Raising environmental awareness through local-based environmental education in STEM lessons

Maria Theresa G. Tadena1*, Monera A. Salic-Hairulla2

1Department of Science and Mathematics Education, College of Education, Mindanao State University –Iligan Institute of Technology, Iligan City 9200, Philippines

2Department of Science and Mathematics Education, College of Education, Mindanao State University –Iligan Institute of Technology, Iligan City 9200, Philippines

*Corresponding author’s e-mail address: mariatheresa.tadena@g.msuiit.edu.ph

Abstract. Republic Act 9512 mandates the promotion of environmental awareness through and by integrating environmental education in both public and private schools. Seeing STEM education in new light that seeks in helping learners use the local environment as a vehicle for developing understanding various environmental issues. Providing adequate STEM and environmental education will make everyone appreciate their relationship with the environment which lead to environmental awareness and in developing a sustainable future. This study aimed to develop Local-Based Lessons on Environmental Education through integration to STEM lessons to raise environmental awareness among grade 8 learners. The study employed Quasi-experimental qualitatively supported with two-group pre-test-post-test design to examine the effectiveness of the Developed Local-Based Lessons on Environmental Education. T-test analysis between post-test scores of the control and experimental groups revealed to be significantly different at t (75.108)= -17.595, p=0.000 with the experimental group (M=24.49, SD=4.98) scoring higher than control group (M=8.99, SD=3.20). Similar result was found between the two groups gain score at: control and experimental, t(56.207)= -19.408, p(0.000)<.05, two-tailed with the experimental group gaining score higher than the control group. This implies that the Developed Local-Based Lessons on Environmental Education integrated to STEM lessons has increased the environmental awareness of the learners.

1. Introduction
The world in general faces environmental crisis and our country in particular is also in a verge of environmental degradation. There is no denying of the urgency of global and local environmental issues. In the Philippines, the pressing environmental issues include mining, climate change, solid waste management [1] and pollution specially plastic-related pollution [2] that made our country as the third worst plastic polluter of the world’s oceans. Indeed, there is a dire need of environmental awareness on every aspects of the environment so as to produce socially responsible citizens [3].

In spite of the government’s effort in promoting environmental awareness through Republic Act 9512, which mandates the promotion of environmental awareness through and by integrating environmental education, the country still ranked at 82nd among 180 countries on its Environmental Performance Index in 2018 based on nation’s performance to address high-priority environmental issues [4]. This is...
supported by the statement of [5] that various environmental laws have been released in the last decade in the Philippines but awareness about content and objectives of these environmental laws remains too low.

Moreover, the Department of Education in compliance with R.A. 9512, issued DepEd Order No.52,s. 2011 on “Strengthening of Environmental Education in Public and Private Schools.” According to [6], promoting environmental awareness is considered a crucial goal in the context of contemporary education. Environmental Education teaching could be a promising step in addressing local environmental challenges. According to [7] as cited by [8], this can be achieved through formal education by integrative approach which combines or unites Environmental Education materials into a particular subject like science. As asserted by [9], that science is a subject which offers opportunities for fostering environmental awareness and science teachers are best agents in facilitating students to be involved in making solutions on environmental issues.

However, an assessment of in-service training programs on environmental education for classroom teachers and school administrators in the Philippines showed that there is inadequate Environmental Education trained teachers at the elementary and secondary education level, integration of environmental education in school curricula is not sufficient [10] and studies of [11, 12] emphasized that inadequate teacher preparation and lack of expertise in the subject matter hinders the implementation of Environmental Education.

The development of ready-to-use teaching-learning materials could fill in the gaps in the integration of environmental education. This prompted the researcher to develop a contextualized (local-based) learning material that can be readily integrated and contents are based on the local environment. This study is also in response to the “Enhanced Basic Education Act of 2013” or R.A. 10533 on the contextualization, localization, indigenization and enhancement of learning materials.

Seeing STEM education in new light that seeks in helping learners deal with complexity and splendour of the environment as well as looking to use the local environment as a vehicle for developing understanding aspects of the science curriculum. There is a need to shift from seeing environment as a focus for considering science concepts to seeing a STEM education as one which seeks to help learners understand various environmental issues in the context of their lives, and their lives in the context of environmental issues [13].

