

GAMIFYING SCIENTIACABULARY (SCIENCE VOCABULARY): A PATH TO ENHANCED UNDERSTANDING AND RETENTION AMONG FOURTH GRADE STUDENTS

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Abstract

The study entitled Gamifying Scientiacabulary (Science Vocabulary): A Path to Enhanced Understanding and Retention among Fourth Grade Students aimed to analyze the impact of interactive games on the acquisition of science vocabulary for the learner's enhanced comprehension and retention. By doing so, the researcher provided the Scientiacabulary word booklet and game manual that improved the academic performance and students' engagement in science 4. The study utilized mixed-methods research, incorporating qualitative and quantitative methods. Throughout the study, a sequential exploratory research design, combining phenomenological and quasi-experimental techniques, was used. Qualitative interview analysis indicated an emerging theme: There are very limited resources that are suited to the needs and levels of the learners. It found that content, visual and text components, interactivity, and evaluation are essential to effective teaching materials. The researcher designed the Scientiacabulary Word Booklet and Game Manual based on the Matatag Curriculum's Learning Competencies for content alignment and expert validation. Scientiacabulary Word Booklet and Game Manual in Science 4 had a high weighted mean score and standard deviation. Science teacher respondents verbally interpreted them as highly acceptable in terms of objective, content, adaptability, and aesthetic value. All factors were evident in the developed material, which helped students learn easily and effectively. The students' participation, focus, attention, and attitude toward games had a high weighted mean score, indicating a great extent. Furthermore, learners' pre-test and post-test ratings shifted from satisfactory to very satisfactory. Data shows that the Scientiacabulary word booklet and game manual elevated learning and performance. It was concluded that there is a significant difference between the two. The pre-test scores are substantially lower than the post-test. The alternative is accepted since the null hypothesis, "There is no significant difference in the level of performance of students in terms of pre-test and post-test," is rejected. Through the conclusion drawn from the findings, the researcher recommended that the study be proposed as one of the school projects and may be applied in other grade levels and different learning areas.

Keywords: Science Vocabulary; Game-Based Learning; Student's Performance; Student's Engagement; Fourth Grade

1. INTRODUCTION

Philippine education has strived to improve scientific education. The DepEd K-12 curriculum aims to teach students science and critical thinking. These people are anticipated to boost the nation's economy and society. Numerous studies show that Filipino pupils struggle with scientific instruction, particularly language

and comprehension.

According to the 2019 Program for International Student Assessment (PISA) results, the Philippines ranks 79th out of 89 nations in science literacy, scoring 353, below the OECD average of 489. The 2018–2020 National Achievement Test (NAT) results show that grade 4 Filipino students continue to do poorly in science, with an average score of 45.14% to 51.16%. In the 2019 Trends in International Mathematics and Science Study (TIMSS), the Philippines scored 297 in science, behind the global average of 477. The Philippines rated fifty-eighth out of sixty-four countries surveyed.

Philippine primary schools need to prioritize science (Africa, M. 2022). The curriculum often covers many other subjects, limiting time for scientific investigation and vocabulary expansion. Science education depends on vocabulary to understand complex scientific concepts. Students need a robust scientific vocabulary to comprehend, assess, and communicate science. Scientific literacy, a 21st-century skill, requires a rich scientific vocabulary.

The importance of vocabulary in science teaching cannot be understated. Numerous studies indicate that children with extensive science vocabulary routinely surpass other pupils in science exams. Additionally, these learners display higher levels of competence while engaging in scientific studies and a more profound comprehension of scientific notions. Furthermore, comprehensive scientific terminology has been associated with greater scholastic performance, heightened student drive, and expanded professional prospects in the domains of science, technology, engineering, and mathematics (STEM).

Nevertheless, the process of acquiring a scientific language can be complex, especially for learners who are just beginning their scientific education. The intricacy and subtlety of scientific terminology can be overpowering, resulting in a situation referred to as "vocabulary poverty." Conventional learning materials and instructional resources may need more ability to captivate or involve students sufficiently, thereby failing to inspire them to acquire and enhance their scientific vocabulary. This behaviour is especially alarming, as it can establish a harmful cycle of science uncertainty, decreased academic performance, and lowered career ambitions.

As an answer to this complexity, teachers and experts have been investigating creative ways to improve the growth of science vocabulary. An effective method is using game-based instruction, which have demonstrated potential in creating a captivating and dynamic educational atmosphere. Recently, there has been an increase in enthusiasm for utilizing game-based instruction as a method to improve science vocabulary acquisition. These games have been proven to be an efficient instrument in boosting pupil participation, enthusiasm, and academic achievements in science education. Through harnessing the engaging and creative aspects of games, teachers may cultivate a comprehensive vocabulary-learning encounter that fosters active participation, inspires cooperation, and nurtures a passion for scientific investigation.

That said, it is necessary to investigate the performance of game-based instruction in improving the acquisition of scientific vocabulary, particularly among fourth-grade students in the Philippines. The purpose of this research aims to analyze the impact of interactive games on the acquisition of science vocabulary. By doing so, it intends to provide evidence-based instructional methods that can improve the scientific literacy and academic performance of students in the Philippines and beyond.

1.1 Objectives of the Study

The purpose of the study was to develop a Scientiacabulary Word Booklet and Scientiacabulary Game manual in Science 4 to Enhance their Science Vocabulary Knowledge. Specifically, it sought to answer the following questions:

1. What are the challenges teachers face in teaching vocabulary acquisition, understanding and retention among students in the current instructional methods?
2. What are the elements of the instructional materials that have been developed?

