Contextualized Lesson Exemplars for Enhancing Scientific Literacy in Science

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Abstract

Scientific literacy is crucial for enabling learners to grasp and utilize scientific concepts in everyday scenarios. Nonetheless, international assessments such as PISA and TIMSS have shown that students in the Philippines still encounter difficulties in this area, demonstrating the need for meaningful and effective science teaching.

The study aimed to develop contextualized lesson exemplars and determine their impact on students' scientific literacy. In particular, it examined whether there was a significant difference between students' scores before and after the implementation of the developed contextualized lesson exemplar. Using a descriptive-developmental research design, the study involved 80 Grade 7 students from Plaridel Integrated National High School enrolled in the academic year 2025–2026, selected through cluster random sampling. Before developing the lesson exemplars, the researcher conducted a survey to assess the learners' perceived scientific literacy and administered interviews to explore the socio-cultural, historical, and environmental context of Nagcarlan, Laguna. Then, the contextualized lesson exemplars were organized according to the 4C's framework of the Matatag Curriculum and included data from the local context of Nagcarlan. Altogether, this exemplar aimed to enhance scientific literacy by making the lesson meaningful and relatable to learners. Pre and post-assessments were used to assess students' performance after using the contextualized lesson exemplars. Results revealed a significant difference in the students' scientific literacy, as indicated in the pretest and post-test scores. This result revealed that the lesson exemplar helped to enhance learners' scientific literacy. Furthermore, the contextualized lesson exemplars were rated highly acceptable by science experts, indicating their effectiveness and reliability as instructional guides.

Keywords: scientific literacy ; contextualized lesson exemplars; 4C's framework; socio-cultural context; historical context; environmental context; Nagcarlan Laguna;

1. Introduction

Scientific literacy is an essential skill that contributes to the awareness of reality around us. It involves the ability to understand, evaluate, and convey scientific concepts (Graham, 2024), which is important in today's generation. It is not merely about memorizing and recalling facts, but more about one's interaction with scientific matters, analyzing data, and assessing choices in the personal, societal, and global scenes.

According to Bybee (1997), the development of scientific literacy can be categorized into four levels. These include nominal, functional, conceptual, procedural, and multidimensional, which show the progression of broadening knowledge and understanding of science. These levels were also described in the study of Aquino et al. (2025). As illustrated, students first learn the basic ideas and skills. Eventually, they learn how to think carefully, make good decisions, and understand how science affects people, culture, and society. The levels also aligned with the three types of knowledge of the OECD (2025). In the initial stages, the emphasis of content knowledge is established, and learners gain a basic understanding of key scientific ideas and information. As students move forward, they gain procedural knowledge, learning the skills needed to conduct scientific investigations and apply scientific methods. Finally, in the multidimensional stage, students engage with epistemic knowledge, evaluating scientific statements, making evidence-based decisions, and considering the ethical, cultural, and social implications of scientific issues.

But until today, the difficulties in promoting scientific literacy continue, especially in the Philippine context. In the 2022 Program for International Student Assessment (PISA), Filipino students ranked 78th out of 80 countries in science (OECD, 2022). This result highlighted a serious concern in the country's science education. Findings of different studies revealed recurring challenges in cultivating scientific literacy. The studies of Schaeffer and Shapiro (2017) and Shahzadi and Nasreen (2020) indicate that the difficulties in connecting science to everyday life, limited engagement with scientific inquiry, and lack of opportunities to apply concepts meaningfully limit the development of scientific literacy in learners. In Philippine classrooms, these challenges are intensified by curriculum gaps and limited access to instructional materials. While innovative teaching strategies are being introduced, many learning resources rely on passive, textbook-based instruction owing to the slow shift in pedagogical approaches and insufficient systemic support (Bantillo & Ngag, 2024).