Providing adequate STEM and environmental education will make everyone appreciate their relationship with the environment which lead to environmental awareness and in developing a sustainable future [14].

2. Theoretical Background
The fundamental postulate of contextual learning otherwise known as context-based learning is it must be somehow connected with real world characteristics for it to make sense to the learners [15]. This practical context enables learners to connect symbolic learning content like concepts and principles to the real world referents. According to the Theory of Contextual learning, learning occurs only when learners process new information or knowledge in such a way that it makes sense to them in their frame of reference like their own inner world of memory, experience, and response [16].

This approach to learning and teaching assumes that the mind naturally seeks meaning in context—that is, in the environment where the person is located—and that it does so through searching for relationships that make sense and appear useful. In this sense, the use of local-based terms and examples like using local species of fish to teach fish species diversity to the learners can be an effective strategy in meaning making for the components of such concept is found on the environment where the person is located. According to [17], when students can relate the concepts they have learned to real-life situations, it means that they have inserted the context learned to the actual situation and transformed it as life experiences and encourage positive attitude towards learning science.
3. Methods
The development and implementation of the Developed Local-Based Lessons on Environmental Education in this study involves four (4) main stages (see Fig. 1):

**Stage 1: Needs Assessment.** This stage involved the survey on the level of environmental awareness and the assessment on the need for environmental education integration. This was done using the following instruments: (a) Environmental Awareness Survey Questionnaire which was given to 90 Grade 8 learner-respondents to determine the level of their environmental awareness (b) Written interview was given to junior highschool science teachers to assess their insights in order to validate and confirm the need for the development of a local-based lessons as teaching-learning material on environmental education and its integration to biology lessons. The results gathered from these instruments were utilized as springboards for the conduct of this study.

**Stage 2: Development.** The following steps were considered and utilized in the development of the Local-Based Lessons on Environmental Education:

- 1. Identification of the Topic
- 2. Identification of standards-based learning competencies based on chosen topic
- 3. Designing and Conceptualization of the Developed Local Based Lessons on Environmental Education
- 4. Face Validation by the panel members and research adviser
- 5. Revision of the Developed Local-Based Lessons on Environmental Education
- 6. Expert Validation
- 7. Revision of the Developed Local-Based Lessons on Environmental Education based on the experts’ feedbacks
- 8. Pilot Testing
- 9. Final Revision
- 10. Developed Local-Based Lesson on Environmental Education
- 11. Implementation

The development stage is where the creation of the Local-Based Lessons on Environmental Education was carried out. There are 11 steps involved in the development of the Local-Based Lessons on Environmental Education: (1) Identification of the Topic (2) Identification of standards-based learning competencies – K to 12 Education Curriculum identifies the standards as stipulated in the Junior High School Curriculum Guide provided for the Grade 8 level(3) Designing and Conceptualization of the developed local-based lessons on environmental education- designed by the standards and competencies as stipulated in the K to 12 science Curriculum Guide for Grade 3 to 10. The activities, materials for the teachers and learners, achievement tests were all conceptualized
and designed by the researcher in this step. (4) **Face Validation by the panel members and research adviser** – to validate the developed learning material. The said lesson material was evaluated by selected experts who are the in-service science teachers of Marawi City National High School and environmental experts through numerical ratings, comments and suggestions for improvement. (5) **Revision of the Developed Local-Based Lessons on Environmental Education** - The first phase of the revision of the Environmental education integrated Biology lesson material is based upon the comments and suggestions given by the research and panel members during the face validation. (6) **Expert Validation** - On the second phase of the revision will be done based on the comments and suggestions of the experts. (7) **Revision of the Developed Local-Based Lessons on Environmental Education based on the experts' feedbacks** (8) **Pilot Testing** - Determined the difficulty and discriminating index of the test item, assess the feasibility of the material and identify the weaknesses of the developed local-based lessons on environmental education prior its implementation. Was conducted on Grade 8 learners not included to the official implementation in Marawi City. (9) **Final Revision** - the comments, suggestions, and errors are corrected and applied to improve the teaching-learning material. (10) **Developed Local-Based Lessons on Environmental Education** – ready to use learning material to be utilized by the teachers and students. This material is now ready for implementation. (11) **Implementation**.

