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# Strengthening Science Vocabulary Skills through Gamification and Hands-on Learning: A Community-based Action Research

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A B S T R A C T

This community-based action research arises from the observed challenges in science vocabulary acquisition among students, identified through the observation made by science pre-service teachers and a science teacher. Limited vocabulary was found to hinder students' comprehension of scientific concepts and their engagement in learning activities. To address this issue, an intervention integrating gamification and hands-on learning was developed. Gamified activities were designed to make learning more interactive and enjoyable, while hands-on tasks aimed to contextualize vocabulary in practical applications. This community-based approach focused on creating strategies tailored to student needs, fostering a more dynamic and engaging science learning environment. The study highlights the importance of observation-driven intervention to address specific educational challenges effectively.

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## INTRODUCTION

In science education, the basic goal is forming the analytical and problem-solving capacity of the student. One of the most significant hurdles to successful science comprehension is the challenge of learning content-specific words that are typically abstract, technical and conceptually intensive (Cohen, 2012). Science vocabulary is not just memorization of words - It is understanding and being able to explain scientific concepts and communicate complicated ideas with precision. This lexical gap is particularly wide at the school level, where young exposure and the embrace of the scientific lexical are scarce (Venida, 2021). Therefore, novel and appealing pedagogies should be developed to assist students' vocabulary learning.

Gamification and experiential learning have become popular and effective teaching strategies in response to these issues. Gamification, defined as the use of game mechanics in non-gaming environments, has been demonstrated to enhance student engagement, motivation, and long-term memorization of vocabulary (Zainal, 2023; Thiagarajah et al., 2022). For vocabulary teaching, spike learning, using fun learning tools like Kahoot, Quizlet, and online simulation will not only generate interest but also provide repetitive as well as contextual use of vocabulary (Waluyo & Bakoko, 2021; Pham, 2022). In science teaching, where procedural and conceptual knowledge are interrelated, a learning experience which has gamified aspects leads to a higher cognitive presence (Macayan et al., 2022). According to Díaz et al. (2022), game design can turn the traditional passive practice of vocabulary instruction into an interactive activity that promotes peer learning and autonomy.

Hands-on learning, deriving from the theories of experiential learning, also supplements gamification strategies due to opportunities for learners to engage with scientific materials, models, and phenomena practically. Tactile and real-world experiences help students grasp the concepts and make vocabulary become more natural within valuable contexts (Bantaokul & Polyiem, 2022). These active learning strategies allow for inquiry-based learning and provide context in a community-based educational experience where resources and cultural backgrounds differ.

New research illustrates the combined effectiveness of gamification and experiential learning in science education. Alahmari et al. (2023) discovered that gamification not only increased retention of vocabulary but also influenced students' cognitive and affective learning in science education. In addition, adaptive gamification approaches that are responsive to students' potential and pace of learning strongly foster motivation and learning effectiveness (Zourmpakis et al., 2023). Abbassyakhrin et al. (2024) believe that metacognitive strategies in conjunction with gamification would strengthen students' critical thinking abilities, particularly when implemented in interactive, authentic contexts.

For community-based education, where the relevance of the context and inclusivity of the learner is crucial, the use of gamification and experiential learning provides accessible, low-cost, and participatory options for the enhancement of scientific literacy. Sappaile (2024) highlights increased excitement, as well as engagement, by elementary students in a science lesson when gamified environments are present. Furthermore, a school-based, action-based approach provides teachers with the flexibility to implement an individually customized vocabulary program that is specific to the needs of their students as well as to community resources (Stringer, 2013). This is reinforced by findings from Asio et al. (2023), which emphasized the importance of aligning student interests and skills—such as teaching, conservation, and safety—with meaningful community service activities. Their study revealed that service-learning, when designed around students' motivations, not only enhances community involvement but also provides a practical context for applying academic knowledge, such as science vocabulary, in real-world settings.