3. What is the level of acceptability of the developed instructional materials in Science 4 in terms of:
 - 3.1 objective;
 - 3.2 content;
 - 3.3 adaptability; and
 - 3.4 aesthetic value?
4. What is the extent of student's engagement in terms of:
 - 4.1 participation;
 - 4.2 focus and attention; and
 - 4.3 attitude towards games?
5. What is the level of students' performance in terms of:
 - 5.1 pre-test; and
 - 5.2 posttest?
6. Is there a significant difference in the level of performance of students in terms of:
 - 6.1 pre-test; and
 - 6.2 posttest?
7. What insights and implications can be derived based on the results of the study?

2. METHODOLOGY

2.1 Research Design

The study utilized a mixed-methods research technique, combining qualitative and quantitative methods. The researcher employed a sequential exploratory research design, namely a combination of phenomenological and quasi-experimental approaches, throughout the course of the research.

The mixed-methods approach, specifically the sequential exploratory research design, was chosen to address the complex nature of improving science vocabulary learning. This design was particularly appropriate as it allowed for an in-depth exploration of challenges, which is the qualitative phase, followed by empirical testing of the developed materials in the quantitative phase.

The phenomenological approach was suitable for uncovering the specific challenges students face in science vocabulary acquisition through semi-structured interviews with teachers. This phase provided essential insights that directly informed the design of the Scientiacabulary Word Booklet and Game Manual, ensuring they were tailored to real educational needs.

Following the qualitative exploration, the quasi-experimental approach in the quantitative phase was appropriate for testing the effectiveness of the developed instructional materials. The pretest-posttest design allowed for the measurement of changes in student performance and engagement before and after the intervention. This approach provided a controlled method to evaluate the impact of the Scientiacabulary Word Booklet and Game Manual on students' science vocabulary acquisition and retention.

The research design combined qualitative insights with quantitative data, ensuring that the developed materials were both theoretically sound and practically effective. This made the study's findings reliable and applicable to real-world educational settings.

2.2 Respondents of the study

The respondent of this study was composed of one hundred (100) students in Grade 4 at Pila Sub-Office all in experimental group. They were exposed on the use of Scientiacabulary Word Booklet and Scientiacabulary

Game Manual in science 4 specifically in the First Quarter.

One hundred fifty (150) science teachers from the Pila Sub-Office were also among the respondents. The respondents are asked to complete an online questionnaire checklist, including comments and suggestions, to assess the impact of using the Scientiacabulary Word Booklet and Scientiacabulary Game Manual as a teaching strategy on students' academic performance in science 4.

Participants for this study consisted of 8 Science teachers handling science for the qualitative data.

2.3 Research Instrument

As part of the qualitative phase of this study, semi-structured interviews were conducted with 8 science teachers who are handling Grades 3 to 6 from Pila Sub-Office. The purpose of these interviews was to gain an in-depth understanding of the challenges students face in learning science vocabulary, particularly in terms of acquisition, understanding, and retention.

The interview focused on two key questions: the difficulties teachers faced in helping students acquire and learn vocabulary, any complaints or feedback students provided about the handed materials, and how teachers addressed such feedback. The interviews were recorded, transcribed, and analyzed using Colaizzi's phenomenological technique. This process involved extracting significant statements, formulating meanings, and organizing them into themes. These themes informed the development of the Scientiacabulary Word Booklet and Game Manual, ensuring the materials addressed the identified challenges.

For the quantitative analysis of this study, the researcher utilized a researcher-made questionnaire answered by one hundred fifty science teachers who are teaching in the Pila Sub-Office to determine the extent of the utilization of Scientiacabulary Word Booklet and Scientiacabulary Game Manual as a teaching strategy. The said questionnaire has three parts. The first part deals with the profiling of the teacher-respondents and the second part deals with the acceptability of Scientiacabulary Word Booklet and Scientiacabulary Game Manual in terms of objectives, content, adaptability, and aesthetic value as rated by science teachers. The third part of the questionnaire gathered qualitative feedback from teachers. The following legends was used on Part II.

Weight	Range	Verbal Interpretation
4	3.26- 4.00	Highly Acceptable
3	2.51- 3.25	Acceptable
2	1.76- 2.50	Slightly Acceptable
1	1.00-1.75	Not Acceptable

Part III deals with the student's engagement in terms of participation, focus and attention, and attitude towards games rated by science teachers. The following legends was used on Part III.

Weight	Range	Verbal Interpretation
4	3.26- 4.00	Great Extent
3	2.51- 3.25	Moderate Extent
2	1.76- 2.50	Minimal Extent
1	1.00-1.75	Very Minimal Extent

The frequency of responses of the evaluators was used in defining the status of the developed and validated intervention made by the researcher, which is the Scientiacabulary Word Booklet and Scientiacabulary Game Manual, as well as defining the extent of the student's engagement.

A test instrument is constructed to measure the performance of the respondents. The pretest consists of fifty (50) items given to the students in science prior to introducing the use of Scientiacabulary Word Booklet and Scientiacabulary Game Manual and fifty items was given after the implementation of the usage of the developed material, wherein the result is used to determine if there is an improvement in their academic performance.

