

Inquiry-Based Supplementary Learning Materials in Living Things and Their Environment

Lester Gene V. Arevalo^{*1}, Edilbert A. Reyes²

¹Notre Dame of Dadiangas University, General Santos City, Philippines

²Department of Education, Division of General Santos City, Philippines

*Corresponding Author Email: lestergene.arevalo@deped.gov.ph

Date received: March 5, 2025

Date revised: April 25, 2025

Date accepted: May 23, 2025

Originality: 90%

Grammarly Score: 99%

Similarity: 10%

Recommended citation:

Arevalo, L. G., & Reyes, E. (2025). Inquiry-based supplementary learning materials in living things and their environment. *Journal of Interdisciplinary Perspectives*, 3(6), 318–334. <https://doi.org/10.69569/jip.2025.143a>

Abstract. Despite the focus on science mastery in the K to 12 curricula, there is still a lack of contextually developed and validated supplementary learning materials specifically designed to improve Key Stage 2 pupils' understanding of science competencies. This study aimed to address this gap by developing inquiry-based supplementary learning materials focused on the least mastered competencies in the topic "Living Things and Their Environment." It sought to answer the following questions: (1) What are the least mastered competencies to be included in developing the materials? (2) What inquiry-based materials can be developed from these competencies? (3) How valid are the content, format, presentation, organization, and accuracy of the developed materials? (4) What is the mastery level of pupils before and after using the materials? (5) Is there a significant difference in the mean pretest and posttest scores? The study used a research and development method with a one-group pretest-posttest quasi-experimental design. Fifteen validators assessed the quality of the materials, and 156 Key Stage 2 pupils participated. The mastery level was measured using the Mean Percentage Score (MPS), and an ANOVA was used to test the significance of the differences in scores. Findings showed an increase in the mastery level from Average Mastery to Moving Towards Mastery. ANOVA results revealed no significant difference in Grade 4 scores but showed a significant difference for Grades 5 and 6. The developed materials effectively improved science mastery, especially at higher grade levels. Based on these findings, the researcher recommends publishing the developed inquiry-based supplementary learning materials in the Learning Resources Management and Development System (LRMDS) portal of the Department of Education (DepEd) for use by both teachers and students as an instructional tool in elementary science education.

Keywords: Science teaching; 5E's model; Inquiry-based learning; Supplementary learning materials.

1.0 Introduction

The persistent lack of quality-assured Science learning materials has significantly contributed to poor academic performance and low mastery of learning competencies, particularly in Biology. Despite the Department of Education's (DepEd) mandate to provide accessible, high-quality learning resources that foster 21st-century skills such as critical thinking and problem-solving, Filipino students continue to underperform in international and national assessments. This consistent underachievement underscores a more profound, systemic issue in Science education that calls for urgent and effective interventions. One promising approach is developing and integrating inquiry-based supplementary learning materials to support learners and enhance Science instruction within the basic education curriculum.

The local level mirrors this broader national concern. In the Malita West District, the situation is particularly

alarming. The district's learning resource inventory reveals a complete absence of Science 6 textbooks and learner materials across all 28 elementary schools. From the initial implementation of the K to 12 programs up to the school year 2023–2024, there has been no recorded distribution or provision of learners' materials, textbooks, or even teacher's guides for Science 6. This lack of foundational resources further complicates the teaching and learning process, leaving teachers and learners at a disadvantage, particularly in covering essential Science competencies.

Recent global assessments further contextualize these localized gaps. The Programme for International Student Assessment (PISA) 2022 results reflect the challenging reality of Science education in the Philippines. According to the Organization for Economic Cooperation and Development (OECD), the Philippines ranked 78th out of 80 participating countries, with an average Science score of 356—placing the country in the lowest tier. Similarly, the 2019 Trends in International Mathematics and Science Study (TIMSS) confirmed the nation's struggles in Science Education, with the Philippines scoring 297 in Mathematics and a notably lower 249 in Science, both among the bottom ranks globally. These data points highlight the urgent need for coordinated and research-based interventions to transform Science education at all levels.

In addition to international evaluations, local assessments provide further evidence of this academic crisis. The Department of Education in Region XI, particularly the Division of Davao Occidental, administered the Regional Assessment Test (RAT) across all learning areas and grade levels. Results showed that in Science for Key Stage 2, the domain "Living Things and Their Environment" had the highest number of least mastered competencies in the second quarter. Further, during the 2022–2023 school year, the Division identified that this domain continued to have the least mastered competencies due to persistently low proficiency levels. Corroborating this, the National Achievement Test (NAT) results for the school years 2016–2017 and 2017–2018 reflected a mean percentage score (MPS) between 50 and 74 in Science, significantly below DepEd's target of 75. Such low MPS scores indicate poor competency mastery, often leading to learning gaps that compound as students' progress to junior high school.

Considering these national and local findings, this study aims to bridge the identified gaps in Science education, particularly in the domain of "Living Things and Their Environment," by developing and validating the inquiry-based supplementary learning materials and determining the effectiveness of the learners' mastery. These materials aim to enhance student performance, foster mastery of learning competencies, and address the urgent demand for accessible, high-quality instructional resources. In doing so, the study aligns with DepEd's broader mandate to nurture 21st-century learners with the skills necessary for critical thinking, scientific inquiry, and lifelong learning.

2.0 Methodology

2.1 Research Design

The Research and Development (R&D) method was used in this study. This design systematically developed, validated, and determined the effectiveness of inquiry-based supplementary learning material in living things and their environment for key stage 2. The research and development method involved problem identification, planning, developing solutions, implementing interventions, and evaluating outcomes (Wahyuni et al., 2022). For this reason, the research and development method allows researchers to systematically develop educational learning resources tailored to improve student learning outcomes and help ensure that the developed materials meet the set academic standards and criteria (Kamidah et al., 2023).

This study also employed a quasi-experimental, specifically a one-group pretest-posttest design, in which the same group of participants was measured on the same dependent variable before and after a treatment or intervention. In this study, a quasi-experimental design was used to collect data on students' pretest and posttest scores, which can provide a comprehensive view of student learning based on the given intervention (Galarosa et al., 2024). Moreover, a one-group pretest-posttest design was used to assess the same group of students before and after introducing new learning materials as the intervention. It allows for the direct comparison of student outcomes, providing insights into the effectiveness of the learning materials (Sheehan et al., 2024). The study does not include a control group because the research focused on evaluating the effectiveness of the learning materials within a naturally occurring group where random assignment and establishing a separate control group were not feasible due to ethical, practical, and contextual constraints.

2.2 Research Locale

The study was conducted in one of the elementary schools within the Municipality of Malita under the Schools Division of Davao Occidental, Department of Education. This school's classes are heterogeneous and offer various programs from the Department of Education. This school belongs to the Malita West District, which has 25 elementary and three integrated schools. The focus of the study centered on the academic activities of this school during the second quarter of the 2024-2025 school year. The specific name of the school was not disclosed in the research locale to protect the confidentiality and privacy of the school and its participants while ensuring transparency by providing sufficient contextual information about the setting, such as its type, location, and general characteristics relevant to the study.

2.3 Research Participants

The study involved two groups of respondents. The respondents comprised fifteen expert validators and pupils from Key Stage 2, in grades four, five, and six.

Table 1. *Frequency Distribution of the Respondents of the Study*

Group of Respondents	F
Experts	15
Grade 4 Pupils	42
Grade 5 Pupils	52
Grade 6 Pupils	62
Total	171

The first group of respondents was selected through purposive sampling. The researcher employed purposive sampling to select participants or respondents to the study who could provide valuable information and gain in-depth insights into the research objectives (Andrade, 2020). The first group of respondents consisted of five experts per grade level, totaling fifteen experts across three grade levels, who specialized in instructional material development and content. This group of experts assessed the developed inquiry-based supplementary learning materials based on the information's content, format, presentation, organization, accuracy, and up-to-dateness (Mijares, 2023). The fifteen experts, comprising five validators per grade level, were carefully selected to validate the inquiry-based supplementary learning materials due to the extensive nature of the learning materials, lesson exemplars, and test questionnaires, which required thorough evaluation for each grade level.

