



Development of Outdoor STEM Activities on Water for Grade IV Learners

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ABSTRACT

Water is the foundation of life and an essential necessity for all living things. However, it is becoming a limited and deteriorating resource, affecting millions all over the world. In addition, water-related topics remain among the least mastered competencies for Grade IV learners. With this, the researcher developed outdoor STEM activities on water for Grade IV learners, investigating its effects on the learners' conceptual understanding, attitude, and perception. Before the development of the outdoor STEM activities, a needs assessment was done for one (1) school administrator and six (6) in-service science teachers of the public and private elementary schools. The results served as the basis for the development of the outdoor STEM activities, which underwent face validation by the thesis adviser and panel members and expert validation for its content by two (2) In-service Science teachers and one (1) school administrator. It also underwent another expert validation for its alignment with STEM Education Principles by four (4) STEM Education experts. The developed outdoor STEM activities were rated very satisfactory by the panel of experts for its content and alignment to STEM education principles.

Key Words: Attitude, Perception. STEM Education, STEM Activities.

1. INTRODUCTION

Water is the foundation of life and an essential necessity for all living things. However, it is becoming a limited and deteriorating resource, affecting millions all over the world (Mishra et al., 2021). The need for enough water continues to rise as a result of rapid population expansion, urbanization, and climate change, making it one of the most pressing issues of recent years. Despite worldwide efforts to improve water availability, many low- and middle-income nations, like the Philippines, continue to have insufficient water supply in schools (McMichael, 2020). Water supply issues in Iligan City, for example, such as irregular availability and poor water quality, persist and affect schools (Montemayor et al., 2022). Access to safe water and water education in schools is essential for achieving the United Nations' Sustainable Development Goals (SDGs), particularly SDG 3 (good health and well-being), SDG 4 (quality education), SDG 6 (clean water and sanitation for all), and SDG 12 (responsible consumption). In line with these goals, science education in the Philippines seeks to produce scientifically literate individuals capable of contributing to environmental sustainability and technological development. However, the country has consistently performed poorly in both international large-scale assessments (ILSAs) and national assessments. Additionally, water-related topics remain among the least mastered competencies for Grade IV learners (Acosta, 2023). Current approaches have yet to produce significant improvements, highlighting the pressing need for a innovative and new approach to strengthening scientific education, as emphasized by the DepEd Undersecretary for Curriculum and Teaching (Servallos, 2024). Furthermore, the basic education research agenda D.O. 39, s. 2016 encourages the study of various teaching

approaches, lesson plans, and instructional materials because they provide teachers with the tools needed and students with the solid foundation needed to learn (Department of Education, 2016).

Given these challenges, there is a pressing need for innovative teaching approaches that promote scientific literacy and student engagement. This study explored the use of outdoor Science, Technology, Engineering, and Mathematics (STEM) activities on water for Grade IV learners. Although research shows that outdoor STEM activities can increase academic achievement and scientific literacy, few studies have thoroughly investigated the impact (Burns et al., 2023; Pitipornatapin et al., 2024). This study aims to address this gap by developing and evaluating outdoor STEM activities that align with the Sustainable Development Goals (SDGs) and contribute to improved learning outcomes, environmental awareness, and sustainable water management.

The general objective of this study was to develop and utilize outdoor STEM activities on water for Grade IV learners. Specifically, the following objectives were aimed: (1) Assess the need to develop outdoor STEM activities on water for Grade IV learners through the school administrator and in-service science teachers; (2) Develop outdoor STEM activities on water for Grade IV learners; and (3) Evaluate the developed outdoor STEM activities on water for Grade IV learners.

2. METHODS

The study employed the 4D model, which is a systematic four-phase process that includes the define, design, develop, and disseminate phases of developing outdoor STEM activities. Prior to developing the material, a needs assessment was undertaken to determine the need and demand.

2.1 Needs Assessment Survey Questionnaire

The researcher adopted a needs assessment survey questionnaire from the study of Hadji Shaeef et al. (2023) in press to assess the need and demand for the development of outdoor STEM activities on water. The needs assessment survey questionnaire consisted of two parts. The first part is the respondent's profile, while the second part is about outdoor STEM education. Their responses, including their comments and suggestions, were considered in the development of outdoor STEM activities.

2.2 Development of Outdoor STEM Activities on Water for Grade IV Learners

Before the development of outdoor STEM activities on water, the researcher determined the least mastered competency and a social issue topic. The Matatag curriculum, along with the Most Essential Learning Competencies (MELCs), were considered in the development of the said material. Furthermore, the feedback, comments, and suggestions in the needs assessment served as the basis for crafting and developing the outdoor STEM activities.