The researcher used the Department of Education Mastery level to assess the learner's performance in the pre-test and the post-test, providing a standardized benchmark for evaluating the effectiveness of the educational interventions.

Score	Mastery Level
41-50	Outstanding
31-40	Very Satisfactory
21-30	Satisfactory
11-20	Fairly Satisfactory
0-10	Did Not Meet Expectation

2.4 Analysis of Qualitative Data

A qualitative methodology was employed to build an empirical foundation for developing the instructional material. A qualitative analysis was conducted to examine the issues that instructors encounter in relation to the current teaching materials. The data obtained from the analysis served as the foundation for the subsequent part of the study. The information collected during the qualitative phase was transcribed in a narrative format. The data collected from participants' narratives were evaluated and categorized according to Colaizzi's phenomenological technique. Codes were created from the responses of the participants, and themes subsequently formed. The themes of the research are determined by the participants' subjective viewpoints on the effectiveness of the current learning material and their personal experiences with it. It served as the foundation for the educational resource that was created to meet the existing needs.

The instructional material was designed with a focus on the outcomes identified during the analysis portion of the process which was the emerging themes from the statements of teachers from the in the interview. The researcher devised an innovative design to alleviate some instructional material elements that impact the learning performance of the intended users. During the development phase, the design was implemented by referencing the most recent sources. The educational material came from reliable sources. The researcher diligently utilized all available resources and exerted maximum effort to ensure that the educational material was both realistic and practical.

The instructional materials are examined and evaluated to improve their quality before being sent to the students who are supposed to utilize them. This occurs after the materials have been prepared. The material was evaluated by the expert validators in terms of its content, objective, adaptability, and aesthetic quality. A Likert scale with four points was utilized by the researcher in order to evaluate the participants' opinions on the quality of the educational content that was developed.

A preliminary examination was administered to pupils in the fourth grade in order to evaluate the efficacy of the educational material that was developed. After the intervention, a posttest was carried out with the Scientiacabulary booklet serving as the instructional resource for the fourth-grade science course. The difference between the pretest and posttest results confirmed the effectiveness of the instructional materials in improving the learners' performance.

2.5 Statistical Treatment of Data

To interpret the data effectively, the proponent employed the following statistical treatment.

Mean and Standard Deviation- The mean provides a clear summary of the data by presenting a single number that reflects the average. The standard deviation quantifies the dispersion of the data, providing insights into its uniformity, assisting in risk assessment, and facilitating statistical analysis. The combination of the mean and standard deviation provides a full representation of the data, enabling researchers to make relevant inferences and effectively address research inquiries. The research's goal is to assess the degree of acceptability of the Scientiacabulary Word Booklet and the Scientiacabulary Game Manual based on their objectives, content, adaptability, and aesthetic value. Additionally, the study examined the level of student engagement in terms of participation, focus, attention, and attitude toward the games.

Frequency and Percentage- A frequency and percentage distribution are a graphical representation of data that displays the individual proportions of observations for each item of data or collection of data points. This type of distribution is also known as a frequency scatter chart. Survey response and data frequency analysis are quite helpful when it comes to describing the relative frequency of variables. This technique was utilized to assess the learner's level of academic competence by examining the learner's results on both the pre-test and the post-test.

T-test- The main objective of doing a t-test is to ascertain if there is a statistically significant disparity in performance scores (or any measurable variable) prior to and following an intervention or procedure. This study aimed to assess the statistical significance of the difference in student performance levels between the pre-test and posttest.

3. RESULTS AND DISCUSSION

This section presents the analysis and interpretation of the results of the researcher's survey findings. This section also aims to answer the objectives as a basis to determine the influence of the Scientiacabulary word booklet and game manual.

1. What are the challenges teachers face in teaching vocabulary acquisition, understanding and retention among students in the current instructional methods?

Table 1. Challenges Encountered by The Teachers in Addressing the Demands And Requirements Of Vocabulary Acquisition And Learning Among Students

Formulated Meanings	Theme Cluster	Emerging Theme
Teachers face difficulties due to students' limited vocabulary, difficulty in pronunciation, and lack of resources	Resource Limitations and Pronunciation Challenges	Challenges with Vocabulary Acquisition
Existing materials are often of poor quality and fail to engage students effectively.	Issues with Quality and Engagement in Materials	Ineffective and Unengaging Learning Materials
Teachers often face challenges due to inadequate clear and related images in the materials.	Inadequacy of Clear and Related Images	Lack of Visual Clarity and Relevance

Science teachers from Grades 3 to 6 in the Pila Sub-Office were interviewed to identify vocabulary

teaching challenges. Participants had diverse qualifications and experience levels, revealing key issues and areas for improvement. Analysis using phenomenological and quasi-experimental approaches identified three main clusters related to vocabulary acquisition, comprehension, and retention. These clusters point to critical needs in instructional materials and suggest areas for targeted interventions to improve educational outcomes and teaching practices.

Moody (2019) emphasizes that a solid understanding of scientific terminology is crucial for grasping scientific concepts and engaging in discussions. The study highlights the significance of directly teaching scientific language to students, which enhances their ability to understand and apply concepts effectively. Early vocabulary acquisition is particularly important for young learners.

Nguyen, P., & Walker, S. (2022) study analyzed how student feedback led to the enhancement of educational resources, particularly in science education. Students identified specific areas where materials were lacking, such as in the clarity of explanations and visual support. Teachers responded by revising materials and integrating multimedia elements, which resulted in higher student satisfaction and better learning outcomes.