In response, the Department of Education introduced the MATATAG K to 10 Curriculum that changes the instructional framework by introducing the four key aspects of instructional design, collectively known as the 4Cs. The 4Cs instructional framework comprises Context, Connection, Collaboration, and Creativity. Context is the setting or environment that affects students' learning, and it also relates to learners' daily-life experiences for meaningful relevance. Connection, on the other hand, bridges concepts and ideas, promoting deeper understanding and transferable knowledge. Collaboration refers to the cooperative process in which students work together to achieve a common goal. Finally, creativity promotes innovative thinking and active engagement with content that encourages learners to use their imagination and critical thinking to create authentic expressions of their learning (DepEd, 2023). Furthermore, the curriculum also promotes contextualized instruction to offer more meaningful and relevant learning opportunities. This contextualized learning includes specific elements such as learners' abilities, socio-cultural, historical, and environmental context (DepEd, 2024). These contribute to a more learner-centered, relevant, and inclusive learning.

Although the MATATAG K to 10 Curriculum encourages education that focuses on students and is inclusive through contextualized teaching methods, several challenges still hinder its effective implementation. One of these is creating instructional materials that reflect students' cultural backgrounds, real-life experiences, and promote 21st-century skills. Thus, the researcher developed contextualized lesson exemplars that are aligned with the 4Cs instructional framework of the Matatag K to 10 Curriculum, focusing on Quarter 2 Life Science. These lessons aimed to connect scientific ideas to daily experiences, encourage collaboration, and improve imaginative thinking. Moreover, this study aimed to enhance students' understanding of science and promote scientific literacy through contextualized teaching, making learning relatable and applicable in real-life experiences.

2. Research Methodology

This chapter explains how the research was conducted, including the research design, population and sample, research instruments, validation of contextualized lesson exemplars, data collection, and statistical analysis.

2.1 Research Design

This study used a descriptive-developmental research design to promote scientific literacy among Grade 7 students through the use of contextualized lesson exemplars in Life Science-Quarter 2. A descriptive-developmental method of research is a systematic study of designing, developing, and evaluating instructional programs, processes, and products that must meet an intended criterion (Gaña, 2022). The developmental aspect of the design centered on the systematic manner, verification, execution, and assessment of educational materials, specifically, contextualized lesson exemplars. The materials were centered on Grade 7 Quarter 2 Life Science and targeted the competencies that students have struggled to master.

In this design, the lesson exemplars were developed through a structured process informed by students' baseline data, curriculum standards, and expert input. The lesson exemplars were then validated by the experts in terms of their content, format, presentation, and organization, as well as the accuracy and up-to-dateness of the information (Department of Education, n.d.). After validation, the lesson exemplars were used to see how well they improved students' scientific literacy. The researcher collected both qualitative and quantitative data to find out how students engaged with the contextualized lesson exemplars.

2.2 Respondents of the Study

The study sought the participation of two groups of respondents. The first group consisted of six (6) science expert teachers, including one Head teacher, two Master Teachers, and three Science subject teachers, who offered ratings, feedback, and recommendations for the research instruments and acceptability of the Contextualized Lesson Exemplars in terms of content, format, presentation, organization, and accuracy and up-to-datedness.

The second group of respondents comprised eighty (80) Grade 7 students at Plaridel Integrated National High School who participated in the implementation of contextualized lesson exemplars in Life Science. The student groups were selected using cluster random sampling. A pre-assessment was administered at the beginning to measure their initial knowledge and understanding. Following this, the intervention was implemented, and then a post-assessment was conducted to evaluate the effect of the intervention on the learners' understanding of the lessons.

2.3 Sampling Technique

Cluster random sampling was used to select the participants of the study. In this method, the research area was divided into equal clusters, and some of these clusters were randomly selected to represent the entire population. All members of the chosen cluster had an equal probability of being chosen as a respondent. Cluster sampling is a probability sampling technique that is often used when populations are divided into natural groups, such as classes or schools, and entire clusters are randomly selected (Thomas, 2020). Therefore, useful for sampling large or widely spread populations. The participants of the study were selected through this type of sampling and underwent both a pre-test and a post-test to measure the effectiveness of the contextualized lesson exemplars.