The researcher then created a STEM lesson that followed the recommended seven stages of the context-based STEM education learning approach by Sutaphan and Yuenyong (2019) and a Lesson Plan, anchored on the Matatag Curriculum and the Most Essential Learning Competencies (MELCs). The obtainment of the needed resources was also conducted. Afterward, the researcher created a prototype of the outdoor STEM activities on water. The developed prototype was face-validated by the research panels and the research adviser. After the completion of the needed revision, the researcher developed the outdoor STEM activities. The developed outdoor STEM activities were evaluated by a panel of evaluators and experts. Two (2) in-service science teachers and one (1) school administrator validated or evaluated the material for its content. It also underwent another expert validation for its alignment with STEM Education Principles by four (4) STEM Education experts. Comments and suggestions were considered for the betterment of the outdoor STEM activities on water for Grade IV learners.

2.3 Data Gathering Procedure

For the needs assessment, the respondents were six (6) in-service science teachers and one (1) school administrator. The needs assessment was intended to determine the need or demand for the development of the material. Comments

and suggestions were also considered in the needs assessment. Before conducting the needs assessment, a letter was given to the respondents to ensure that their participation was voluntary.

2.4 Data Analysis

Mean was used to analyze the first part of the needs assessment survey questionnaire and the ratings on the developed outdoor STEM activities. For the ratings, the mean score was interpreted as 3.25 – 4.00, labeled as Very Satisfactory, 2.50 - 3.24 labeled as Satisfactory, 1.75 - 2.49 labeled as Poor, and 1.00 – 1.74 labeled as Not Satisfactory. For the qualitative data on the needs assessment, content analysis was used to generate codes on the responses of the school administrator and in-service science teachers.

3. RESULTS AND DISCUSSION

3.1 Needs Assessment for the School Administrator and In-service Science Teachers

The school administrator and six in-service science teachers were the respondents of the needs assessment. Table 3.1.1 provided an overview of their responses regarding outdoor STEM education. To protect their privacy, this study employed coding. KI1 meant Key Informant Science Teacher 1, and KIS1 meant Key Informant School Administrator 1.

Table 3.1.1. Summary of the Responses on Outdoor STEM Education

Themes	Mentions	Utterances
Familiarity with Outdoor STEM Education	7	<p><i>"I am not familiar with Outdoor STEM Education (KIS1)(KI1)(KI3)(KI4)."</i></p> <p><i>"Yes, I am a little bit familiar with Outdoor STEM Education (KI2)(KI5)(KI6)."</i></p>
Training on Outdoor STEM Education	7	<p><i>"I haven't attended any seminars or training about outdoor STEM education (KIS1)(KI1)(KI2) (KI3)(KI4)(KI5)(KI6) ."</i></p>
Benefits of Outdoor STEM Education in the Teaching-Learning Process	7	<p><i>"Outdoor STEM Education is beneficial because when teaching about water, learners learn fast through experience, when inside the classroom we can only show them limited pictures and/or videos, but if they see it, like experience it happening in real-life, then, they can easily learn it and that applies to all learning topics (KI1)(KI2)(KI3)(KI4)(KI6)."</i></p> <p><i>"Outdoor STEM Education is beneficial because learners are using it in their everyday lives (KIS1)."</i></p> <p><i>"I think outdoor STEM Education would be beneficial because it allows for deeper learning and critical thinking skills. This kind of activity will be used in the future to uplift or develop our teaching and learning styles (KI5)."</i></p>

Table 3.1.1 presents a summary of the respondents' responses to outdoor STEM education. As shown above, most respondents were unfamiliar with or had little knowledge about outdoor STEM education. Furthermore, all of the respondents were not able to attend training and seminars on outdoor STEM education. Poor science curriculum and inadequate science preparedness for teachers were the primary reasons for Filipino learners' low performance in science at the elementary level (Almerino et al., 2020). Despite this, the respondents were aware of the benefits and importance of outdoor STEM education in the teaching-learning process, especially in teaching about water. Most of the respondents stated that outdoor STEM education encourages critical thinking, active participation, experiential learning, and real-world application. This was relevant since one of the benefits of outdoor STEM education highlighted in the literature was that it provides real-world experience, active participation, and critical thinking skills to learners (Mackenzie, 2017; Yaki, 2022).