2. What are the elements of the instructional materials that have been developed?

Table 2

Elements of the instructional materials that have been developed in terms of concepts and components

Elements
Content
Visual and textual elements
Interactivity
evaluation

The developed instructional materials were based on qualitative interviews and aligned with the MELCs from the MATATAG curriculum. Visual and textual elements use colored visuals and text to enhance understanding and retention, as supported by research on the benefits of visual aids. Interactivity, crucial for engagement and retention, was incorporated to support various learning styles and foster collaboration. Evaluation ensured alignment with learning objectives and improved effectiveness, highlighting the role of assessment in boosting student engagement and outcomes.

To effectively include elements and components for the different scientific teaching tools and materials for fourth grade, it's important to closely examine their content, visual and textual elements, interactivity, and evaluation, as well as their designs and characteristics. This analysis aimed to understand the strengths, weaknesses, and effectiveness of these resources in promoting student learning and engagement. By

evaluating how well these tools align with educational standards and cater to diverse learning styles, educators can ensure that the materials not only convey scientific concepts effectively but also captivate and motivate students. Additionally, examining the usability and accessibility of these tools helps identify potential barriers and opportunities for enhancement, ultimately leading to more effective and engaging science education.

Derwing and Munro (2021) explored the challenges students face with pronouncing scientific terms, emphasizing the need for effective pronunciation strategies. Smith and Wilson (2023) highlighted that outdated or poorly designed educational materials can decrease student motivation and learning. Kim and Lim (2022) found that low-quality images in instructional materials can hinder student engagement and comprehension.

3. What is the level of acceptability of the developed instructional materials in Science 4 in terms of:

- 3.1 objective;
- 3.2 content;
- 3.3 adaptability; and
- 3.4 aesthetic value?

Table 3

Level of acceptability of the developed instructional materials in Science 4 in terms of objective

Statements	Mean	Sd	Verbal Interpretation
The Scientiacabulary Games...			
1. contains clearly defined objectives for learning	4.000	.000	Highly Acceptable
2. utilizes instructional materials that are directly related to the specified learning objectives.	4.000	.000	Highly Acceptable
3. provides precise objectives that aim to enhance a particular skill	3.713	.454	Highly Acceptable
4. uses lessons that include objectives that are both realistic and achievable.	3.800	.401	Highly Acceptable
5. applies instructional materials that effectively communicate specific learning objectives and demonstrate measurable mastery goals.	4.000	.000	Highly Acceptable
Weighted Mean	3.903		
SD	0.275		
Verbal Interpretation	Highly Acceptable		

Legend: 3.26-4.00=Extremely Acceptable; 2.51-3.25=Acceptable; 1.76-2.50=Slightly Acceptable; 1.00-1.75=Not Acceptable

The Scientiacabulary Games contains clearly defined objectives for learning, utilizes instructional materials that are directly related to the specified learning objectives and applies instructional materials that effectively communicate specific learning objectives and demonstrate measurable mastery goals.

The degree of acceptance of the developed instructional materials in Science 4 in terms of objective reached a weighted mean score of 3.903 and a standard deviation of 0.275 and was verbally interpreted as

Highly acceptable among the Science teachers.

In summary, the Scientiacabulary Word Booklet and Scientiacabulary Game Manual, applied instructional materials that effectively communicate clearly defined objectives for specified learning and demonstrate measurable mastery goals.

In 2023, Liu and Bera conducted a study examining the effective use of learning objectives in developing interactive learning tools. The study demonstrated that by intentionally connecting tasks and assessments with intended outcomes, incorporating learning objectives in interactive materials enhances their educational effectiveness. The authors provided examples of interactive materials in which explicit goals led to increased student engagement and improved learning efficacy.

4. What is the extent of student's engagement in terms of:
 - 4.1 participation;
 - 4.2 focus and attention; and
 - 4.3 attitude towards games?

Table 4

Level of acceptability of the developed instructional materials in Science 4 in terms of content

Statements	Mean	Sd	Verbal Interpretation
The Scientiacabulary Games...			
1. assist in the careful examination of educational concepts, theories, and concerns through the methodical use of Science Vocabulary words.	4.000	.000	Highly Acceptable
2. divides the content into individual portions of vocabulary words to facilitate comprehension of the lesson for the learners.	4.000	.000	Highly Acceptable
3. provides educational materials that are organized and thorough.	4.000	.000	Highly Acceptable
4. provides an array of vocabulary terms and exercises that are in line with the lesson and curriculum.	4.000	.000	Highly Acceptable
5. facilitates learners in understanding the connection between vocabulary terms and their role in the application of concepts.	3.720	.451	Highly Acceptable
Weighted Mean		3.944	
SD		0.213	
Verbal Interpretation		Highly Acceptable	

Legend: 3.26-4.00=Highly Acceptable; 2.51-3.25=Acceptable; 1.76-2.50=Slightly Acceptable; 1.00-1.75=Not Acceptable

The acceptability rating of the developed instructional materials in Science 4 in terms of content reached a weighted mean score of 3.944 and a standard deviation of 0.213 and was verbally interpreted as Highly Acceptable among the Science teachers.

In summary, the Scientiacabulary Word Booklet and Scientiacabulary Game Manual are designed to enhance students' understanding of scientific concepts and vocabulary. Together, these resources facilitate comprehension and retention of science vocabulary through engaging and curriculum-focused interactive activities, making the learning process both effective and enjoyable.