The second group of respondents consisted of Key Stage 2 pupils in grades 4, 5, and 6 who officially enrolled for the 2024-2025 school year. The researcher employed the complete enumeration method, which collects data from the entire population, not just a sample (Lee et al., 2013). The complete enumeration method for pupils was used in the study to ensure that all members of the target population were accurately represented, thereby eliminating sampling bias and enhancing the reliability and generalizability of the findings, which strengthens the rationale by providing a more comprehensive and valid assessment of the research problem. The researcher selected all pupils in grades four, five, and six to all sections per grade level, which served as an experimental class, and underwent a pretest and posttest using the researcher-made test. To avoid the teacher-factor effect, the same science teacher managed the experimental group throughout the entire duration. The science teacher administered the pretests and posttests before and after implementing the inquiry-based supplementary learning material.

2.4 Research Instrument

The Evaluation Rating Sheet

The study used the evaluation rating sheet for print resources, adapted from the Learning Resources Management and Development System (LRMDS) of the Department of Education (DepEd), as a validation tool. The evaluation rating sheet included items that assessed the following factors: Factor A: content; Factor B: format; Factor C: presentation and organization; and Factor D: accuracy and up-to-datedness of information.

The Researcher-made Test

The researcher developed and conducted a validation of the pretest and posttest to ensure the test was both reliable and valid for measuring the intended constructs. The researcher developed a Table of Specifications (TOS), which outlined the identified learning competencies, cognitive levels, and distribution of test items to ensure content alignment. The item pool was created, where test questions were carefully crafted based on the

TOS, considering clarity, difficulty, and discrimination. The researcher intended to conduct this at other schools within the Schools Division of Davao Occidental. The developed test underwent a series of trials, with the first trial focusing on item analysis and the second trial aimed at determining the reliability and internal consistency of the test.

The first trial run was conducted on a sample population to gather initial performance data. Following this, **item** analysis was performed, where each test item was evaluated for item difficulty, item discrimination, and item recommendation. Item analysis helps the researcher improve the tests by showing which questions are too easy or too hard (item difficulty), which ones tell apart high- and low-performing students (item discrimination), and which ones should be kept, revised, or removed (item recommendation) to make the test fairer and more effective. The item analysis of the researcher-made test across Grades 4, 5, and 6 reveals that most test items fell within the acceptable difficulty range (0.30–0.70), ensuring a balanced assessment. In Grade 4, 47 out of 60 items were classified as having average difficulty, with an overall difficulty index of 0.38, while 22 items exhibited good discrimination and 21 were deemed acceptable. Similarly, Grade 5 had a slightly higher difficulty index of 0.45, with 52 items of average difficulty and 26 items accepted based on discrimination analysis. Grade 6 followed a comparable trend, with 51 items of average difficulty and an overall difficulty index of 0.43. The discrimination indices, ranging from 0.30 to 0.33 across the three grade levels, indicate that most test items effectively distinguished high and low-performing pupils. However, a few items were either too easy, too tricky, or lacked sufficient discrimination, leading to recommendations for revision or removal. Revising test items based on item analysis improves the quality of the test by enhancing its validity, reliability, and fairness, as it allows the researcher to identify and modify or remove poorly performing questions, such as those that are too difficult, too easy, or misleading thereby ensuring that the test more accurately measures students' proper understanding and learning outcomes.

A second trial run was conducted to evaluate the effectiveness of the revised test items and ensure improvements in measurement accuracy. The reliability testing was established through statistical methods using the Kuder-Richardson formula 20 (KR-20) to confirm that the test consistently produces stable and accurate results, making it valid for its intended purpose. The reliability and internal consistency of the test across three grade levels, as measured using the Kuder-Richardson Formula 20 (KR-20), indicate that the test was generally reliable for testing. The KR-20 is used to assess the reliability and consistency of test results, especially when the questions have only right or wrong answers. According to Setiabudi et al. (2019), the minimum acceptable reliability score for teacher-made tests must demonstrate a reliability coefficient of 0.60 or greater. Grade 4 pupils achieved a reliability score of 0.86 among the three groups, suggesting a strong internal consistency in their test responses. Grade 5 pupils had a reliability score of 0.67, while Grade 6 pupils recorded a reliability score of 0.62. All three grade levels fall within the acceptable range of reliability, indicating that the students consistently understood and answered the test items. The reliability values for all-item and dichotomous-item analyses further support the test's dependability in measuring pupils' knowledge across the different grade levels.

The Lesson Exemplar

During the lesson delivery, the researcher developed a lesson exemplar in a 5E cycle (engagement, exploration, explanation, elaboration, and evaluation) cycle in a format that guides the implementation of inquiry-based supplementary learning materials (Sotáková & Ganajová, 2023). The cycle entails engaging, exploring, explaining, elaborating, and evaluating while aligning the learning objectives with the least-mastered competencies from DepEd's most essential learning competencies (MELC). The lesson exemplar guided the teacher in executing the lesson flow using the developed inquiry-based supplementary learning material in an inquiry-based learning approach. The lesson exemplar was validated by the experts who were assigned to the grade level. The researcher revised the lesson exemplar based on the feedback and recommendations from the validators. The lesson exemplars were used together with the utilization of the developed inquiry-based supplementary learning materials within the teaching and learning process for the entire duration of the second quarter of the school year 2024-2025.

The Inquiry-Based Supplementary Learning Material

Inquiry-based supplemental learning materials were developed using the Department of Education's (DepEd) guidelines and procedures for LRMDs assessment and evaluation. Five experts of each grade level validated the developed inquiry-based supplementary learning material. Based on the validation results, the validators did

not recommend supplementary learning material for lesson delivery if it failed in at least one of the four evaluation rating factors. However, the validators did not recommend any material that failed factor 4 for lesson delivery until the researcher fixed the identified issues. The researcher considered the comments and suggestions of the validators to enhance the inquiry-based supplementary learning materials.

2.5 Data Gathering Procedure

The study was conducted with official consent from the Office of the Schools Division Superintendent in the Schools Division of Davao Occidental. It involved submitting a letter request, endorsed by the Graduate School, to the office of the Schools Division Superintendent. After receiving approval from the School Division Superintendent, the researcher also submitted a letter requesting permission from the head of the identified school. Upon receiving approval, the researcher initiated the study. The inquiry-based supplementary learning material was developed using the ADDIE model framework. The procedure followed a sequence of steps in each phase.

During the analysis phase, the researcher identified the least mastered competencies in grades four, five, and six during the second quarter of the 2023–2024 school year, based on the consolidated proficiency level report from the School Division of Davao Occidental. When the mastery level indicates low proficiency, the researcher identifies it as the least mastered competency in Science. Using data from the identified least mastered competencies, the researcher chose the learning competencies to be covered in developing the supplementary learning materials. This phase took two weeks from a request from the division office until the least mastered competencies were identified.

In the design phase, the researcher incorporates inquiry-based learning into the supplemental learning materials. The LRMDs's procedures and guidelines suggested by the Department of Education (DepEd) for developing learning resources must be followed (Department of Education, 2011). The researcher also considered the basic requirements when designing the supplemental learning materials, including the language, graphics, structure, chronology, and content. Regarding the technical specifications, the researcher also looked at the paper, binding, pictures, page design, and layout. The design phase requires one week, during which the researcher seeks assistance from the Learning Resource Manager of the Division Office for technical assistance and guidance in designing the material.

After the design phase was identified, the development phase followed. During this stage, the validation process took place. It required experts to validate the materials. Rapada and Servañez (2024) explain that the purpose of the validation was to gather feedback and enhance the supplementary learning material under development. The supplementary learning material was improved based on suggestions and comments from validators. The following factors were considered in validating the materials: content, format, presentation, organization, and accuracy and up-to-date information. The researcher adopted the validation criteria from the evaluation rating sheet for the Learning Resource Management and Development System (LRMDS) print resources. This phase requires a significant amount of time, and the researcher spent four months developing the supplementary learning materials and the lesson exemplars.