However, in selecting expert respondents, a purposive sampling technique was used. The chosen experts in the study were Science educators with relevant teaching experience and skills in assessing instructional materials. The group included one Head Teacher, two Master Teachers, and three Science subject teachers. The researcher used expert sampling to provide evidence for the validity of the developed materials. The advantage of this approach was that the researcher did not have to defend her decisions alone; instead, acknowledged experts supported the findings, making it easier to generalize the results of the study.

2.4 Data Gathering Procedure

The data were collected using a structured approach based on a descriptive-developmental research design, consisting of three stages: pre-development, development, and post-development.

In the pre-development stage, the researcher gathered relevant data in Nagcarlan, Laguna through approved coordination with various municipal offices, including the Agriculture Office, Tourism Office, MENRO, and BPLO. Data were collected through interviews, informal conversations, and document analysis to understand the socio-cultural, historical, and environmental context of the locality. Additional data were obtained through a focus group discussion (FGD) with twelve Grade 7 students, which revealed their experiences in local agricultural practices, food production, cultural traditions, and environmental concerns. These findings were used as a basis for contextualizing the lesson exemplars. Furthermore, a modified Perceived Scientific Literacy Survey based on Uno and Bybee (1994) was administered to assess learners' scientific literacy across five dimensions. The instrument underwent reliability testing prior to its use.

In the development stage, the collected data were utilized to design contextualized lesson exemplars for Grade 7 Life Science (Quarter 2) aligned with the 4Cs framework—Context, Connection, Collaboration, and Creativity. The lesson exemplars were validated by content experts and science teachers using the Learning Resources Management and Development System (LRMDS) rubric, focusing on content accuracy, organization, and relevance. Feedback from validators guided the revision of the materials.

In the post-development stage, the revised lesson exemplars were implemented among 80 Grade 7 students at Plaridel Integrated National High School. A pre-assessment was conducted to determine students' baseline knowledge, followed by a two-week implementation of the lessons, integrating local contexts such as historical landmarks, community practices, and environmental features. Learning activities included collaborative tasks such as role-playing and constructing models. After the intervention, a post-assessment was administered to evaluate effectiveness. Data were analyzed using frequency, percentage, mean, standard deviation, and paired t-test with the assistance of the CTE-GSAR Research and Statistics Center (GRACE).

2.5 *Research Instrument*

Four research instruments were utilized in the development, implementation, and evaluation of the contextualized lesson exemplars in Grade 7 Life Science: (1) Interview Guide for Grade 7 Learners, (2) Perceived Scientific Literacy Survey, (3) Scientific Literacy Assessment Tool, and (4) Teacher Validation Tool.

The Interview Guide for Grade 7 Learners, titled "Exploring Socio-Cultural, Historical, and Environmental Contexts," was used to gather in-depth information about students' daily lives and community experiences. It was divided into three sections: socio-cultural context, historical background, and environmental awareness. The data collected helped ensure that the lesson exemplars were relevant and responsive to the learners' local context.

The Perceived Scientific Literacy Survey, adapted from Uno and Bybee (1994), measured students' self-assessed scientific literacy across five dimensions: nominal, functional, conceptual, procedural, and multidimensional. The instrument consisted of 40 items using a 4-point Likert scale and was administered at the beginning of the study to identify students' strengths and areas for improvement.

The Scientific Literacy Assessment Tool was developed to measure students' actual scientific literacy in Life Science. It was based on the five levels of scientific literacy and aligned with the OECD (2025) knowledge domains and Aquino et al. (2025) framework. The test included 52 items with a total of 60 points: 48 multiple-choice questions assessing nominal to procedural levels, and 4 open-ended questions measuring multidimensional literacy. Responses to open-ended items were scored using a 3-point rubric. The test was administered as both pre- and post-assessment and was divided into two sets for easier implementation.