Williams and Lee (2022) investigate the influence of content relevance on student engagement and

learning. The researchers discovered that information that establishes a connection with students' interests and real-life experiences results in increased levels of engagement and improved learning outcomes. The research emphasizes the importance of creating relevant and meaningful content for learners.

Table 5

Level of acceptability of the developed instructional materials in Science 4 in terms of adaptability

Statements	Mean	Sd	Verbal Interpretation
The Scientiacabulary Games...			
1. functions as a versatile instrument that may be utilized in various learning competencies.	3.960	.197	Highly Acceptable
2. user-friendly and aligned with modern teaching methods in the 21st century.	3.767	.424	Highly Acceptable
3. provides activities that cater to the many learning styles of the learners.	3.947	.225	Highly Acceptable
4. includes diverse, challenging, and enjoyable activities suitable for learners with varying levels of ability.	4.000	.000	Highly Acceptable
5. adaptable and may be utilized by educators and students in different classes or subject areas.	4.000	.000	Highly Acceptable
Weighted Mean		3.935	
SD		0.230	
Verbal Interpretation		Highly Acceptable	

Legend: 3.26-4.00=Highly Acceptable; 2.51-3.25=Acceptable; 1.76-2.50=Slightly Acceptable; 1.00-1.75=Not Acceptable

Table 5 shows the level acceptability of the developed instructional materials in science 4 in terms of adaptability. Also shows the statements, mean, standard deviation and remarks.

The Scientiacabulary Word Booklet and Scientiacabulary Game Manual includes diverse, challenging, and enjoyable activities suitable for learners with varying levels of ability and adaptable and may be utilized by educators and students in different classes or subject areas.

The mean ($M = 4.00$) suggests an extreme acceptable style in terms of adaptability. Also, it provides activities that cater to the many learning styles of the learners and shown by the Science teachers. While the mean is slightly lower ($M = 3.767$), it is user-friendly and aligned with modern teaching methods in the 21st century in terms of insistence by the Science teachers.

The degree of acceptance of the developed instructional materials in Science 4 in terms of adaptability achieved a weighted mean score of 3.935 and a standard deviation of 0.230 and was verbally interpreted as Highly Acceptable among the Science teachers.

In summary, the Scientiacabulary Word Booklet and Scientiacabulary Game Manual, includes diverse, challenging, and enjoyable activities suitable for learners with varying levels of ability and adaptable and utilized by educators and students in different classes or subject areas.

Adaptive learning materials impact students' motivation and performance (Chen and Davis, 2019). Research revealed that adaptive learning materials, which customize educational activities based on student data, resulted in significant improvements in both student achievement and engagement. The students exhibited heightened interest and had improved academic outcomes as a result of the personalized learning experiences. The researcher discovered that an adaptable material has a considerable impact on student comprehension and achievement.

Table 6

Level of acceptability of the developed instructional materials in Science 4 in terms of aesthetic value

Statements	Mean	Sd	Verbal Interpretation
The Scientiacabulary Games...			
1. has a vibrant and visually appealing designs; it enhances the sense of excitement and enjoyment associated with learning.	4.000	.000	Highly Acceptable
2. utilizes suitable text font, size, and style.	3.853	.355	Highly Acceptable
3. utilize captivating and relevant illustrations that align with the lessons.	4.000	.000	Highly Acceptable
4. includes graphics that are appropriate for the target learners' interests, knowledge, and skills.	4.000	.000	Highly Acceptable
5.the material includes visual representations that clarify complex ideas and aid in the development of science processing skills.	4.000	.000	Highly Acceptable
Weighted Mean		3.971	
SD		0.157	
Verbal Interpretation		Highly Acceptable	

Legend: 3.26-4.00=Highly Acceptable; 2.51-3.25=Acceptable; 1.76-2.50=Slightly Acceptable; 1.00-1.75=Not Acceptable

The acceptability rating of the developed instructional materials in Science 4 in terms of aesthetic value accomplished a weighted mean score of 3.971 and a standard deviation of 0.157 and was verbally interpreted as Highly Acceptable among the Science teachers.

In summary, the Scientiacabulary Word Booklet and Scientiacabulary Game Manual, has a vibrant and visually appealing, captivating and relevant illustrations designs that includes graphics that were appropriate for the target learners' interests, knowledge, skills and visual representations.

According to Smith and Johnson (2020) as they examined the impact of aesthetic value components, including colour, layout, and typography, on learning outcomes. The research discovered that learning materials that are visually appealing and well-structured enhance student involvement and understanding.

5. What is the level of students' performance in terms of:

5.1 pre-test; and

5.2 posttest?

Table 7

Extent of student's engagement in terms of Participation

Statements	Mean	Sd	Verbal Interpretation
The students...			
1. eagerly engage in Scientiacabulary activities throughout class since it enhances their comprehension of subjects.	3.873	.334	Great Extent
2. are strongly encouraged to participate in and cooperate with other learners.	3.887	.318	Great Extent
3. comprehend the material more effectively due to the presence of interaction among others in the class.	3.873	.334	Great Extent
4. consistently demonstrate a willingness to answer questions and share ideas.	3.827	.380	Great Extent
5.enjoy the challenge of a healthy competition with their classmates in educational games, and it makes them want to try their best.	3.807	.413	Great Extent
Weighted Mean		3.853	
SD		0.335	
Verbal Interpretation		Great Extent	

Legend: 3.26-4.00=Great Extent; 2.51-3.25=Moderate Extent; 1.76-2.50=Minimal Extent; 1.00-1.75=Very Minimal Extent

The extent of student's engagement in terms of Participation achieved a weighted mean score of

3.853 and a standard deviation of 0.335 and was verbally interpreted as Great Extent among the Students.