The service-learning initiative addresses pedagogical and sociocultural demands- enabling inclusive education, one that respects and embraces learners' contexts, using gamification and hands-on strategies to enrich theory in context-based science education, represents an innovative intervention targeted at an underserved population. The originality of this method is to culturally localize gamifying learning while not depending on powerful hands-on technology, which shows the flexibility of these innovative pedagogies in a resource-limited context. More generally, this work is not only a way to enhance the quality of education but also to redress the imbalances in the availability of good deeds in education and the learning of science.

Strengthening science vocabulary among learners poses unique challenges, particularly in geographically isolated and disadvantaged areas where technological resources are limited. Anchored on community-based action research, this study was carried out in Sitio Mampueng, Old Cabalan, an upland community in Olongapo City where learners have limited access to digital learning resources. To address this lack of science literacy, particularly in the learning of vocabulary, this paper incorporates gamification and hands-on learning in science to make the science vocabulary easier to access and more engaging for the students.

## IMPLEMENTATION AND METHODS

This paper represents the dedication to quality education and providing relevant extension programs for the Bachelor of Secondary Education (BSEd) major in Science as represented by its organization, the Interactive Organization of Natural Sciences (IONS). The primary aim of this paper is to address scientific literacy needs, specifically at its first level, nominal scientific literacy, by providing relevant community extension programs in the target community.

This community-based action research followed a structured framework, as shown in Figure 1. The process involves five stages: identifying needs, training program implementers, implementation of program, monitoring, and evaluation.

