, the developed contextualized STEM module was valid and can be used for pilot testing. This supports the results of Paduada (2022) that the developed localized module is highly acceptable in terms of content, applicability, clarity, and accuracy. Thus, the use of the localized module was effective in enhancing the performance of the learners. According to Ballesteros (2019), the K12 Basic Education Program explicitly highlighted the use of localization and contextualization as a novel method in Science. Science education is not limited to the four walls of the classroom; additional materials can be found in the physical environment.

5. Conclusion

During the implementation of the needs assessment questionnaire, it was found that there was a need to develop a contextualized STEM module on Biodiversity because of the common challenges encountered by teachers with limited or insufficient learning resources. These were ones identified that would help provide students with relevant and authentic learning experiences through the integration of STEM skills, real-world application, student engagement, and motivational lessons and activities.

On the other hand, the developed contextualized STEM module was rated very satisfactory in terms of (a) content, (b) format, (c) presentation and organization, and (d) accuracy and up-to-datedness of information with a mean of 3.90. Thus, the use of the localized module was effective in enhancing the performance of the learners.

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