**Stage 3: Evaluation.** The developed Local-Based Lessons on Environmental Education was rated and assessed using a rubric by the “Panel of Experts” based on a criterion for a good Local-Based Lessons on Environmental Education like its content and technicality. Suggestions made for the enhancement of the Local-Based Lessons on Environmental Education served as a guide for its revision.

**Stage 4: Implementation.** In this stage, the Developed Local-Based Lessons on Environmental Education were used as an instructional materials for environmental education integration in teaching Biogeochemical Cycles to Grade 8 learner-respondents who belong to the experimental group. In the control group, the Developed Local-Based Lessons on Environmental Education were not utilized, the teacher only used the traditional lecture method of teaching and also used limited decontextualized environmental lesson. The study was conducted in Marawi City National High School, Marawi City, Philippines with a total of 90 Grade 8 respondents. The respondents were officially enrolled during the School Year: 2018-2019. In the study, the total number of respondent was divided into two groups (experimental group and control group). Both groups had 45 respondents each. Prior to the implementation, a pilot testing was conducted to 45 learners from the same school in Marawi city. The study conducted utilized a Quasi-Experimental Non-randomized Two Group (control and experimental) Pre-test/Post-test Research Design. The researcher assessed the effect of the experimental treatment (Local-Based Lessons on Environmental Education) and control group (non-localized traditional lecture method) by comparing the pre-test and post-test scores of the two groups. The researcher made use of quantitative research with 30-item Environmental Awareness Achievement Test which was face validated by the research adviser and panel members and was also tested for test validity and reliability. On the other hand, it is qualitatively supported from the data drawn from the comments and suggestions of the experts and the comments of the respondents from the respondents’ self-reflections. Purposive sampling was used with the following qualifiers: (1) Grade 8 topics – One of the grade 8 level topics is the biogeochemical cycles which was taken into account in choosing the topic and respondents in order to align the developed learning material to the current topics that was discussed during the 4th grading period of the said school (2) Grade 8 level learners – only in this grade level that the implementation can be aligned to the biology topics for the 4th grading. On the other hand, Biogeochemical Cycles is one of the Four Principles of Sustainability. The four interconnected principle of sustainability are derived from learning how nature has sustained a variety of life forms on earth for about 3.56 billion years [18].

After the implementation stage, all the data were analyzed using Microsoft Excel 2010 and IBM SPSS in order to present the data and results accurately. Codes were given to the respondents in order to protect their identities.
4. Results and Discussion

Needs Assessment: Students

The need to develop an integrating environmental awareness material for science lessons was assessed through an Environmental Awareness Survey that was given to the learners and Environmental Education Need for Integration written interview was given to junior high school science teachers.

Figure 3. Level of environmental awareness of students.

Figure 3 above shows the percentage of students based on the level of environmental awareness that they possess. It was found out that 61% of the students have low environmental awareness, 36% very low environmental awareness, and 3% high environmental awareness. From the responses gathered there are still more who put least important consideration on the state of environment. This implies the necessary application of knowledge from different disciplines to manage the environment [19]. Knowledge on the issue is the only thing that determines environmentally aware individuals and that environmental awareness guarantee motivation on students to adopt new behavior [20]. Therefore, environmental awareness should be deeply rooted in the education system at all levels of school education [21] in order to protect and conserve the environment [22]. This suggests teachers who are active and potential change agents to integrate environmental lessons to raise students’ awareness so they can outline and perform even in their own little ways mitigation measures in dealing with local environmental issues in their own community.

The developed Local-based Lessons on Environmental Education was based on the K to 12 curriculum guide as well as related environmental issue topics on Environmental Education.

Figure 4. Experts ratings on the evaluation of the developed local-based lessons on environmental education.

Figure 4 shows the overall data of mean scores after the expert validation of the Developed Local-Based Lessons on Environmental Education. The overall mean for: (a) Content is 3.9 (b) Quality of
Content is 3.9 (c) Potential Effectiveness is 3.7 (d) Ease of Use is 3.9. All means of each criteria are rated Excellent. Thus, the Developed Local-Based Lessons on Environmental Education could be an effective tool in increasing the environmental awareness of the students.