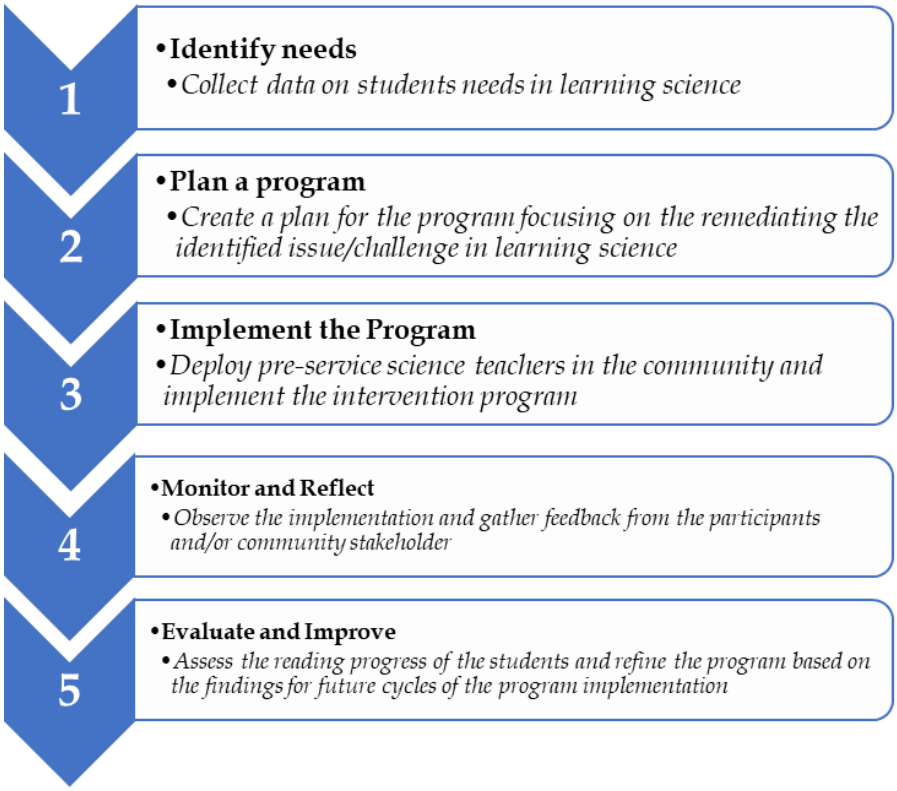


**Figure 1. Conceptual Flow of the Study**

## RESULTS AND DISCUSSION

This community-based action research was initiated through the efforts of the science education students of Gordon College, embodied by their organization, the Interactive Organization of Natural Sciences (IONS). To realize one of the UN Sustainable Development Goals, specifically SDG 4: Quality Education, this action research resulted in a community extension program by providing an intervention program integrating gamification and hands-on learning to strengthen the science vocabulary skills of students in the Sitio Mampueng, Old Cabalan, Olongapo City. Though this research follows the structured process as seen in Figure 1, this paper will only present four phases since the program is still implemented, which will be evaluated at the end of its proposed deadline.

### *Identifying the Needs*

During the community extension activity of the institution, the science pre-service teachers are tasked to observe the student and gather data focusing on the needs of the student in learning science. The pre-service teachers were asked to make a report to reflect on their observations. The documents were analyzed thematically, leading to four major themes: (1) the Language Barrier in Science Learning, (2) the Disconnect between Concept and Real-Life Application, (3) the Eagerness to learn amid Challenges, and (4) the Necessity for Intervention Program.

***Language Barrier in Science Learning***

The students' limited proficiency in the English language hinders the student's ability to recognize and understand science vocabulary. Science pre-service teachers noted that students struggle to differentiate between scientific terms and their everyday meanings, such as confusing "gas" with "gasoline". This barrier impacts their comprehension and flow of lessons, making it challenging to introduce new scientific concepts effectively.

Here are some notes from the observation records of the science pre-service teachers:

> *"I observed that students of IEM are struggling in the usage of the English language." – Science Pre-service Teacher 1.*
>
> *"Most of the students do not know common scientific terms such as solid, liquid, and gas. Some students thought that 'gas' is the same as gasoline or LPG." – Science Pre-service Teacher 2.*
>
> *"They do not use English terms very often and have difficulty relating scientific concepts to simple things around them." – Science Pre-service Teacher 3.*

***Disconnect between Concept and Real-Life Application***

Students face challenges in relating science vocabulary words to their everyday experiences. This lack of contextual understanding prevents them from fully grasping the scientific concept, highlighting the need for science vocabulary acquisition. In the levels of scientific literacy of Bybee (1997), nominal scientific literacy is indicated by the ability of the individual to identify scientific terms and express naïve explanations. In the case of the students being observed, there is a need for a targeted program for achieving nominal scientific literacy since the students have difficulty identifying scientific terms.

Here are some notes from the observation records of the science pre-service teachers:

> *"It's really hard for them to give some examples of the three states of matter we taught to them." – Science Pre-service Teacher 1.*
>
> *"We had a hard time teaching them the phase changes for them to understand what's happening in the water cycle." – Science Pre-service Teacher 2.*
>
> *"In order for them to understand our lesson better, we need to explain and give lots of examples related to the terms we're using." – Science Pre-service Teacher 3.*

***Eagerness to learn amid Challenges***

Despite the difficulty in identifying basic scientific terms, students demonstrate curiosity and eagerness to participate in lessons. Science Pre-service teachers observed active engagement, with students asking questions to clarify concepts they struggled to understand. This enthusiasm indicates a learning potential, provided the proper support is offered.

Here are some notes from the observation records of the science pre-service teachers:

> *"My observations with the students are that they are outgoing and curious/eager to learn." – Science Pre-service Teacher 1.*

*"Even though they are having a hard time analyzing our topic, they are still participating and asking questions for better understanding." – Science Pre-service Teacher 2.*
*"They pay attention to our discussion even if they are chatty at times." – Science Pre-service Teacher 3.*

***Necessity for Intervention Program***

The science pre-service teachers emphasized the need for an intervention program to address these challenges. Suggested strategies include gamification to make learning interactive and engaging, as well as hands-on activities to contextualize vocabulary. Such interventions are viewed as essential for improving both students' science vocabulary and their overall comprehension of scientific concepts.