3.2 Development of Outdoor STEM Activities on Water for Grade IV Learners

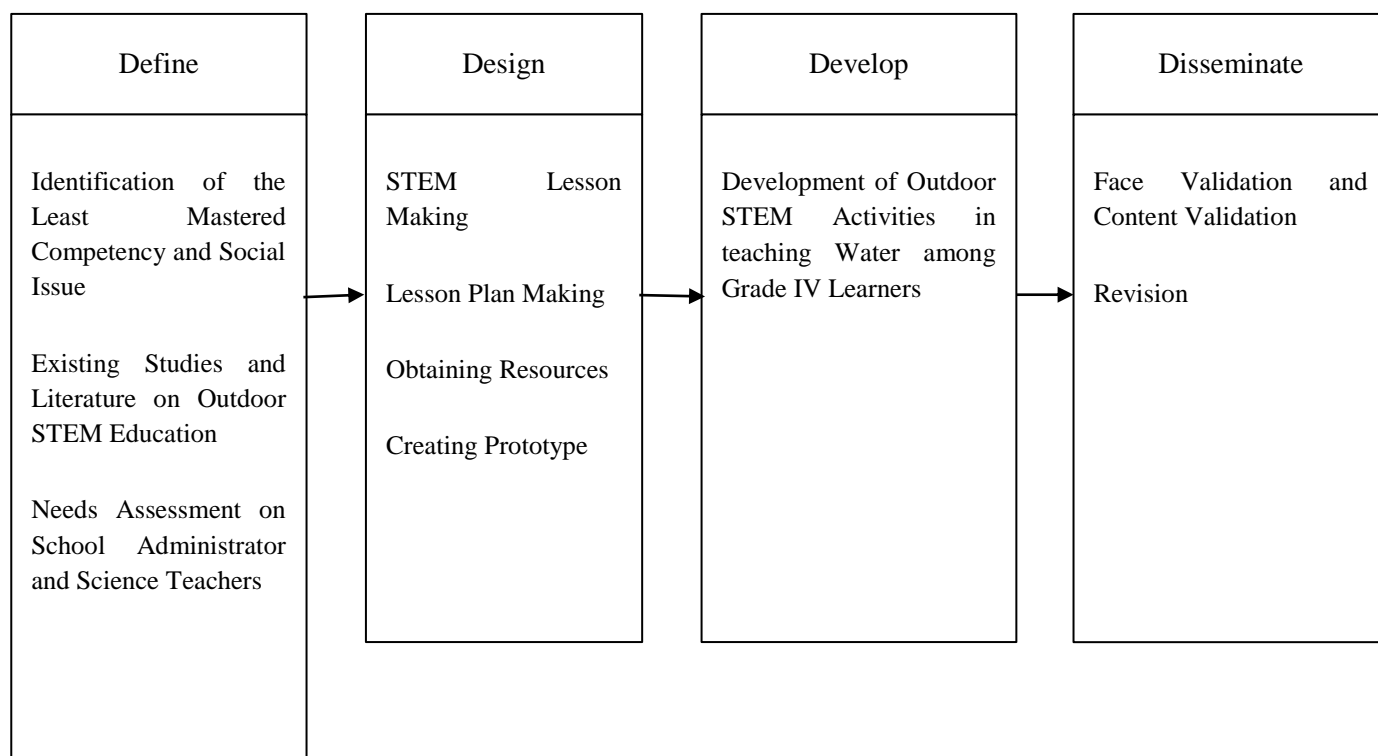


Figure 3.2.1. 4D Model on the Development of Outdoor STEM Activities

Figure 3.2.1 presents the 4D model of the outdoor STEM activities on water for Grade IV learners. Several steps have been taken in the development of outdoor STEM activities on water. The researcher began with the define phase, where the identification of the least mastered competency and the social issue was conducted. An analysis of the existing studies and literature revolving around outdoor STEM education was also conducted. A needs assessment intended for the school administrator and science teachers was employed to assess the need to develop outdoor STEM activities. After that was the design phase, where the development of the STEM Lesson that followed the recommended seven stages of the context-based STEM education learning approach by Sutaphan and Yuenyong (2019) and the Lesson Plan occurred, anchored on the Matatag Curriculum and the Most Essential Learning Competencies (MELCs). An assessment and the obtaining of the resources that were used in constructing the outdoor STEM activities were also considered. This was then followed by the development of a prototype that was assessed, reviewed, and face-validated by the research adviser and panel members, and this process was continued until the best output was achieved. It was then followed by the development phase, where the material was developed based on the review and assessment of the research adviser and panel members. Lastly, in the dissemination phase, another face validation was conducted to ensure that the needed revision was made. Two (2) in-service science teachers and one (1) school administrator validated or evaluated the material for its content. It also underwent another expert validation for its alignment with STEM Education Principles by four (4) STEM Education experts. The application of the needed revision to develop a much better output based on their feedback was done.