Lastly, the Teacher Validation Tool, adapted from the LRMDS evaluation criteria, was used by expert teachers to assess the quality of the lesson exemplars. The materials were evaluated based on content accuracy, format, organization, and up-to-datedness using a 5-point Likert scale. Feedback from validators was used to improve the instructional materials.

2.6 *Statistical Treatment of Data*

The data collected from the research instruments were analyzed using appropriate statistical methods to determine the effectiveness and acceptability of the contextualized lesson exemplars. The mean and standard deviation were computed to assess students' levels of scientific literacy across the five dimensions—nominal, functional, conceptual, procedural, and multidimensional—during the pretest and posttest. These measures were also used to analyze the evaluation of the lesson exemplars by expert validators in terms of content, format, presentation, organization, and accuracy of information.To measure students' improvement, the mean gain score was calculated. Furthermore, a paired-samples t-test was employed to determine whether there was a significant difference between the pretest and posttest scores at the 0.05 level of significance.

3. Results and Discussions

This chapter presents the tabular representations of the data gathered based on the problems and methods presented in the previous chapters. Together with the tables are the interpretations of the values found.

Table 1. Perceived Scientific Literacy Survey on Learners' Understanding and Abilities in Science in terms of Nominal Scientific Literacy.

Indicators	M	SD	VI
1. I can remember basic science facts when needed.	2.93	0.54	MH
2. I can recognize science-related terms I have learned before, but I cannot explain their meanings.	2.97	0.62	MH
3. I know the names of common science tools and materials, but I do not know how to use them.	2.94	0.72	MH
4. I can match science terms with their correct definitions, but I may not fully understand them.	2.75	0.76	MH
5. I can name parts of things in science without explaining what they do.	2.71	0.71	MH
6. I can point out common science symbols or signs, even if I do not know their full meaning.	2.53	0.74	MH
7. I can give examples of science things I know, even if I cannot explain them.	2.79	0.83	MH
8. I can recognize science topics, even if I do not fully understand them.	2.69	0.83	MH
MEAN	**2.77**	**0.33**	**MH**

Legend: 1.00–1.49 (Low) (L); 1.50–2.49 (Moderate) (M); 2.50–3.49 (Moderately High) (MH); 3.50–4.49 (High) (H); 4.50–5.00 (Very High) (VH)

Table 1 displays the findings of the perceived scientific literacy of learners in terms of nominal scientific literacy. With the overall mean score of 2.77 (SD=0.33), this shows that learners perceived themselves to have a moderately high level of nominal scientific literacy and confident in recognizing basic scientific facts, terms, symbols, and topics, although their understanding remains superficial and limited, this may be attributed to the lack of conceptual understanding, minimal engagement in critical thinking skills and few opportunities in a meaningful scientific application.

With a mean score of 2.97, indicator 2 obtained the highest mean score among the indicators, indicating that learners can recognize previously learned science-related terms, although they still have

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difficulty fully explaining their meanings. In comparison, indicator 6 received the lowest average score of 2.53, suggesting that students can recognize common scientific symbols without fully understanding them. These results revealed that learners have a basic awareness of scientific ideas but struggle to explain or fully comprehend them. Furthermore, their learning appears to focus more on memorizing facts than on developing a deeper understanding of concepts. As a result, learners may find it challenging to interpret scientific data, clearly explain ideas, and apply scientific knowledge effectively in real-world situations.

These results are consistent with the research by Ulmiyah et al. (2022), which stated that nominal scientific literacy signifies a basic understanding that goes no further than identifying scientific concepts, representing an initial but shallow level of comprehension. Similarly, Aquino et al. (2024) observed that learners at this stage may know science terms and ideas but may not fully connect them to meaningful scientific reasoning. Overall, these findings suggested that students' grasp of the lessons remains limited, and targeted instructional support is necessary to help them advance from basic identification to deeper understanding.