Here are some notes from the observation records of the science pre-service teachers:

*Yes, I believe that the students of IES need an intervention program to further enhance their science vocabulary." – Science Pre-service Teacher 1.*
*"An intervention program would be helpful to improve their understanding and use of scientific vocabulary, making it easier for them to grasp and relate to the concepts being taught." – Science Pre-service Teacher 2.*
*"It would be easier for them and for the teacher to have a great flow of discussion if they undergo a program that can help them in learning different things, especially in science."– Science Pre-service Teacher 3.*

The analysis revealed a substantial challenge in science vocabulary acquisition caused by language barriers and a lack of conceptual and contextual alignment or relating scientific terms to their everyday experiences. However, students' curiosity and eagerness to learn present an opportunity for improvement through intervention programs that integrate gamification and hands-on learning.

***Planning a Program***

The IONS executive officers, who were the science pre-service teachers, were tasked to plan a program focusing on improving the student's understanding and usage of scientific terms through gamification and hands-on learning. The program will be implemented every Friday from October 2024 to March 2025. Interactive sessions will be implemented, combining games and hands-on learning to make learning engaging and relatable. Science pre-service teachers will plan different activities weekly, which will ensure the contextualization of scientific concepts and relating concepts to daily living.

This program will be known as "*Project IONS:* Interactive Opportunities for Nurturing Science Vocabulary". The main objective of the project is to provide the students with contextualized learning experiences by implementing gamification and hands-on activities to address language and vocabulary barriers and foster understanding of scientific concepts in a real-world context, which will also develop not only the nominal scientific literacy but also functional and conceptual scientific literacy, which will enable students to understand and use scientific terms, and understanding the conceptual scheme of science.

**Implementing the Program**

In collaboration with the master teacher of Iram II Elementary School, the project commenced last October 18, 2024. The project will be implemented every Friday until the end of March 2024. However, due to weather disturbances and cancellation of classes, some sessions are cancelled.

The "*Project IONS*: **I**nteractive **O**pportunities for **N**urturing **S**cience Vocabulary" is a community outreach initiative of the Interactive Organization of Natural Sciences (IONS), the student organization of BSEd-Science students. IONS officers, under faculty supervision, engaged the students with an interactive lesson delivered using gamified techniques, including picture diagrams, process identification, and open discussions, making the concepts engaging and relatable. These activities encouraged participation and critical thinking while addressing science vocabulary challenges. The first day of the project/program concluded with refreshments and prizes for the students. This fosters a joyful and engaging learning environment.

**Figure.2 The Photo on the Left is the IONS President Presiding Over a Short Discussion, the Photo on the Right is the Opening Activity of Project YUGTO Year 2 and Project IONS**

*Monitoring and Reflection*

The monitoring phase of this action research involved continuous observation and documentation of student engagement, participation, and progress during the implementation of "Project IONS". Facilitators will regularly assess student understanding through interactive discussions, gamified activities, and their ability to use science vocabulary in context. The reflection phase provided an opportunity for both science pre-service teachers and educators to identify the strengths and challenges of the activities. Science pre-service teachers noted improvements in the students' enthusiasm and participation, as well as their growing familiarity with the scientific terms. To better assess this part, the succeeding session will focus on providing a pre-test before integrating the gamified and hands-on activities in the familiarization of scientific terms. Such data will be presented once the project is evaluated. It is also important to note that the words or science vocabulary being taught in each session are based on the science competencies in the science curriculum.

## CONCLUSIONS AND RECOMMENDATIONS

The findings from this action research highlight the pressing need to address the challenge in science vocabulary acquisition among students of the community, particularly those arising from language limitations and difficulty in relating scientific terms to real-life applications. While these challenges hinder students' comprehension and engagement, their eagerness to learn and curiosity present an opportunity to improve their scientific literacy through targeted intervention, which integrates gamification and hands-on activities in science learning.