In summary, the students participate in and cooperated with other learners and eagerly engaged in Scientiacabulary activities throughout class since it enhanced their comprehension and comprehend the material more effectively due to interaction among others in the class.

Johnson and Lee (2021) investigated the impact of student participation on engagement and learning outcomes. The researchers discovered a positive correlation between higher levels of student participation, increased engagement, and improved academic achievement. Engaging in conversations and group activities actively improves comprehension and long-term memory of course information. The study revealed that actively participating in class activities, such as engaging in debates and working on collaborative projects, had a substantial positive impact on students' levels of engagement. Engagement shown a positive correlation with heightened motivation, contentment, and scholastic success.

Table 8

Extent of student's engagement in terms of Focus and Attention

Statements	Mean	Sd	Verbal Interpretation
The students...			
1. are more attentive in class with the use of the Scientiacabulary games.	3.847	.362	Great Extent
2. closely monitor the assigned tasks to prevent missing outputs,	3.773	.436	Great Extent
3. listen carefully to the instructions for the given tasks.	3.907	.292	Great Extent
4. concentrate on the task ahead of them to achieve their goal.	4.000	.000	Great Extent
5. feel intrinsically motivated to gain a new and deeper understanding of the lessons.	3.880	.326	Great Extent
Weighted Mean		3.881	
SD		0.304	
Verbal Interpretation		Great Extent	

Legend: 3.26-4.00=Great Extent; 2.51-3.25=Moderate Extent; 1.76-2.50=Minimal Extent; 1.00-1.75=Very Minimal Extent

Table 8 shows the extent of student's engagement in terms of Focus and Attention. Also shows the statements, mean, standard deviation and remarks.

The Students concentrated on the task ahead of them to achieve their goal. The mean ($M = 4.000$) suggests a Great Extent in terms of Focus and Attention. Also, they listen carefully to the instructions for the given tasks and showed by the Students. While the mean is slightly lower ($M = 3.773$), they closely monitor the assigned tasks to prevent missing outputs in terms of confidence by the students.

The level of student's engagement in terms of Focus and Attention reached a weighted mean score of 3.881 and a standard deviation of 0.304 and was verbally interpreted as Great Extent among the students.

In summary, the students concentrated on the task ahead of them to achieve their goal and listen carefully to the instructions for the given tasks.

Nguyen and Brown (2019) critically examine several tactics aimed at enhancing concentration and attentiveness in educational environments. The study discovered that the integration of active learning strategies could improve students' focus and reduce interruptions. Additionally, incorporating varied instructional methods helps maintain student interest and engagement. Furthermore, efficient classroom management strategies are associated with improved concentration and academic achievement. These findings highlight the importance of a multifaceted approach to creating an optimal learning environment that supports sustained attention and reduces distractions

Table 9

Extent of student's engagement in terms of Attitude towards Game

Statements	Mean	Sd	Verbal Interpretation
The students...			
1. enjoy the lesson with the help of the Scientiacabulary game.	4.000	.000	Great Extent
2. find the lesson very fun and interesting because of the Scientiacabulary game.	4.000	.000	Great Extent
3. followed the instructions of the Scientiacabulary games cheerfully because it gives a conducive classroom ambiance.	3.800	.418	Great Extent
4. enjoy the sense of accomplishment they get from completing challenges in games during class.	4.000	.000	Great Extent
5. don't feel bored during the class because the Scientiacabulary games make them feel excited to learn vocabulary words.	4.000	.000	Great Extent
Weighted Mean		3.960	
SD		0.188	
Verbal Interpretation		Great Extent	

Legend: 3.26-4.00=Great Extent; 2.51-3.25=Moderate Extent; 1.76-2.50=Minimal Extent; 1.00-1.75=Very Minimal Extent

Table 9 shows the extent of student's engagement in terms of Attitude towards games.

The students enjoy the lesson with the help of the Scientiacabulary game, find the lesson very fun and interesting because of the Scientiacabulary game, enjoy the sense of accomplishment they get from completing challenges in games during class and don't feel bored during the class because the Scientiacabulary Word Booklet and Scientiacabulary Game Manual make them feel excited to learn vocabulary words. The mean ($M = 4.000$) suggests a Great Extent in terms of Participation. While the mean is slightly lower ($M = 3.800$), they followed the instructions of the Scientiacabulary Word Booklet and Scientiacabulary Game Manual cheerfully because it gives a conducive classroom ambiance in terms of assertiveness by the students.

The weighted mean score for the extent degree of student participation in terms of attitude towards games was 3.960, with a standard deviation of 0.188. This number was verbally interpreted as Great Extent among the Students.

In conclusion, the students take pleasure in the satisfaction of achievement and find the lesson to be extremely enjoyable. They received this sense of accomplishment from solving challenges in games, which also motivated them to learn vocabulary terms and made them feel excited to learn more.