Table 2. Perceived Scientific Literacy Survey on Learners' Understanding and Abilities in Science in terms of Functional Scientific Literacy.

Indicators	M	SD	VI
1. I can use science words I know when they are about my daily life.	3.08	0.83	MH
2. I can understand and explain basic science topics, but not in detail.	2.85	0.78	MH
3. I can understand basic science words when I read or hear them.	3.24	0.74	MH
4. I can identify science concepts in news articles or videos.	2.88	0.76	MH
5. I can show what I learned from a science activity by sharing familiar examples	3.03	0.57	MH
6.I can use science words when talking about common experiences.	2.95	0.73	MH
7. I can connect science lessons to things I see or do in real life.	3.05	0.77	MH
8. I can answer basic science questions when they are related to my everyday life	3.32	0.76	MH
MEAN	**2.95**	**0.39**	**MH**

Legend: 1.00–1.49 (Low) (L); 1.50–2.49 (Moderate) (M); 2.50–3.49 (Moderately High) (MH); 3.50–4.49 (High) (H); 4.50–5.00 (Very High) (VH)

Table 2 shows how students perceived their functional scientific literacy. The data revealed a mean score of 2.95 (SD = 0.39), indicating a moderately high level of functional scientific literacy. This implies their belief in having the ability to correctly describe basic scientific concepts and terminology, even if their understanding remains somewhat shallow. This emphasizes that learners can use scientific knowledge in familiar situations, but have difficulty applying concepts to unfamiliar problems, engaging in critical thinking, or making decisions grounded in scientific reasoning. In other words, learners can understand and use basic scientific information, but they are not yet able to apply it to more difficult or unfamiliar situations. This occurs as students have limited opportunities to engage in critical thinking or problem-solving, with classes primarily centered on memorizing information or completing standard tasks instead of gaining a deep understanding of concepts. Moreover, assessments are mostly simple rather than including situational or task-based questions. Moreover, indicator 9 obtained the highest mean score of 3.32, indicating that learners showed stronger confidence in answering basic science questions related to everyday life and in using basic science words when discussing common experiences, demonstrating that they are able to relate science to their daily activities. In contrast, indicator 2 received a 2.85 mean score, which suggests that learners perceived less confidence in explaining basic science topics in detail, showing that while they can identify and apply scientific ideas, they still struggle with deeper explanations. The findings support the assertion made by Grancharova (2025) that functional scientific literacy allows learners to use science in context but still requires further development to strengthen their explanations and reasoning.

In general, students viewed themselves as having a moderately high level of functional scientific literacy, as the survey results showed they can relate scientific learning to daily life, yet still struggle to explain topics thoroughly. This indicates that classroom instruction should focus on improving students' understanding by providing meaningful, real-world examples of scientific concepts and helping them communicate their ideas more effectively.

Table 3. Perceived Scientific Literacy Survey on Learners' Understanding and Abilities in Science in terms of Conceptual Scientific Literacy.

Indicators	M	SD	VI
1. I can explain why a science event happens, but only for topics I have studied.	3.03	0.76	MH
2. I can compare and tell the differences between science ideas I know, but only within the topics I have learned.	3.06	0.66	MH
3. I can organize science ideas to show how they are connected, but only for topics I have studied.	2.97	0.65	MH
4. I can give reasons for how things work in science, but only for examples I understand.	3.12	0.72	MH
5. I can connect different science ideas to understand a concept better, within the ideas I have studied.	2.97	0.72	MH
6. I can explain cause-and-effect in science, but only for lessons I have learned.	2.95	0.74	MH
7. I can explain why one science idea leads to another within the topics I have studied.	2.77	0.67	MH
8. I can understand and explain science ideas and how they relate to other concepts I know.	2.89	0.75	MH
MEAN	**2.78**	**0.32**	**MH**