"Project IONS" effectively demonstrate how gamification and hands-on activities can bridge the learning gap and create more engaging and relatable learning experiences for learners. To further enhance this program's impact, it is recommended that future sessions include more contextualized examples, involve more gamified and collaborative activities, and integrate periodic evaluations every after session. Expanding this kind of initiative to underserved communities could amplify its positive effect on science education.

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**REFERENCES**

Abbassyakhrin, A., Setyosari, P., Zubaidah, S., & Sulton, S. (2024). Gamification and academic ability impact on students' meta-cognition and critical thinking skills. Research and Development in Education (Raden), 4(1), 127–137.

Alahmari, M., Jdaitawi, M., Rasheed, A., Abduljawad, R., Hussein, E., Alzahrani, M., & Awad, N. (2023). Trends and gaps in empirical research on gamification in science education: A systematic review of literature. Contemporary Educational Technology, 15(3), ep431.

Asio, J. M. R., Sardina, D. P., & Olaguir, J. A. O. (2023). Student's community service involvement: Implications for a sustainable community extension service. Asian Journal of Community Services (AJCS), 2(1), 65-76.

Bantaokul, P., & Polyiem, T. (2022). The use of integrated 5Es of inquiring-based learning and gamification to improve grade 8 student science learning achievement. Journal of Educational Issues, 8(1), 459.

Bybee, R. W. (1997). Achieving scientific literacy: From purposes to practices. Heinemann, 88 Post Road West, PO Box 5007, Westport, CT 06881.

Cohen, M. (2012). The importance of vocabulary for science learning. Kappa Delta Pi Record, 48(2), 72–77. https://doi.org/10.1080/00228958.2012.680372.

Díaz, D., Pérez, M., Ramírez, E., & Aristega, J. (2022). Case study: Gamification as a strategy for vocabulary learning in university students. Ciencia Latina Revista Científica Multidisciplinar, 6(6), 7992–8005.

Macayan, V., Baguistan, D., & Golias, J. (2022). Game-based activities and gamification in the mastery of science process skills: A systematic literature review. EPRA International Journal of Multidisciplinary Research (IJMR), 388–398. https://doi.org/10.36713/epra10950.

Pham, Q. (2022). Maximizing vocabulary retention with gamification tools. Scientific Journal of Tan Trao University, 8(4). https://doi.org/10.51453/2354-1431/2022/837.

Sappaile, B. (2024). The impact of gamification learning on student motivation in elementary school learning. Scientechno Journal of Science and Technology, 3(2), 1–13. https://doi.org/10.55849/scientechno.v3i2.1050.

Stringer, E. T. (2013). Action Research (4th ed.). SAGE Publications.

Thiagarajah, K., Ng, M., Jeyaraja, S., Gunasehgaran, V., & Maniam, M. (2022). Effectiveness of gamification tool in teaching vocabulary. International Journal of Academic Research in Business and Social Sciences, 12(9). https://doi.org/10.6007/ijarbss/v12-i9/14604.

Venida, A. (2021). Integration of explicit vocabulary instruction in teaching science. Journal of Research Policy & Practice of Teachers & Teacher Education, 11(2), 1–16. https://doi.org/10.37134/jrpptte.vol11.2.1.2021.

Waluyo, B., & Bakoko, R. (2021). Vocabulary list learning supported by gamification: Classroom action research using Quizlet. The Journal of AsiaTEFL, 18(1), 289–299. https://doi.org/10.18823/asiatefl.2021.18.1.20.289.

Zainal, N. (2023). University students' perspectives on gamification in vocabulary learning: A literature review. Malaysian Journal of Social Sciences and Humanities (MJSSH), 8(5), e002314. https://doi.org/10.47405/mjssh.v8i5.2314.

Zourmpakis, A., Kalogiannakis, M., & Papadakis, S. (2023). Adaptive gamification in science education: An analysis of the impact of implementation and adapted game elements on students' motivation. Preprints. https://doi.org/10.20944/preprints202306.1513.v1.