Peterson and Brown (2021) investigate students' perspectives on educational games across various age ranges. The results suggest that younger students, specifically those in elementary and middle school, tend to have a more favourable disposition towards the incorporation of games in educational settings as compared to older students, namely those in high school and college. According to the study, younger learners see game-based learning as more engaging and entertaining, leading to increased motivation and involvement.

6. Is there a significant difference in the level of performance of students in terms of:

- 6.1 pre-test: and
- 6.2 posttest?

The data on the pupil-respondents before and after the implementation of the developed instructional materials is presented in Table 10.

Pre-test**Table 10.**

Level of students' performance in terms of Pre-test

Score	f	%	Descriptive Equivalent
41 - 50	0	0.00	Outstanding
31 - 40	34	34.00	Very Satisfactory
21 - 30	41	41.00	Satisfactory
11 - 20	25	25.00	Fairly Satisfactory
0 - 10	0	0.00	Did not meet Expectation
Total	100	100	
Weighted Mean	26.4400		
SD	7.6135		
Verbal Interpretation	Satisfactory		

Table 10 presents the level of students' performance in terms of pre-test. Out of the total number of one hundred respondents, "21 to 30" received the highest frequency of forty-one (41) or 41.00% of the total population with a descriptive equivalent of Satisfactory. While the scores "11 to 20" received the lowest frequency of twenty-five (25) or 25.00% of the total population with a descriptive equivalent of Fairly Satisfactory. With a (Weighted Mean = 26.44, SD = 7.6135) it shows that the level of students' performance in terms of Pre-test has a descriptive equivalent of Satisfactory.

Chen and Zhang (2021) investigate the utilization of pre-test scores in adaptive learning systems for the customization of instructional tactics. The results indicate that pre-test scores are useful for tailoring learning routes, enabling educators to concentrate on areas where pupils exhibit the most significant requirement for enhancement. Research has shown that this methodology improves educational outcomes and reduces the time required to achieve proficiency.

Posttest**Table 11**

Level of students' performance in terms of Posttest

Score	f	%	Descriptive Equivalent
41 - 50	35	35.00	Outstanding
31 - 40	26	26.00	Very Satisfactory
21 - 30	37	37.00	Satisfactory
11 - 20	2	2.00	Fairly Satisfactory
0 - 10	0	0.00	Did not meet Expectation
Total	100	100	
Weighted Mean	34.9900		
SD	7.9601		
Verbal Interpretation	Very Satisfactory		

Table 11 presents the level of students' performance in terms of post-test. Out of a total number of one hundred respondents, "21 to 30" received the highest frequency of thirty-seven (37) or 37.00% of the total population with the descriptive equivalent of Satisfactory. While the scores "11 to 20" received the lowest frequency of two (2) or 2.00% of the total population with the descriptive equivalent of Fairly Satisfactory.

With a (Weighted Mean = 34.99, SD = 7.4166) it shows that the level of students' performance in terms of Posttest has a descriptive equivalent of Very Satisfactory.

Robinson and Kim (2022) examine the importance of post-test analysis in assessing knowledge retention and conceptual comprehension in scientific education. The results suggest that post-test scores are reliable indicators of students' ability to recall and apply scientific information over time. Additionally, the study emphasizes that analyzing test results after their completion provides valuable insights into students' understanding and areas needing improvement. This analysis is crucial for refining instructional approaches, ensuring that educational strategies are effectively supporting long-term retention and comprehension.

Significant difference in the level of performance of students in terms of pre-test and posttest

The following data presents the significant difference between the pre-test and posttest scores of the learners after the implementation of the Scientiacabulary Word Booklet and Scientiacabulary Game Manual.

Table 12

Test of Difference between the performance of the students in terms of Pre-test and Posttest

Scientiacabulary games	Pre-test		Posttest		Mean Difference	95% Confidence Interval of Difference		t	df	Sig (2-tailed)
	Mn	SD	Mn	SD		L	U			
Performance	26.44	7.61	34.99	7.96	8.55	4.272	11.86	4.21	139	0.000

Legend: *Significant at 0.05

The results of the test that was conducted to determine the difference in performance in science before and after utilizing the Scientiacabulary Word Booklet and the Scientiacabulary Game Manual are presented in Table 12. Based on the results obtained from a paired t-test, it was determined that the improvement in performance scores is, in fact, statistically significant ($p < 0.05$).

The use of the Scientiacabulary Word Booklet and Scientiacabulary Game Manual in science resulted in improved classroom performance among the students. The quality of students' learning experiences has shown a substantial improvement, rising from high to very high.

Downie (2022) states that the two most prevalent forms of assessment used before and after the transfer of knowledge and skills are the pre-test and the post-test. These tests allow one to assess the strengths and shortcomings of the teacher's instructional service in the classroom by measuring students' abilities, knowledge, intellect, capacities, and attitudes.

Both Vargianniti and Karpouzis (2019) investigated the potential of game-based learning (GBL) to enhance student engagement and performance in the classroom. This research explores the statistical significance of the game's effect on students' performance, interest-performance relationships, and gender differences in performance. The quantitative data analysis well answered all study questions: the game significantly improved students' performance, and the resulting strong correlation between the two variables demonstrated the connection between students' interest and performance.

7. What insights and implications can be derived based on the results of the study?

Creative Insights

The researcher embarked on a study addressing the problem of low Science vocabulary levels among students in fourth grade. To address this problem, the researcher developed an educational resource that aimed to improve the students' performance and engagement and enhanced their understanding and retention.