Comparison Between the Pre-test Scores of the Control and Experimental Group

The aim of the pre-testing the groups with the Environmental Awareness Achievement Test was to ascertain whether the students selected to participate in the Experimental group and Control group had comparable academic characteristic.

**TABLE 2.** Comparison between the pre-test and post-test scores of the control group.

![Image of Table 2](image.png)

Table 2 above shows that the computed p-value (0.115) was greater than the alpha of 0.05. The pre-test mean scores of both experimental group and control group were non-significantly different at 0.05 alpha level (t(88) = -1.590, p= 0.115). The magnitude of the differences in the means (mean difference = -1.02) which has an effect size of 0.3 implies that the two groups means differ only by one third of a standard deviation. This is considered a small effect size. Together, this suggests that the groups were deemed similar on environmental awareness achievement test measure and had comparable characteristics, hence homogenous.

Comparison Between the Post-test Scores of the Control and Experimental Groups

The t-test result in table 3 below showed that the difference in achievement post-test mean scores of the respondents between the Experimental and Control groups were significant. The t-test analysis results revealed that the computed p-value (0.000) was lesser than the alpha of 0.05. Therefore, the post-test mean scores of both experimental group and control group were significantly different at 0.05 alpha level (t (75.108) = -17.595, p= 0.000) with the experimental group (M = 24.49, SD = 4.98) scoring higher than control group (M = 8.99, SD = 3.20). The magnitude of the differences in the means (mean difference = -15.5333) which has an effect size of 3.38 which means that the experimental group is more than 3.38 standard deviations better than the control group in terms of post-test scores. Together, this suggests that there is a significant difference between the control and experimental group.

**Table 3.** Independent sample t-test for the environmental awareness achievement test (eaat) post-test scores between the control and experimental groups.

![Image of Table 3](image.png)
Comparison of the Difference of the Experimental and Control Groups Gain Scores

An independent t-test analysis found the pattern between the mean gain score and standard deviation of the control and experimental groups significant. There was a significant difference in scores between the two groups: control and experimental, t (56.207) = -19.408, p (0.000) <.05, two-tailed with the experimental group (M = 13.3111, SD = 4.6944) gaining score higher than the control group (M = -1.2, SD = 1.76584). The magnitude of the differences in the means (mean difference = -14.5111) which has an effect size of 2.84 which means that the experimental group is more than two standard deviations better than the control group in terms of improvement of scores from pre-test to post-test. Together, this further suggests that there is a significant difference between the control and experimental group for which the null hypothesis is rejected and considered non-significant. Thus, the gain score of the experimental group is higher than the control group which implies that the Developed Local-Based Lessons on Environmental Education is effective in influencing the environmental awareness of learners by increasing it. This result agreed to the study of [23] conducted to determine the relationship between environmental awareness in selected topics in science and academic performance of students to assess the level of environmental awareness of the students. Findings of this study showed that environmental awareness of the students was associated to their academic performance.

Table 4. Comparison of the gain scores between the control and experimental groups

| Group     | N  | Mean Gain Score | Standard Deviation | Mean difference | t       | p-value |
|-----------|----|-----------------|--------------------|-----------------|--------|--------|
| Control   | 45 | -1.20           | 1.77               | -14.51111       | -19.408| 0.000  |
| Experimental | 45 | 13.31           | 4.69               | -14.51111       | -19.408| 0.000  |

Findings in other studies showed the positive effects on integration, contextualization and localization of learning materials and in response to Republic Act 10533 that teaching and learning materials be contextualized and localized to improve and make the curriculum responds, conforms, reflects and flexible to the needs of the 21st century learners who need to be holistically and skillfully developed. Findings on the study conducted by [24] revealed that localized and contextualized learning materials are more acceptable to the respondents. [25] affirmed on the effectiveness of using contextualized and localized teaching in which the overall performance of the learners showed a proficient level with a mean of 86.67 that implies that there was significant improvement in their performance in science using localization and contextualization approach in teaching science. [8] in his study in developing a learning model for integration of environmental education claimed that integration of environmental education materials in science subject matter effectively improved students’ knowledge of the environment. These effect was observed both in large groups of students and in small groups of students.