Next was the implementation phase. The experimental group utilized the developed and validated supplementary learning material. The pupils and science teachers utilize this supplementary learning material during the lesson delivery based on the identified least-mastered competencies. The teacher was provided with a researcher-created lesson plan, along with supplementary learning materials, to facilitate efficient lesson delivery. One inquiry-based supplementary learning material was developed for each least-mastered competency. Each inquiry-based supplementary learning material consisted of various lessons, depending on the outcome of the unpacked learning competencies. Each pupil received one copy of the inquiry-based supplementary learning material during the implementation. The researcher used field notes or observation notes to monitor the class, ensuring all lesson conduct variables were followed. The researcher randomly observed the classes to ensure the material was effectively used during the lesson. The researcher ensured proper documentation and took field or observation notes after each observation. The observation method used in the study can minimize observer bias by employing structured protocols, standardized checklists, and inter-observer reliability measures, ensuring consistency, objectivity, and accuracy in data collection. Upon the school head's invitation, the researcher facilitated a Learning Action Cell (LAC) session between the science teachers of grades four, five, and six and the school head. Through this LAC session, the science teachers engaged in

collaborative learning sessions and discussed the processes of implementing inquiry-based supplementary learning material during the teaching and learning process. The implementation was conducted over the entire second quarter of the school year, which spans three months.

The evaluation phase was the final stage. This phase determined whether the development of inquiry-based supplementary learning materials affected pupils' mastery of the least mastered competencies through pretests and posttests. The researcher subsequently determined the efficacy of the inquiry-based supplementary learning material. Diestro (2023) suggested using a pretest and posttest, both created by the researcher, to assess the students' level of mastery. Wiltz (2023) indicated that the pretest is to determine the students' prior knowledge and create the first foundation for the scores before implementing the learning materials. To evaluate the effectiveness of the inquiry-based supplemental learning material on the learners, the researcher administered a posttest after they had completed it. It runs within one week before and another week after the intervention is implemented.

To determine the effectiveness of the inquiry-based supplementary learning material, the researcher recorded the scores and compared them to determine whether there was a significant difference between the groups (Wolfson et al., 2015). The researcher also wanted to determine whether the development of inquiry-based supplementary learning materials affected pupils' mastery of the least mastered competencies. Pretest and posttest data were collected, gathered, calculated, and subjected to statistical treatment. The researcher concluded that the inquiry-based supplementary learning material was effective.

2.6. Data Analysis

The researcher followed the general guidelines established by the LRMDs-DepEd when developing inquiry-based supplementary learning materials. Tables 2 and 3 are the descriptive analyses used to interpret the results of validating the inquiry-based supplementary learning materials for factors a, b, and c of the evaluation rating sheet.

Table 2. *Rating Scale and Description for Factors A, B, and C*

Rating Scale	Description
4	Very Satisfactory
3	Satisfactory / Not Applicable
2	Poor
1	Not Satisfactory

Using the scale above, inquiry-based supplementary learning materials must acquire at least 21 points out of a maximum of 28 points to pass the content. To meet the respective criteria, the inquiry-based supplementary learning material must achieve a minimum score of 54 out of 72 points for format and a perfect score of 24 out of 24 for presentation and organization. The researcher used the scale below for factor d, which is the accuracy and up-to-datedness of information.

Table 3. *Rating Scale and Description for Factor D*

Rating Scale	Description
4	Present
3	Present but very minor and must be fixed
2	Present and requires significant development
1	Do not evaluate further

To validate the accuracy and up-to-datedness of information in the material, the inquiry-based supplementary learning material must score 24 out of a maximum of 24 points to pass this criterion. When the material fails to meet the requirements for accuracy and up-to-date information, it is necessary to document all issues in the comments section. Upon failing any of the four criteria in the validation process, the learning material must be revised and revalidated for the relevant criterion before being endorsed for use in the study. Descriptive analysis describes or summarizes a set of data. It interprets the scores given by the group of experts as the validator based on the evaluation rating sheet as the validation tool. The mean scores were calculated to determine the validity of the inquiry-based supplementary learning materials. The mastery level of pupils using the inquiry-based supplementary learning materials was interpreted using the criteria adopted by the Department of Education in the National Achievement Test (NAT) based on DepEd Order No. 160, Series of 2012. The mean percentage score was interpreted in relation to the mastery level and descriptive equivalent, as shown in Table 4.

Table 4. Mastery Level and Descriptive Equivalent	
Mastery Level Mean Percentage Score (MPS)	Descriptive Equivalent
96-100%	Mastered
86-95%	Closely Approximately Mastery
66-85%	Moving Towards Mastery
35-65%	Average Mastery
16-34%	Low Mastery
5-15%	Very Low Mastery
0-4%	Absolutely No Mastery

**Adopted from the National Achievement Test (NAT) of DepEd*

Mean percentage score (MPS) was used as a basis to determine the mastery level of pupils who were exposed to inquiry-based supplementary learning material using the results of the pretest and posttest scores. On the other hand, the Analysis of Variance (ANOVA) was used to determine the significant difference in pupils' mean pretest and posttest scores, and the result showed a substantial difference at a p -value of 0.05.

2.7 Ethical Considerations

To maintain the integrity and ethical standards of the research, this study addressed several ethical considerations. These include informed consent, voluntary participation, data confidentiality, and results communication. The pupils were given an informed consent letter containing all relevant information about the study. The pupil's parent or guardian signed the informed consent letter to confirm their consent to participate. The pupils chose to participate in the study voluntarily, without coercion or undue influence. The researcher told the validators and pupils that they could withdraw from the survey without facing any negative consequences or losing their entitlement to benefits. The researcher guaranteed the confidentiality and secure storage of personal information and responses. The researcher anonymized or coded the data to prevent the identification of individual participants. Only the researcher and an authorized person had access to the data, and any publications or presentations of the results did not include identifiable information. The researcher communicated the results transparently and responsibly. The researcher reported the study's findings honestly and accurately, without any fabrication or falsification. The researcher ensured that the results were accessible to participants and other stakeholders through summaries or reports that understandably explained the findings. This study was approved by the University Research Ethics Board of Notre Dame of Dadiangas University, General Santos City. All procedures involving human participants were conducted according to the ethical standards of the institution's research committee.

3.0 Results and Discussion

3.1. Least Mastered Competencies

The following tables outline the learning competencies in Key Stage 2 for the second quarter, under the domain of Living Things and Their Environment, for the school year 2023-2024. The table displays the mean percentage score for learning competencies and the corresponding proficiency level.

Table 5. Identified Least Mastered Competencies in Science 4 in the Second Quarter, "Living Things and Their Environment" for School Year 2023-2024

Learning Competencies	Mean Percentage Score	Proficiency Level
"Describe the main function of the major organs."	52%	Nearly Proficient
"Communicate that the major organs work together to make the body function properly."	33%	Low Proficient
"Infer that body structures help animals adapt and survive in their particular habitat."	45%	Low Proficient
"Identify the specialized structures of terrestrial and aquatic plants."	64%	Nearly Proficient
"Compare the stages in the life cycle of organisms."	76%	Proficient
"Describe the effect of the environment on the life cycle of organisms."	38%	Low Proficient
"Describe some types of beneficial and harmful interactions among living things."	31%	Low Proficient
"Describe the effects of interactions among organisms in their environment."	61%	Nearly Proficient

*Legend: Highly Proficient- 90 %-100 %, Proficient- 75 %-89%, Nearly Proficient- 50%-74%, Low Proficient-25%-49%, Not Proficient- 0%-24%

As shown in Table 5, the lowest proficiency level falls within the range of 25%-49% was observed in learning competency of "communicating that the major organs work together to make the body function properly," "inferring that body structures help animals adapt and survive in their particular habitat," "describe the effect of the environment on the life cycle of organisms," and "describing beneficial and harmful interactions among living things." In contrast, the remaining learning competency falls within a nearly proficient to proficient level.