The interviews indicated a significant problem, teachers highlighted several emerging themes that compounded the difficulty: Challenges with Vocabulary Acquisition due to the wide variety of scientific

words, confusing interpretations, and pronunciation issues; Ineffective and Unengaging Learning Materials that did not capture students' interest or support effective learning; and Lack of Visual Clarity and Relevance, emphasizing the need for high-quality photos and illustrations to enhance comprehension and facilitate a better understanding of complex scientific concepts.

The qualitative analysis of the interviews revealed several key elements critical to the development of effective instructional materials. These elements included content, visual and text components, interactivity, and evaluation. The researcher addressed these elements in the creation of two resource materials that are crafted and edited using Canva: the Scientiacabulary Word Booklet and the Scientiacabulary Game Manual that are based on the Matatag Curriculum's Learning Competencies for it's content alignment and are validated by experts.

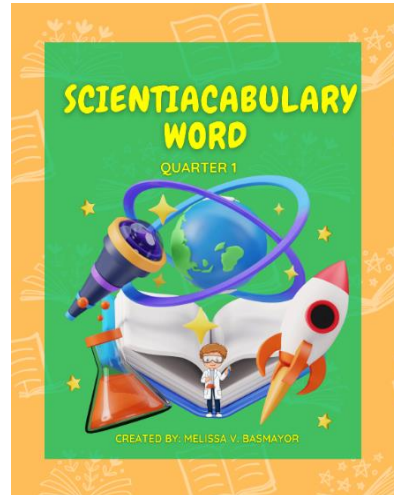


Figure 1: Scientiacabulary Word Booklet

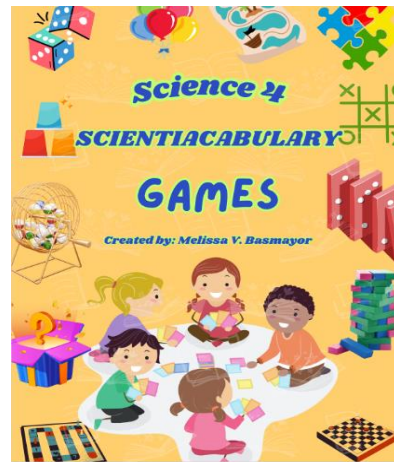


Figure 2: Scientiacabulary Game Manual

Scientiacabulary Word Booklet and Game manual provides a clear, comprehensive lessons with well-structured contents. Visuals like graphics and pictures of excellent quality helped understanding and

retention. Activities and games promoted active learning and involvement. The learners enjoyed using the developed materials and shows promising result and improvement.

The researcher surveyed experts to rate these resources' effectiveness. The findings confirmed the quality and relevancy of the generated resources, showing high acceptance. Implementing these resources also improved student performance. The Scientiacabulary materials improved pupils' vocabulary from satisfactory to very satisfactory.

Collectively, the research emphasized the pressing need for suitable and engaging teaching resources in science education and demonstrated the effective use of the created resource material, namely the Scientiacabulary word booklet and game manual, in addressing educational challenges.

4. CONCLUSION AND RECOMMENDATION

The following conclusions were deduced from the findings presented.

This study effectively identified and addressed critical challenges in teaching science vocabulary to fourth-grade students. Through detailed analysis and interpretation of interview data and existing instructional materials, key issues were revealed that were the basis for the developed Scientiacabulary word booklet and Scientiacabulary game manual.

The materials were designed to address the identified needs and challenges. By aligning with curriculum objectives and incorporating simple explanations, engaging activities, and interactive elements, these resources aimed to enhance student comprehension and engagement. The high level of acceptance among participating science teachers and the significant improvement in student performance from satisfactory to very satisfactory, as evidenced by the pre-test and post-test scores, validate the effectiveness of the developed materials.

The significant difference between pre-test and post-test scores indicates that the new resources positively impacted student learning outcomes. The rejection of the null hypothesis confirms that the implemented educational tools significantly improved students' performance and engagement. This underscores the importance of continuously evolving educational resources to meet the dynamic needs of learners and highlights the value of ongoing professional development for educators to optimize instructional strategies.

Overall, the researcher therefore concludes that the materials were effective for the adoption of well-designed educational materials, emphasizing that effective science education hinges on the quality and relevance of the resources used. The research highlights that traditional teaching tools often fall short in engaging students and addressing their diverse learning needs. Therefore, the development and implementation of educational materials that are thoughtfully designed to meet curricular objectives and enhance student engagement are crucial.

Through the conclusion drawn from the findings, the following recommendations were made.

1. In future research, it may be beneficial to investigate the potential positive impact of incorporating the Scientiacabulary word and game manual into other areas of learning, particularly at the elementary level, where it forms the basis of education. It is also important to consider the input and feedback from teachers who have evaluated and assessed the study's results.
2. To enhance teachers' knowledge and skills, the school administration could organize workshops and training sessions focused on educational resources and writing.
3. Teachers are urged to create their own versions of the study's findings to enhance the quality of education and may integrate it into their classrooms or across different grade levels to improve their competencies and to remain globally competitive.
4. There is potential for the study to be proposed to local government bodies and other stakeholders to support the distribution of educational materials.

5. The study could be presented to other school leaders to implement it in their respective institutions.
6. The study could also be suggested as a school project and applied across different grade levels and subjects.

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