DEVELOPMENT AND IMPLEMENTATION OF PLACE-BASED LEARNING MODULE ON SOURCES OF ENERGY IN PROMOTING CONCEPTUAL UNDERSTANDING AND ATTITUDE AMONG GRADE 11 STUDENTS

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Abstract

This study aimed to develop and implement a Place-Based Learning (PBL) module on the topic Sources of Energy to promote conceptual understanding and positive attitudes among Grade 11 students. This is particularly necessary as it addresses a significant gap in Philippine educational research on PBL, despite its growing international recognition. The study followed the ADDIE instructional design model and employed both quantitative and qualitative data collection methods. The instruments used—the Conceptual Understanding Test (CUT) and the Energy-Issue Attitude Questionnaire (EIAQ)—demonstrated strong reliability, with KR-20 and Cronbach's alpha values of 0.889 and 0.829, respectively. Findings revealed a significant improvement in students' conceptual understanding after the intervention, with the mean post-test score increasing from 27.07 to 44.96 ($p < .001$). Attitudes toward energy issues remained consistently positive, with qualitative responses indicating deeper environmental awareness and engagement. The module's strong content validity (CVL = 87.06%) and the observed learning outcomes support the effectiveness of PBL as a pedagogical approach.

Keywords: Place-Based Learning, Module, Conceptual Understanding

Introduction

Place-based education, as defined by Sobel (2004), uses local communities and environments as foundations for teaching across subjects, fostering both academic understanding and a sense of relevance. Building on this concept, Place-Based Learning (PBL) connects students' learning experiences to their immediate surroundings, promoting meaningful engagement and environmental awareness.Traditional classroom instruction often fails to connect academic content to real-world issues, contributing to gaps in student performance. Filipino students continue to lag behind their peers internationally, with TIMSS 2019 scores of 297 in mathematics and 249 in science, and PISA 2022 results showing only 23% achieving basic

proficiency in science (Bernardo, 2020; Philstar, 2023). These outcomes highlight the need for instructional approaches that integrate local context to enhance understanding and practical skills.

PBL has shown promise in enhancing environmental stewardship and critical thinking (Sobel, 2004; Litz, 2024), yet most studies focus on developed countries or elementary education, leaving gaps in research on secondary education in the Philippines (Gruenewald, 2003; Dorji et al., 2021). This study addresses these gaps by developing and implementing a PBL module on sources of energy for Grade 11 students, using local DOE data and insights from the Agus 2 Hydropower Plant.

By situating learning in students' communities, this study aims to improve science proficiency, foster environmental awareness, and equip students with practical skills to address local and global energy challenges. The research contributes to the body of knowledge on PBL while providing a localized, adaptable tool for meaningful, real-world learning in Philippine secondary schools.

Research Methodology

This study employed a developmental research design to create and validate a Place-Based Learning (PBL) module on "Sources of Energy" for Grade 11 students. Developmental research involves the systematic design, development, and evaluation of instructional materials, ensuring that the product meets specified criteria for effectiveness. A mixed-methods approach was adopted, combining quantitative measures through pre- and post-tests with qualitative data gathered via interviews to assess both conceptual understanding and attitudes toward energy issues.

The study was conducted at MSU-Saguiaran Community High School, chosen for its proximity to the Agus II Hydroelectric Power Plant, which served as a key local example for the PBL module. Participants included 88 Grade 11 students aged 16–18 years, selected from two sections based on academic performance and readiness for senior high school core science subjects.

Research instruments included a Conceptual Understanding Test (CUT), an Energy-Issue Attitude Questionnaire (EIAQ), and a post-intervention interview guide. The CUT and EIAQ were validated and pilot-tested for content validity and reliability. The PBL module itself was

developed following the ADDIE framework—Analysis, Design, Development, Implementation, and Evaluation—and incorporated localized content, virtual tours, and hands-on activities contextualized to the students' community.

Data collection procedures included pre-testing, a two-week implementation of the PBL module, post-testing, and student interviews. Quantitative data were analyzed using descriptive statistics (mean, median, standard deviation) and paired sample t-tests to measure changes in conceptual understanding and attitudes.

Results and Discussion

This study developed and implemented a Place-Based Learning (PBL) module on Sources of Energy for Grade 11 students using the ADDIE instructional design model. Guided by three research objectives, the study examined (1) the development and validation of the PBL module, (2) students' conceptual understanding and attitudes before and after implementation, and (3) the statistical significance of conceptual learning gains.