Table 6. *Identified Least Mastered Competencies in Science 5 in Second Quarter, "Living Things and Their Environment" for School Year 2023-2024*

Learning Competencies	Mean Percentage Score	Proficiency Level
"Describe the parts of the reproductive system and their functions."	56%	Nearly Proficient
"Explain the menstrual cycle"	71%	Nearly Proficient
"Describe the different modes of reproduction in animals such as butterflies, mosquitoes, frogs, cats, and dogs."	32%	Low Proficient
"Describe the reproductive parts in plants and their functions."	81%	Proficient
"Describe the different modes of reproduction in flowering and non-flowering plants such as moss, fern, mongo, and others."	41%	Low Proficient
"Discuss the interactions among living things and non-living things in estuaries and intertidal zones."	39%	Low Proficient
"Explain the need to protect and conserve estuaries and intertidal zones."	47%	Low Proficient

*Legend: Highly Proficient- 90 %-100 %, Proficient- 75 %-89%, Nearly Proficient- 50%-74%, Low Proficient-25%-49%, Not Proficient- 0%-24%

In Table 6, low proficient learning competencies were indicated in "describing the different modes of reproduction in animals such as butterflies, mosquitoes, frogs, cats, and dogs," "describing the different modes of reproduction in flowering and non-flowering plants such as moss, fern, mongo, and others," "discussing the interactions among living things and non -living things in estuaries and intertidal zones," and "explaining the need to protect and conserve estuaries and intertidal zones." Meanwhile, other learning competencies were classified as nearly proficient.

Table 7. *Identified Least Mastered Competencies in Science 6 in Second Quarter, "Living Things and Their Environment" for School Year 2023-2024*

Learning Competencies	Mean Percentage Score	Proficiency Level
"Explain how the organs of each organ system work together."	28%	Low Proficient
"Explain how the different organ systems work together."	32%	Low Proficient
"Determine the distinguishing characteristics of vertebrates and invertebrates."	70%	Nearly Proficient
"Discuss the interactions among living things and non-living things in tropical rainforests, coral reefs, and mangrove swamps."	45%	Low Proficient
"Explain the need to protect and conserve tropical rainforests, coral reefs, and mangrove swamps."	79%	Proficient

*Legend: Highly Proficient- 90 %-100 %, Proficient- 75 %-89%, Nearly Proficient- 50%-74%, Low Proficient-25%-49%, Not Proficient- 0%-24%

The learning competencies "explain how the organs of each organ system work together," "explain how the different organ systems work together," and "discuss the interactions among living things and non-living things in tropical rainforests, coral reefs, and mangrove swamps," respectively, are categorized under the low proficient level. Notably, the two remaining learning competencies belong to the nearly proficient and proficient levels. The findings highlight the need for targeted instructional interventions to improve student proficiency in the Science of Key Stage 2, particularly in "understanding organ systems, interactions among organisms, and environmental conservation." Teachers should integrate more hands-on activities, such as models and simulations, to enhance comprehension of abstract biological concepts. Additionally, interdisciplinary approaches that connect Science with real-life scenarios, such as environmental field studies and health education, could help reinforce learning and increase student engagement. Methodologically, these findings emphasize the importance of differentiated instruction, where students receive tailored support based on their proficiency levels to address gaps effectively. Moreover, formative assessments and diagnostic tools throughout the quarter can provide teachers with timely feedback to adjust teaching strategies, ensuring mastery of critical competencies.

The study's findings align with the previous research by Mahardika and Putra (2020), who emphasized that low proficiency in Science means students struggle to grasp fundamental concepts about the natural world. It can hinder their ability to relate scientific knowledge to real-life situations, which is crucial for developing critical thinking skills. It agrees with the previous study of Purkat and Devetak (2023), which explains that learners without sufficient exposure to interactive and inquiry-based learning, students may find it challenging to apply theoretical knowledge to real-life situations, limiting their ability to develop critical thinking and problem-

solving skills that would lead to low proficient in academic performance in Science. Umara (2022) also explained that one contributing factor to these low proficiency levels is the ineffective use of diverse teaching strategies, leading to low student engagement and retention of scientific concepts. Research suggests that interactive and hands-on instructional methods, such as demonstrations and inquiry-based learning, significantly enhance student comprehension and learning outcomes.

The findings reveal that several learning competencies in Science for Grades 4 to 6 were categorized under low proficiency, particularly in understanding organ systems, interactions among organisms, and reproduction in animals and plants. These results highlight the need for targeted interventions to strengthen students' comprehension of these fundamental scientific concepts. It is recommended that educators implement differentiated instruction strategies, such as hands-on activities and visual representations, to enhance students' understanding of complex biological processes. Additionally, integrating interactive and inquiry-based learning approaches, including experiments and real-world applications, can further support mastery of these least proficient competencies.

3.2. Development of Inquiry-Based Supplementary Learning Materials

The subsequent tables present the identified least mastered competencies in Science for key stage 2, serving as the basis for developing inquiry-based supplementary learning materials. A table also outlines the parts, purpose, and description of the developed inquiry-based supplementary learning materials in Science. Table 8 shows the least mastered competencies in Science across the three grade levels. The grade 4 and 5 levels have four identified least mastered competencies, while the grade 6 level has three least mastered competencies. These least mastered competencies served as the basis for developing the inquiry-based supplementary learning materials.

Table 8. *Least Mastered Competencies in Science in Key Stage 2 Basis for the Development of Inquiry-Based Supplementary Learning Materials*

Grade Level	Least Mastered Competencies
4	"Communicate that the major organs work together to make the body function properly."
	"Infer that body structures help animals adapt and survive in their particular habitat."
	"Describe the effect of the environment on the life cycle of organisms."
	"Describe some types of beneficial and harmful interactions among living things."
5	"Describe the different modes of reproduction in animals such as butterflies, mosquitoes, frogs, cats, and dogs."
	"Describe the different modes of reproduction in flowering and non-flowering plants such as moss, fern, mongo, and others."
	"Discuss the interactions among living things and non-living things in estuaries and intertidal zones."
	"Explain the need to protect and conserve estuaries and intertidal zones."
6	"Explain how the organs of each organ system work together."
	"Explain how the different organ systems work together."
	"Discuss the interactions among living things and non-living things in tropical rainforests, coral reefs, and mangrove swamps."

Below are the key findings on the parts, purposes, and descriptions of the developed learning materials, as detailed in Table 9. Inquiry-Based Supplementary Learning Material refers to educational resources designed to support and enhance student learning through inquiry-based learning (IBL). These materials encourage students to explore concepts, ask questions, investigate, and construct knowledge through hands-on activities and critical thinking. The developed inquiry-based supplementary learning materials comprise five key parts, each designed to address specific stages of the learning process. The section "Get Ready to Discover!" serves as the activation phase, sparking students' curiosity by introducing the lesson's theme through relatable real-life scenarios, thought-provoking questions, or visually stimulating prompts. This section sets the stage for inquiry by connecting students' prior knowledge to new concepts, fostering an initial sense of engagement and relevance. Next, "Go on a Journey!" provides opportunities for experiential learning, where students engage in hands-on activities such as experiments and guided investigations. This part emphasizes active exploration, critical thinking, and collaboration, ensuring that students directly interact with the subject matter and test their ideas.

Following exploration, "Let's Figure It Out!" facilitates the processing and interpretation of data or experiences. In this phase, students analyze their findings, draw conclusions, and connect their observations to scientific principles. This critical thinking stage deepens understanding and clarifies misconceptions under the guidance of the teacher. Moving beyond the basics, "Let's Dig Deeper!" extends learning by introducing advanced

concepts, real-world applications, and cross-disciplinary connections, enriching students' comprehension and inspiring further inquiry. The final section is titled "Take This Challenge!" It is an assessment phase, allowing students to independently apply their knowledge and skills through performance tasks, creative projects, or problem-solving activities.