3.3 Validation of Outdoor STEM Activities on Water for its Content

The developed outdoor STEM activities were evaluated and validated for its content by two (2) in-service science teachers and one (1) school administrator through the Department of Education LRMDs Evaluation Rating Sheet for Print Materials. Comments and suggestions were considered for the betterment of the material. Ratings for each of the criteria are presented in Table 3.2.1.

Table 3.2.1. Summary of the Evaluators' Rating on the Content of the Outdoor STEM Activities on Water

Components	Mean	Description
Content	3.90	Very Satisfactory
Format	3.98	Very Satisfactory
Presentation and Organization	4.00	Very Satisfactory
Accuracy and Up-to-dateness of Information	4.00	Very Satisfactory
Overall Rating	3.97	Very Satisfactory

Note. 1.00-1.79 Not Satisfactory 2.50-3.24 Satisfactory
1.75-2.49 Poor 3.25-4.00 Very Satisfactory

Table 3.2.1 shows the summary of ratings by the two (2) in-service science teachers and one (1) school administrator. The rating sheet has four components, namely, content, format, presentation and organization, and accuracy and up-to-dateness of information. Outdoor STEM activities on water were rated very satisfactory, with a mean of 3.90 in terms of content, which means that the content that was presented was accurate and precise. The format was also rated very satisfactory with a mean of 3.98, which implies that the format was appropriate, including its prints, illustrations, paper binding, and size and weight. Furthermore, presentation and organization were also rated very satisfactory by the panel of evaluators with a mean of 4.00, which indicates that the material was well organized and planned. Lastly, accuracy and up-to-dateness of information were rated very satisfactory, with a mean of 4.00, which means that the material was timely and relevant to the learners.

3.3 Validation of Outdoor STEM Lesson and Activities on Water for Alignment to STEM Education Principles

The developed outdoor STEM lesson plan and activities were evaluated for their alignment with STEM education principles by four STEM experts through the STEM rubric of Francisco et al. (2024, as cited in Tecson & Salic-Hairulla, 2019). For the betterment of the learning material, their comments and suggestions were considered. Ratings for each of the STEM rubric's criteria were presented in Table 3.3.1.

Table 3.3.1. Summary of the Evaluators' Rating on the Alignment to STEM Education Principles of the Outdoor STEM Lesson and Activities on Water

Components	Mean	Description
Learning Objectives	3.83	Very Satisfactory
Learning Content	3.83	Very Satisfactory
Degree of Contextualization	3.91	Very Satisfactory
STEM Lesson Stages	3.96	Very Satisfactory
Overall Rating	3.88	Very Satisfactory

Note. 1.00-1.79 Not Satisfactory 2.50-3.24 Satisfactory
1.75-2.49 Poor 3.25-4.00 Very Satisfactory

Table 3.3.1 shows evaluators' ratings on the alignment to STEM education principles of the outdoor STEM lesson and activities. The outdoor STEM activities were rated based on the learning objectives, content, degree of contextualization, and STEM lesson stages. The learning objectives were rated 3.83, the learning content was rated 3.83, the degree of contextualization was rated 3.91, and the STEM lesson stages were rated an average of 3.96. All were described as very satisfactory, with an interval ranging from 3.25 to 4.00. This demonstrated that the outdoor STEM lesson and stages had a guaranteed level of quality as an instrument and material for this study.

5. CONCLUSION

The findings of the needs assessment revealed that school administrators and in-service science teachers recognize the benefits of outdoor STEM education. However, their familiarity with the concept is limited. Furthermore, none of the respondents had attended training or seminars on this pedagogical approach, emphasizing the importance of professional development programs and instructional materials. In addition, the validation of the developed outdoor STEM activities on water demonstrated their quality in terms of content, format, presentation and organization, and

accuracy and up-to-dateness of information. Evaluators rated the material as "very satisfactory" across all criteria, indicating its suitability for implementation. Similarly, the assessment of the outdoor STEM activities and the lesson's alignment with STEM education principles were rated "very satisfactory", indicating its success in generating contextualized, inquiry-based learning experiences. Thus, the study emphasizes the potential of outdoor STEM education to enhance science education, provided educators have adequate resources to apply it. The findings also highlight the necessity of creating well-structured, research-based instructional resources to support innovative teaching practices in outdoor STEM education.

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