Development and Validation of the PBL Module on Sources of Energy

During the Analysis phase, a needs assessment was conducted, which involved (a) a curriculum review based on the K to 12 Senior High School Science standards and (b) a dry run of the PBL module on Sources of Energy, including the reliability testing of the Conceptual Understanding Test (CUT) and the Energy Issue Attitude Questionnaire (EIAQ). Findings revealed that Sources of Energy is explicitly included in the K to 12 SHS curriculum. To ensure alignment, the K–12 learning competencies related to energy sources were reviewed and mapped onto the module's lessons. This guided the formulation of measurable learning objectives and served as the structural foundation of the PBL module. Additionally, two assessment instruments were validated. The Conceptual Understanding Test (CUT) obtained a KR-20 reliability coefficient of 0.889, while the Energy-Issue Attitude Questionnaire (EIAQ) achieved a Cronbach's alpha of 0.829—both indicating strong internal consistency. Prior to their use in the main implementation, these instruments were piloted with Grade 12 students who had previously studied the topic.

Based on insights gathered during the analysis phase, the design and development phases proceeded with the finding that the target competencies are taught during the third and fourth

weeks of the first quarter. Consequently, the developed PBL module was implemented over a two-week period. The learning objectives were aligned with the K–12 Learning Competencies, with each set of competencies addressed within a one-week duration—Week 1 focusing on renewable energy sources and Week 2 on non-renewable energy sources. These objectives were articulated using both higher-order thinking skills (HOTS) and lower-order thinking skills (LOTS) as framed by Bloom's Taxonomy.

The module was to reflect the key processes of place-based learning, including inquiring into place, identifying local challenges, revising and implementing curriculum, building student ownership, collaborating with peers, and measuring outcomes. The module featured contextualized lessons, QR-code-enabled virtual tours, reflective activities, and a culminating PBL task in which students traced how electricity is transmitted from Lake Lanao to their homes. Expert evaluation, conducted using a scale adapted from Manoga (2024), resulted in an overall Content Validity Level (CVL) of 87.06%, exceeding the 70% benchmark set by Noah and Ahmad (2005). This indicates that the module possesses a high level of content validity.

Students' Level of Conceptual Understanding and Attitude Before and After Implementation

In addressing students' conceptual understanding and attitudes, results showed notable improvements following the module's implementation. Pre-test data indicated that 85.23% of students were at the "Beginning" level. After the intervention, 54.54% achieved the "Advanced" level, with the mean score increasing from 27.07 to 44.96. Qualitative reflections revealed enhanced comprehension of energy systems and a deeper connection to local environmental issues. Meanwhile, students' already positive attitudes toward energy conservation slightly improved (pre-test mean = 3.15; post-test mean = 3.22), suggesting reinforcement of existing environmental dispositions rather than a dramatic shift.

The Statistical Significance of Conceptual Learning Gains

To evaluate the statistical significance of learning gains, a paired-samples t-test was conducted. Results showed a significant difference between pre- and post-test scores ($t = -19.95$, $p < .001$), leading to the rejection of the null hypothesis. This demonstrates that the PBL module had a substantial positive impact on students' conceptual understanding. These findings align

with previous studies (Dorji et al., 2021; Asakle & Barak, 2022; Sobel, 2004), which emphasize that contextualized learning deepens understanding and promotes meaningful engagement.

Table 1. Descriptive Statistics on Students' Conceptual Understanding of the PBL Module

		Mean	Standard Deviation
Conceptual Understanding of PBL Module	*Pre-test*	27.07	9.14
	Post-test	44.96	9.87

Conclusion

The study concludes that the Place-Based Learning (PBL) module developed through the ADDIE model effectively enhanced Grade 11 students' conceptual understanding of Sources of Energy. The significant gains in post-test scores, supported by both quantitative and qualitative data, demonstrate that contextualized learning grounded in local environments promotes deeper comprehension of scientific concepts. The high validity and reliability of the instruments, along with strong expert evaluation of the module, confirm that the instructional design is instructionally sound and contextually meaningful for senior high school learners.

In light of these findings, several recommendations are advanced. First, wider implementation of the developed PBL module is encouraged, particularly in schools with similar geographic characteristics or contextual relevance, such as those situated near power-generating facilities or key environmental sites. Second, teacher training and orientation in Place-Based Learning should be provided to equip educators with the skills necessary to meaningfully integrate local content and community resources into instruction. Lastly, future researchers are encouraged to explore the effectiveness of PBL in other STEM-related topics, across different grade levels, or within more diverse learning contexts to further expand its applicability and impact.

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