Table 9. *Parts and its Purpose and Description of the Developed Inquiry-Based Supplementary Learning Materials in Science*

Part	Purpose	Description
Get Ready to Discover!	To activate prior knowledge and spark curiosity about the topic.	This section introduces the lesson's theme or concept using real-life scenarios, thought-provoking questions, or intriguing visuals. It sets the context for inquiry and prepares learners to engage with the topic by building a strong foundation. Teachers use it to connect students' existing knowledge with new concepts.
Go on a Journey!	To encourage experiential learning through hands-on activities and exploration.	Learners actively explore the topic through structured tasks, experiments, or guided investigations. This section fosters inquiry and critical thinking, allowing students to observe, hypothesize, and test their ideas. Teachers guide this process to ensure alignment with lesson objectives while promoting collaboration and engagement.
Let's Figure It Out!	To guide learners in analyzing and reflecting on their observations and findings.	Students process and interpret data or experiences gathered during exploration. This section encourages critical thinking, helping learners analyze results, draw conclusions, and link their observations to scientific principles. Teachers use this part to clarify misconceptions and scaffold understanding for deeper comprehension.
Let's Dig Deeper!	Extend learning by introducing advanced concepts, real-world applications, and cross-disciplinary connections.	This section challenges students to think beyond the basics by exploring broader implications, applications, or complex ideas. It may include additional resources like readings or case studies. Teachers use it to enrich understanding, demonstrate the relevance of Science, and inspire curiosity for further exploration.
Take This Challenge!	To assess learning and encourage independent application of knowledge and skills.	Students apply their learning through performance tasks, problem-solving activities, or creative projects. This section assesses mastery of content and skills like critical thinking and creativity. Teachers can use it as a summative or formative assessment tool, fostering reflection and celebrating students' progress and achievements.

Based on the developed learning materials, educators can use these materials to activate prior knowledge, promote hands-on learning, and encourage critical thinking, ensuring a more interactive and student-centered learning experience. The structured framework of these materials supports inquiry-based teaching by providing clear stages that align with effective pedagogical strategies. Educators can integrate these materials into various instructional settings, ensuring consistency in science lessons and promoting experiential learning. The study conducted by Dewi (2024) explains that developing supplementary learning materials using an inquiry-based learning model can significantly enhance students' science process skills. It is essential as these skills are foundational for understanding scientific concepts and conducting experiments effectively.

In the same way, the study of Sari Wulandari (2023) presents that inquiry-based learning encourages students to participate actively in their education. This approach encourages curiosity and critical thinking, enabling students to delve more deeply into scientific concepts. The study's findings support the idea that when students engage in inquiry, they are more likely to develop a genuine interest in Science, leading to better learning outcomes. It is concluded that the developed inquiry-based supplementary learning materials provide structured and flexible learning experiences that integrate real-world applications and active exploration. They comprise an interconnectedness section that promotes inquiry-based learning, such as "Get Ready to Discover!" "Go on a Journey!" "Let's Figure it Out!" "Let's Dig Deeper!" and "Take This Challenge!" It is recommended that teachers integrate these learning materials into their science instruction to promote inquiry-based learning inside the classroom. The school, district, and school division may intensify the conduct of workshops and teacher training through the Learning Action Cell (LAC), In-Service Training for Teachers (INSET), and Collaborative Expert Sessions for teachers on developing learning materials in an inquiry-based learning approach.

3.3. Validation of the Inquiry-Based Supplementary Learning Material

The following validation findings were conducted on all developed inquiry-based supplementary learning materials in key stage 2. The validation encompasses the content, format, presentation, and organization, as well as the accuracy and up-to-datedness of the information in the developed inquiry-based supplementary learning

materials. Table 10 shows the result of validating the developed inquiry-based supplementary learning material for Science 4, aligned with the Department of Education's criteria for print materials. It indicates that all learning competencies and criteria were met.

Table 10. Results of Validation for the Developed Inquiry-Based Supplementary Learning Material in Science 4 based on the criteria for Print Materials provided by the Department of Education-DepEd

Criteria	Validator					Mean Score	Remarks
	1	2	3	4	5		
Learning Competency: "Describe the Main Function of the Major Organs"							
Content	25	25	24	26	22	24.40	Passed
Format	65	63	62	62	68	64.00	Passed
Presentation and Organization	19	20	18	19	17	18.60	Passed
Accuracy and Up-to-dateness of information	24	24	24	24	24	24.00	Passed
Learning Competency: "Infer that body structures help animals adapt and survive in their particular habitat."							
"Content"	24	27	25	28	27	26.20	Passed
"Format"	62	72	64	69	65	66.40	Passed
"Presentation and Organization"	19	19	17	19	20	18.80	Passed
"Accuracy and Up-to-dateness of information"	24	24	24	24	24	24.00	Passed
Learning Competency: "Describe the effect of the environment on the life cycle of organisms."							
"Content"	21	25	24	23	24	23.40	Passed
"Format"	54	63	63	64	57	60.20	Passed
"Presentation and Organization"	15	18	18	17	16	16.80	Passed
"Accuracy and Up-to-dateness of information"	24	24	24	24	24	24.00	Passed
Learning Competency: "Describe some types of beneficial and harmful interactions among living things."							
"Content"	28	25	26	24	23	25.20	Passed
"Format"	72	55	67	65	64	64.60	Passed
"Presentation and Organization"	20	20	18	18	16	18.40	Passed
"Accuracy and Up-to-dateness of information"	24	24	24	24	24	24.00	Passed

The validation of learning materials across different competencies showed consistently passing scores in all criteria. The competency in "describing the primary function of major organs" achieved a passing remark on the validation. Similarly, the learning competency on "inferring that body structures help animals adapt and survive in their particular habitat" showed passing comments. Although the competency in "describing the effect of the environment on the life cycle of organisms" had slightly lower ratings in some areas, it still met the criteria. In contrast, the competency in "describing beneficial and harmful interactions among living things" met the requirements and indicated passing remarks.

Table 11 presents the results of validating the inquiry-based supplementary learning material in Science 5. The validation of the supplementary learning material confirmed their alignment with DepEd criteria, as all areas received passing marks. The learning competency in "describing the different modes of reproduction in animals such as butterflies, mosquitoes, frogs, cats, and dogs" showed passing remarks in all criteria. Similarly, the learning competency in "describing the different modes of reproduction of flowering and non-flowering plants such as moss, fern, mongo, and others" marks passing scores across all criteria. Additionally, the learning competencies on "discussing the interactions among the living things and non-living things in estuaries and intertidal zones" and "explaining the need to protect and conserve the estuaries and intertidal zones" reflected compliance with the criteria and indicated passing remarks.

The validation results confirmed that the developed inquiry-based supplementary learning material in Science 6 successfully met the criteria for print materials across all learning competencies. The learning competency in "explaining how organ systems work together" demonstrated passing remarks across all requirements. Similarly, the learning competency in "explaining how different organ systems work together" reflected passing remarks on all validation criteria. The learning competency in "discussing the interactions among living things and non-living things in tropical rainforests, coral reefs, and mangrove swamps" also showed passing scores across the criteria. The findings of the validation of the inquiry-based supplementary learning materials confirm their effectiveness in aligning with educational standards, ensuring that students receive accurate and well-structured content to support their learning. It implies that the positive validation results reinforce the reliability of the instructional framework, demonstrating that the materials adhere to established pedagogical principles

and meet the Department of Education's criteria for quality print materials. Additionally, these findings highlight the importance of continuous evaluation and refinement in curriculum development, emphasizing that validated instructional resources can enhance student engagement and comprehension while maintaining accuracy and relevance in science education.