Summary of Learners’ Performance

Table 5 below shows the results of the performance of the respondents on the different activities provided in the Developed Local-Based Lessons on Environmental Education. It can be drawn from the scores of group discussion and poster making activity.
Table 5. Performance of respondents on different activities provided in the local-based lessons on environmental education.

| Grade equivalent | Interpretation | Group discussion | Poster making |
|------------------|----------------|------------------|---------------|
|                  |                | f   %         | f   %         | f   %         | f   %         |
| 90-100           | Outstanding   | 18  40        | 18  40        | 11  24        | 21  47        | 8   18        | 7   16        |
| 85-89            | Very Satisfactory | 9   20        | 9   20        |                |                |                | 7   16        |
| 80-84            | Satisfactory  | 18  40        | 9   20        | 30  67        | 18  40        | 31  69        | 17  38        |
| 75-79            | Fairly Satisfactory | 9   20        |                |                |                |                | 8   18        |
| Below 75         | Did not meet Expectation | 4   9          | 6   13        | 6   13        | 6   13        |

These results supported the significant increase of the experimental group’s post-test scores and explained why experimental group has higher gain score compared to the control group. It was noted that each group participated well in the group discussion, they have their own ideas to share although each group was given different cases in group discussion. Most respondents have more ideas to share on issues of deforestation and improper waste disposal, but the groups assigned on cases greenhouse effect and hydroelectricity got satisfactory rating but still got a good performance. Similar results can be found on their performance on poster-making activity where most of the students got an outstanding rate of their performance although one group was rated as fairly satisfactory but this is still above the passing rate. The performance of respondents in poster-making activity can be affected by factors like the ability of group members to draw, there are a few who were not gifted with an artist hand which will matter in this aspect. The activities numbered 1, 2, and 3 are individual activities of the three environmental education integration that were done on the the three lessons on biogeochemical cycles, water cycle, oxygen-carbon dioxide cycle, and nitrogen cycle. It can be inferred that the significant increase on the achievement test on environmental awareness of the respondents is due to the respondents engagements on different activities in the local-based lessons on environmental education.

Perception of the Respondents toward the developed Local-Based Lessons on Environmental Education

The bar graph presentation on Figure 8 illustrates the perceptions of the respondents on whether they find interest and enjoyment while doing the lesson activities, the value and usefulness of the lesson activities and the perceived choice in doing the lesson activities.

![Figure 8](image-url)
The first bar graph on Figure 8 illustrates the respondents’ perceptions in terms of their interest and enjoyment while doing the lesson activities. With an overall rating of 5.60, it was described as usually true, this means that most respondents were interested, enjoyed and had fun while doing the activities in the developed lesson material. This further implies that respondents were not bored throughout the lesson. Therefore, the activities in the Developed Local-Based Lessons on Environmental Education as perceived by the respondents’ are interesting and an enjoyable experience.

The second bar graph illustrates the respondents’ perceptions about the value and usefulness of the Developed Local-Based Lessons on Environmental Education. An overall rating of 6.07 described that their average perception as usually true which means that most of the respondents believed that the lesson activities given to them were valuable and useful and that doing the activities could improve their environmental awareness and help them appreciate better ways in addressing environmental issues in their own community. Thus, as perceived by the learners the Developed Local-Based Lessons on Environmental Education is valuable and useful.

The third bar graph showed the respondents’ perceptions on their perceived choice in doing the activities in the Developed Local-Based Lessons on Environmental Education. The overall rating of the perceived choice of the respondents is 4.74 and it is described as often true. This results implied that the respondents did the activities because they wanted to. Thus, the learners perceived the activity to have given them freedom in doing the activities of the Developed Local-Based Lessons on Environmental Education.

5. Conclusion

The researchers have developed and implemented local-based lessons on environmental education for STEM lessons given to the grade 8 junior high school learners at Marawi City National High School in Northern part of Mindanao, Philippines. The learners have shown positive response to the developed lessons and were able to provide and design in their own little ways possible solutions in addressing local environmental issues in their own community using STEM lessons. The learners assessment results to different activities embedded in the developed lessons revealed significant results, thus, the level of environmental awareness of the learners have increased significantly.

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