Table 11. Results of Validation for the Developed Inquiry-Based Supplementary Learning Material in Science 5 based on the Criteria for Print Materials provided by the Department of Education-DepEd

Criteria	Validator					Mean Score	Remarks
	1	2	3	4	5		
Learning Competency: “Describe the different modes of reproduction in animals such as butterflies, mosquitoes, frogs, cats, and dogs.”							
“Content”	25	27	25	24	26	25.40	Passed
“Format”	65	69	66	68	89	71.40	Passed
“Presentation and Organization”	18	16	17	19	17	17.40	Passed
“Accuracy and Up-to-dateness of information”	24	24	24	24	24	24.00	Passed
Learning Competency: “Describe the different modes of reproduction in flowering and non-flowering plants such as moss, fern, mongo, and others.”							
“Content”	23	27	26	23	22	24.20	Passed
“Format”	61	69	66	61	71	65.60	Passed
“Presentation and Organization”	18	16	18	16	19	17.40	Passed
“Accuracy and Up-to-dateness of information”	24	24	24	24	24	24.00	Passed
Learning Competency: “Discuss the interactions among the living things and non-living things in estuaries and intertidal zones.”							
“Content”	24	25	24	24	22	23.50	Passed
“Format”	59	63	64	64	59	61.80	Passed
“Presentation and Organization”	18	20	18	17	16	17.80	Passed
“Accuracy and Up-to-dateness of information”	24	24	24	24	24	24.00	Passed
Learning Competency: “Explain the need to protect and conserve estuaries and intertidal zones.”							
“Content”	25	26	24	25	28	25.60	Passed
“Format”	61	68	68	65	72	66.80	Passed
“Presentation and Organization”	18	19	18	20	20	19.00	Passed
“Accuracy and Up-to-dateness of information”	24	24	24	24	24	24.00	Passed

Table 12. Results of Validation for the Developed Inquiry-Based Supplementary Learning Material in Science 6 based on The Criteria for Print Materials provided by the Department of Education-DepEd

Criteria	Validator					Mean Score	Remarks
	1	2	3	4	5		
Learning Competency: "Explain how the organs of each organ system work together."							
"Content"	26	26	24	28	24	25.60	Passed
"Format"	66	71	66	67	62	66.40	Passed
"Presentation and Organization"	19	18	16	20	16	17.80	Passed
"Accuracy and Up-to-dateness of information"	24	24	24	24	24	24.00	Passed
Learning Competency: "Explain how the different organ systems work together."							
"Content"	26	26	26	27	25	26.00	Passed
"Format"	66	69	68	67	65	67.00	Passed
"Presentation and Organization"	18	23	18	20	20	19.80	Passed
"Accuracy and Up-to-dateness of information"	24	24	24	24	24	24.00	Passed
Learning Competency: "Discuss the interactions among living things and non-living things in tropical rainforests, coral reefs, and mangrove swamps."							
"Content"	28	26	27	29	27	27.40	Passed
"Format"	67	54	61	56	72	62.00	Passed
"Presentation and Organization"	23	18	17	18	20	19.20	Passed
"Accuracy and Up-to-dateness of information"	24	24	24	24	24	24.00	Passed

The study of Alfin et al. (2024) suggests that the development of learning materials should be well-aligned with educational standards and effectively support the learning objectives related to scientific attitudes. Valid content is crucial for ensuring that students engage with accurate and relevant information, thereby enhancing their

understanding and interest in the subject matter. In the same way, a well-organized format helps students navigate the materials quickly, facilitating a smoother inquiry process. A previous study by Edillor (2024) suggested that effective presentations can incorporate bullet points, diagrams, and summaries that highlight key concepts, thereby facilitating students' understanding of essential ideas. Learning materials that are well-organized and easy to navigate allow students to focus on the inquiry process rather than getting lost in confusing layouts or excessive information. When information is structured in a way that guides students through their investigations, it helps them build on prior knowledge and make connections between different concepts.

Aligning with the conclusions of the study conducted by Altares (2024), the learning materials must undergo a thorough review by experts, ensuring that the information presented in the materials is accurate. Students rely on the correctness of the information to build their understanding of complex concepts. As to the up-to-dateness of the information, the materials are based on current scientific knowledge and practices. It concludes that the developed inquiry-based supplementary learning material for Science in key stage 2 meets the DepEd-LRMDs criteria for print materials. All the learning competencies across grade levels received passing marks in content, format, presentation, organization, accuracy, and up-to-date information. These findings recommend that this developed and validated inquiry-based supplementary learning material in key stage 2 may be published in the LRMDs portal of the Department of Education (DepEd). In this way, continuous review, refinement, and incorporation of feedback from experts from the DepEd Central office ensure that the content remains accurate, engaging, and aligned with the latest scientific knowledge and educational best practices.

3.4. Mastery Level of the Pupils before and After Using the Inquiry-Based Supplementary Learning Materials

The mean percentage score of both the pretest and posttest is presented in Table 13. The table also reflects the number of learners tested, the number of items, and their corresponding descriptive interpretation. As shown in Table 13, with 42 participants and a 30-item test, the pretest mean percentage score was 49.13%, which falls under the descriptive interpretation of "average mastery." Following the intervention, the posttest mean percentage score increased to 74.60%, categorized as "moving towards mastery."

Table 13. *Pretest and Posttest Mean Percentage Score and its Descriptive Interpretation in Science 4*

Construct	N	Number of Items	Mean Percentage Score	Descriptive Interpretation
Pretest	42	30	49.13	Average Mastery
Posttest	42	30	74.60	Moving Towards Mastery

As shown in Table 14, the results of the pretest and posttest are presented as mean percentage scores along with their descriptive interpretations. Based on the results in the table above, the pretest mean percentage score was 45.00, indicating an "average mastery" level of understanding before the intervention. However, after the intervention, the posttest mean percentage score increased to 67.76, corresponding to a "moving toward mastery" level of proficiency.

Table 14. *Pretest and Posttest Mean Percentage Score and its Descriptive Interpretation in Science 5*

Construct	N	Number of Items	Mean Percentage Score	Descriptive Interpretation
Pretest	52	30	45.00	Average Mastery
Posttest	52	30	67.76	Moving Towards Mastery

The results in Table 15 show the mastery level of Science 6 students, as shown by their mean percentage scores from the pretest to the posttest. The pretest mean percentage score is 39.25, corresponding to an "average mastery" level. After the intervention, the posttest mean percentage score rose to 69.62, signifying a "moving towards mastery" level of understanding. The significant improvement in students' mastery levels after using the inquiry-based supplementary learning materials demonstrates the effectiveness of enhancing conceptual understanding and retention in Science. It implies that the results validate the effectiveness of inquiry-based learning as a pedagogical approach, supporting its role in fostering active student engagement and deeper comprehension. Furthermore, the findings highlight the importance of incorporating supplementary materials into instruction, suggesting that structured and flexible intervention strategies can help bridge learning gaps and contribute to learners' overall academic progress.

Table 15. *Pretest and Posttest Mean Percentage Score and its Descriptive Interpretation in Science 6*

Construct	N	Number of Items	Mean Percentage Score	Descriptive Interpretation
Pretest	62	30	39.25	Average Mastery
Posttest	62	30	69.62	Moving Towards Mastery

The findings support the previous study of Sapriyadin et al. (2023), which explains that when learning materials are relevant, students are more likely to engage meaningfully with them. They also expound that students actively involved in the learning process, such as through hands-on experiments and discussions, tend to achieve better mastery of concepts. Engaging students in inquiry-based activities enables them to explore and discover new ideas, resulting in a deeper understanding and enhanced retention of knowledge. Furthermore, according to Ruzaman and Rosli's (2020) study, inquiry-based learning materials should actively engage students in the learning process. When students are involved in hands-on activities and experiments, they are more likely to develop a deeper understanding of the subject matter. This engagement promotes curiosity and motivation, which are essential for effective learning. The findings conclude that there was a significant improvement in the mastery level in Science of key stage 2 pupils after using the inquiry-based supplementary learning materials, as evidenced by the increase in their mean percentage scores from average mastery in the pretest to moving toward mastery in the posttest. It is recommended that the inquiry-based supplementary learning materials be continuously utilized and further enhanced to sustain and improve pupils' mastery levels while also exploring their integration into other subject areas to maximize their effectiveness.

3.5. Difference in the Mean Pretest and Posttest Scores of the Pupils

The tables below show the study's significant findings regarding pupils' mean pretest and posttest scores. It presents the values used to determine the important difference between the pretest and posttest using the ANOVA analysis. Table 16 presents the considerable differences between the pretest and posttest scores of pupils in Science 4. Table 16 shows that analysis of the pretest and posttest results revealed a sum of squares of 2.279 across 15 degrees of freedom, yielding a mean square of 0.152 with a standard deviation of ± 0.39 . The computed F-value of 0.552 and p-value of 0.900 indicate no statistically significant difference between the pretest and posttest scores.

Table 16. *Significant Difference in the Mean Pretest and Posttest Scores of Grade 4 Pupils*

Measure	Sum of Squares	df	Mean Square	SD	F	p	Remarks
Test (Pretest and Posttest)	2.27	15	.15	± 0.39	.55	.900	Not Significant

Note: alpha level = 0.05

Based on Table 17, the pretest and posttest results analysis revealed a statistically significant difference in performance, as indicated by an F-value of 3.731 and a p-value of .000, below the accepted significance level. With a sum of squares of 12.705 distributed across 21 degrees of freedom, the mean square value was calculated at .605, with a standard deviation of ± 0.78 . It indicates a significant difference in the pretest and posttest mean scores of Grade 5 pupils before and after using the inquiry-based supplementary learning material.

Table 17. *Significant Difference in the Mean Pretest and Posttest Scores of Grade 5 Students*

Measure	Sum of Squares	df	Mean Square	SD	F	p	Remarks
Test (Pretest and Posttest)	12.70	21	.60	± 0.78	3.73	.000	Significant

Note: alpha level = 0.05

Table 18 presents the significant difference in the mean pretest and posttest scores of Grade 6 students. The analysis of the test scores between the pretest and posttest revealed a considerable difference, as indicated by the F-value of 6.205 and a p-value of .000, which is below the accepted significance level. With a mean square of .903 and a standard deviation of ± 0.95 , the results suggest notable improvements in performance following the intervention.

Table 18. *Significant Difference in the Mean Pretest and Posttest Scores of Grade 6 Pupils*

Measure	Sum of Squares	df	Mean Square	SD	F	p	Remarks
Test (Pretest and Posttest)	15.35	17	.90	± 0.95	6.20	.000	Significant

Note: alpha level = 0.05

Table 19 shows the statistical analysis comparing the pretest and posttest results. The scores significantly improved, as indicated by an F-value of 10.842 and a p-value of .000, below the standard significance level of 0.05. The computed mean square value of 1.603, derived from the sum of squares of 35.269 and degrees of freedom of 22, further supports the substantial variation observed between the test phases. With a standard deviation of ± 1.27 , the results confirm a consistent pattern of performance enhancement.

Table 19. Significant Difference in the Mean Pretest and Posttest Scores across the Three Grade Level

Measure	Sum of Squares	df	Mean Square	SD	F	p	Remarks
Test (Pretest and Posttest)	35.26	22	1.60	± 1.27	10.84	.000	Significant

Note: alpha level = 0.05

The lack of significant differences in the pretest and posttest scores of Grade 4 pupils implies that the instructional approach may not have been effective in enhancing student learning, possibly due to factors such as the complexity of the material, engagement levels, instructional delivery, or the duration of the intervention. Additionally, external factors such as motivation, prior knowledge, or classroom environment may have influenced the results, highlighting the necessity for further investigation to optimize instructional effectiveness. However, the results of grades 5 and 6 suggest that the inquiry-based supplementary learning material employed had a substantial impact on student learning outcomes. The significant increase in scores suggests that students could grasp and apply the concepts more effectively post-intervention, highlighting the effectiveness of the educational approach. The substantial increase in scores implies enhanced comprehension and mastery of the subject matter, demonstrating the efficacy of the inquiry-based supplementary learning material.

The study's finding aligns with the reports of Martínez (2022), who revealed that the differences in students' prior knowledge and experiences can also contribute to the lack of significant change in scores. If students come from diverse backgrounds with varying levels of exposure to various concepts, this can affect their performance on standardized tests. Additionally, the amount of time allocated for instruction and practice may not be sufficient for students to fully grasp the learning material. If the learning competency is rushed or students lack opportunities to practice, their scores may not reflect their potential improvement. Consequently, the researcher viewed the findings as having no significant difference because they relate to the language barrier learners face when transitioning from their mother tongue (*Bisaya*) to the English language used in teaching Science concepts. The study by Naketsana (2019) indicates that learners in Grade 3 faced reading and writing difficulties, as well as low proficiency in English. These challenges can persist into Grade 4, affecting their assessment performance and leading to no significant improvement in scores.

The results showed the positive impact of inquiry-based supplementary learning materials. According to Kliziene et al. (2020), significant differences in mean pretest and posttest scores indicate that students have made measurable progress in their academic performance. This improvement can be attributed to effective teaching methods, learning materials, or interventions. Additionally, notable changes in scores indicate that the employed strategies or interventions are effective. The significant result of the mean scores for both the pretest and posttest of grade 6 pupils in the study of Baysal et al. (2022) reported that the important difference between the pretest and posttest scores indicates that the students' scientific process skills improved after the intervention. Supplementary materials, when used in an inquiry-based approach, can increase student engagement and motivation. The interactive nature of these learning materials allows students to take an active role in their learning, which is crucial for mastering complex scientific concepts (Baysal et al., 2022).

Inquiry-based supplementary learning materials significantly enhance the mastery level of pupils across the three grade levels, leading to improved mastery levels. This approach encourages pupils to explore and investigate, resulting in a deeper understanding of complex concepts. Based on the study of Kurais et al. (2023), students using inquiry-based learning methods achieved a mastery percentage of 92.60% compared to 29.63% in traditional settings. Similarly, research by Sapriyadin et al. (2023) highlighted significant differences in concept mastery between students engaged in inquiry-based learning and those using conventional methods, particularly in subjects like Science. Additionally, inquiry-based learning promotes higher-order thinking skills, enabling students to develop problem-solving abilities.

The findings indicate that while there was no significant improvement in the pretest and posttest scores of Grade 4 pupils, the use of the inquiry-based supplementary learning material led to statistically significant improvements in the performance of Grade 5 and Grade 6 pupils, with a notable overall enhancement across the three grade levels. It is recommended that future researchers conduct studies on the effectiveness of inquiry-based supplementary learning materials in different learning environments. Furthermore, it may also test the efficacy of the inquiry-based supplementary learning materials in Junior High School (JHS) and Senior High School (SHS) in various domains of the Science subject.

4.0 Conclusion

This study significantly addresses the learning gaps in Science among Key Stage 2 learners, particularly in the interdependence of living things, body structures, reproduction, and environmental conservation. The development and utilization of the inquiry-based supplementary learning materials provided a structured, engaging, and learner-centered approach that effectively supported the development of scientific understanding. Organized into five purposeful sections—*Get Ready to Discover!*, *Go on a Journey!*, *Let's Figure It Out!*, *Dig Deeper!*, and *Take This Challenge!*—the materials activated prior knowledge, encouraged exploration, and deepened conceptual comprehension while ensuring learning assessment. Meeting the Department of Education's LRMDs standards, the materials aligned strongly with content, format, and accuracy requirements. The improvement in the mastery levels of learners, particularly in Grades 5 and 6, as evidenced by the statistically significant differences in their pretest and posttest scores, highlights the effectiveness of the intervention. Although no significant difference was observed in Grade 4, the overall trend toward mastery suggests a promising impact. Future studies may further refine the materials for younger learners by integrating digital components and enhancing scalability across broader contexts to improve science instruction and learning outcomes nationwide.

5.0 Contributions of Authors

The authors attest that each section of this work was equally contributed to. All authors examined and approved the final draft.

6.0 Funding

There is no source of funding.

7.0 Conflict of Interests

There is no conflict of interest

8.0 Acknowledgment

The researcher sincerely extends his deepest gratitude to all who contributed to the success of this study. Special thanks to Dr. Edilbert A. Reyes, his dedicated adviser, for his unwavering support and technical guidance; to Dr. Gaudy C. Ortizo, Dean of the Graduate School of the Notre Dame of Dadiangas University, General Santos City, for his insightful guidance; to Dr. Jose Antonio A. Guntaladad, Committee Chair, for his insightful feedback and suggestions; to Dr. Leizle B. Coronica and Dr. Alma A. Hordista, members of the research committee, for their valuable inputs and encouragement. Appreciation is also given to the Schools Division of Davao Occidental, expert validators, teachers, and learner participants for their support during the study. Heartfelt thanks to his loving parents, Edgardo and Elvira Arevalo, his siblings, relatives, and friends for their prayers, love, and encouragement, and to his fellow teachers at Mote Elementary School for their moral support. Above all, he thanks the Almighty Father for the strength, wisdom, and blessings that made this journey possible.

9.0 References

- Alfin, M. B., Cahyono, E., Ridlo, S., Sumarni, W., & Widiyatmoko, A. (2024). The validity of the guided inquiry-based teaching module on additives to improve students' scientific attitudes. *Journal of Innovative Science Education*, 13(1), 12–19. <https://doi.org/10.15294/jise.v13i1.1020>
- Altare, F. (2024). Development and validation of a supplemental learning resource in Chemistry in conversational Filipino. *Journal of Interdisciplinary Perspectives*, 2(1). <https://doi.org/10.69569/jip.2024.0010>
- Andrade, C. (2020). The inconvenient truth about convenience and purposive samples. *Indian Journal of Psychological Medicine*, 43, 86–88. <https://doi.org/10.1177/0253717620977000>
- Baysal, E. A., Yörük, A. O., & Ocak, İ. (2022). Acquiring scientific process and innovative thinking skills for secondary school sixth grade students through digital activities: An action research. *Journal of Science Learning*, 5(3), 411–430. <https://doi.org/10.17509/jsl.v5i3.44806>
- Department of Education. (2016). K to 12 Araling Panlipunan gabay pangkurikulum Mayo 2016. Retrieved from <https://tinyurl.com/yc2at23m>
- Department of Education. (2011). National adoption and implementation of the learning resources management and development system (LRMDs). Retrieved from <https://tinyurl.com/2n4f5eah>
- Dewi, N. R., Saputri, E., Nurkhalisa, S., & Akhlis, I. (2020). The effectiveness of multicultural education through traditional games-based inquiry toward improving student scientific attitude. *Journal of Physics: Conference Series*, 1567(4), 042051. <https://doi.org/10.1088/1742-6596/1567/4/042051>
- Diestro, D. (2023). Exploring students' performance using lingua franca in science education: a study of grade ten students in Capiz, Philippines. *F1000Research*, 12, 1439. <https://doi.org/10.12688/f1000research.141170.1>
- Edillor, J. A. A. (2024). Inquiry-based instruction in Science among grade 8 students in Rizal National High School, Surigao City Division. 129–138. <https://doi.org/10.69481/vrtlingbi10072024>
- Galarosa, M. M., Maningas, O., Manag, K. A., Maningas, R., & Yazon, A. D. (2024). Effectiveness of QUANTOM Kit as a supplementary learning material in enhancing academic performance. *Advanced Journal of STEM Education*, 2(2), 42–60. <https://doi.org/10.31098/ajosed.v2i2.2653>
- Kamidah, N., Zaenuri, & Junaedi, I. (2023). Development of teaching materials using problem-based learning (PBL) models with Ethnomathematics nuances to improve students' critical thinking ability. *International Journal of Research and Review*, 10(8), 228–235. <https://doi.org/10.52403/ijrr.20230829>
- Kliziene, I., Cizauskas, G., Augustiniene, A., Sipaviciene, S., & Aleksandraviciene, R. (2020). The relationship between school age children's academic performance and innovative physical education programs. *Sustainability*, 12(12), 4922. <https://doi.org/10.3390/su12124922>
- Kurais, S. D., Tanor, M. N., & Manuahe, C. (2023). Application of the inquiry learning model in improving student learning outcomes in Biology Science learning at SMP Negeri 6 Tondano. *Dharma Acariya Nusantara*, 1(2), 94–102. <https://doi.org/10.47861/jdan.v1i2.485>
- Lee, H., Hong, S., Kim, J., Kim, J., Lee, K., Lee, J., & Jeong, J. (2013). Complete enumeration for the prevalence of allergic disease in Udo Isle's inhabitants. *Allergy Asthma & Respiratory Disease*, 1, 116. <https://doi.org/10.4168/aard.2013.1.2.116>

- Mahardika, I. K. D. O., & Putra, M. (2020). Teams games tournament assisted by question card increases student knowledge competence in science learning. *International Journal of Elementary Education*, 4(3), 301. <https://doi.org/10.23887/ijee.v4i3.25956>
- Martínez, I. M., Youssef-Morgan, C. M., Chambel, M. J., & Marques-Pinto, A. (2019). Antecedents of academic performance of university students: Academic engagement and psychological capital resources. *Educational Psychology*, 39(8), 1047–1067. <https://doi.org/10.1080/01443410.2019.1623382>
- Mijares, B. F., III. (2023). Development and validation of a supplementary learning material in Earth Science. *Cosmos An International Journal of Art and Higher Education*, 12(1), 56–76. <https://doi.org/10.46360/cosmos.ah.520231005>
- Naketsana, M. (2019). Language transition and epistemic access: The teaching and learning of English as a first additional language in the foundation phase (Master's thesis). University of the Western Cape. <https://core.ac.uk/download/pdf/227107741.pdf>
- Philippine Institute for Development Studies. (2021). Policy notes. Retrieved from <https://tinyurl.com/2nm8ncu6>
- Purkat, M., & Devetak, I. (2023). Fifth-grade students' Science competencies – An opportunity to rethink further education for Science competence. *Center for Educational Policy Studies Journal*. <https://doi.org/10.26529/cepsj.1658>
- Rapada, S., & Servañez, B. (2024). Development and validation of ONHAN supplementary learning module on four basic operations on integers. *Romblon State University Research Journal*, 6(1), 26–37. <https://doi.org/10.58780/rsurj.v6i1.170>
- Ruzaman, N. K., & Rosli, D. I. (2020). Inquiry-based education: Innovation in participatory inquiry paradigm. *International Journal of Emerging Technologies in Learning (Ijet)*, 15(10), 4–15. <https://doi.org/10.3991/ijet.v15i10.11460>
- Sapriyadin, D., Sutopo, S., & Wisodo, H. (2023). Influence of inquiry learning on concept mastery ability and Physics problem solving ability of students on work and energy material. *Jurnal Penelitian Pendidikan IPA*, 9(2), 734–744. <https://doi.org/10.29303/jppipa.v9i2.3253>
- Sari, D. R., & Wulandari, R. (2023). Elevating cognitive learning outcomes via inquiry learning empowered by digital web teaching materials in Science Education. *Indonesian Journal of Education Methods Development*, 18(4). <https://doi.org/10.21070/ijemd.v21i4.797>
- Setiabudi, A., Mulyadi, M., & Puspita, H. (2019). An analysis of validity and reliability of a teacher-made test. *Journal of English Education and Teaching*, 3(4), 522–532. <https://doi.org/10.33369/jeet.3.4.522-532>
- Sheehan, P., Kwon, M., & Steiner, P. M. (2024). Quasi-experimental designs for causal inference: Addressing threats to validity from a graphical models perspective. <https://doi.org/10.31234/osf.io/pdt63>
- Sotáková, I., & Ganajová, M. (2023). The effect of the 5E instructional model on students' cognitive processes and attitudes towards Chemistry as a subject. *Eurasia Journal of Mathematics Science and Technology Education*, 19(9), em2317. <https://doi.org/10.29333/ejmste/13469>
- Umara, R. (2022). The effectiveness of the demonstration method to improve student learning outcomes. *East Asian Journal of Multidisciplinary Research*, 1(9), 1997–2006. <https://doi.org/10.55927/eajmr.v1i9.1513>
- Wahyuni, D., Risnawaty, R., Sutikno, S., & Kartolo, R. (2022). Development of writing teaching materials with a contextual approach of public junior high school (SMPN 1), Pinang City, South Labuhan Batu, Indonesia. *International Journal of Research in Community Service*, 3, 54–57. <https://doi.org/10.46336/ijrcs.v3i2.266>
- Wiltz, J. (2023). The effects of using Case-Based learning in a flipped classroom on First-Semester nursing students' exam scores. <https://doi.org/10.46409/sr.wksw6744>
- Wolfson, T. S., Atesok, K. I., Turhan, C., Mabrey, J. D., Egol, K. A., & Jazrawi, L. M. (2015). Animation and surgical simulation in orthopedic education. In M. N. Doral & J. Karlsson (Eds.), *Sports Injuries* (pp. 3047–3063). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-36569-0_245