Legend: 1.00–1.49 (Low) (L); 1.50–2.49 (Moderate) (M); 2.50–3.49 (Moderately High) (MH); 3.50–4.49 (High) (H); 4.50–5.00 (Very High) (VH)

Table 3 summarizes the perceived scientific literacy of learners in terms of conceptual scientific literacy. The data reveal that with an overall mean score of 2.78 (SD=0.32), the perceived level of learners' conceptual literacy was at a moderately high level. This shows that students feel confident discussing scientific concepts and seeing connections between them, but their understanding is often limited to what they have already learned.

Students demonstrated the greatest perception in indicator 4, achieving a mean score of 3.12, which indicates that students feel fairly secure in their ability to express scientific ideas; however, their comprehension generally remains restricted to the topics they have understood. In contrast, the lowest level of perception was observed in Indicator 7, which recorded an average score of 2.77. This indicator pertains to describing how one scientific concept connects to another within the subjects that have been studied. This suggests that students feel less confident when it comes to connecting different science concepts and reasoning beyond basic examples. Learners often struggle with this level since it requires deep understanding and the skill to connect concepts. Novak and Treagust (2022) noted that students find it difficult to connect scientific ideas when concepts are taught separately, emphasizing the need for teaching strategies that link ideas together. The findings help strengthen conceptual scientific literacy in the developed contextualized lesson exemplar.

Table 4. Perceived Scientific Literacy Survey on Learners' Understanding and Abilities in Science in terms of Procedural Scientific Literacy.

Indicators	M	SD	VI
1. I can follow the steps in science experiments correctly, in a step-by-step manner.	3.37	0.74	MH
2. I can use scientific tools appropriately and safely for routine classroom tasks.	3.34	0.75	MH
3. I can record and organize my scientific observations accurately, in a simple and clear format.	2.85	0.68	MH
4. I can interpret results or data from science activities when patterns are easy to see.	3.17	0.69	MH
5. I can follow safety rules when cleaning and returning science tools.	3.45	0.70	MH
6. I can arrange simple science steps in the correct order from start to finish.	3.12	0.71	MH
7. I can measure or weigh things correctly during science activities.	2.97	0.69	MH
8. I can make simple drawings or diagrams to show what I observed in science activities.	3.25	0.75	MH
MEAN	**2.92**	**0.35**	**MH**

Legend: 1.00–1.49 (Low) (L); 1.50–2.49 (Moderate) (M); 2.50–3.49 (Moderately High) (MH); 3.50–4.49 (High) (H); 4.50–5.00 (Very High) (VH)

Table 4 presents the learners' perceived understanding of scientific literacy in terms of procedural scientific literacy. The mean score of 2.92 (SD=0.35) suggests that students perceived themselves to have a moderately high level of procedural scientific literacy. This finding indicates that students believed they could follow scientific methods, utilize scientific instruments correctly, and understand fundamental results, even if some activities may still be challenging. These difficulties might be linked to limited exposure in laboratory tasks and explorations into various scientific processes. Among the indicators, indicator 5 obtained the highest mean score of 3.45, showing that students felt most confident in following safety rules when cleaning and returning science tools. They believed they could follow laboratory protocols and regulations, as well as properly utilize laboratory instruments. However, indicator 3 had the lowest average score of 2.85, suggesting that students were less confident in accurately recording and organizing their observations. Students frequently find it challenging to accurately record information because this ability involves understanding concepts and organizing thoughts. As Grancharova (2025) and Eymur and Çetin (2024) emphasized, structured practice and hands-on activities can enhance procedural scientific literacy by giving learners opportunities to develop these crucial skills. However, when students lack the experience to connect scientific concepts to real-world contexts, they find it challenging to organize and document their ideas (Novak and Treagust 2022).

Table 5. Perceived Scientific Literacy Survey on Learners' Understanding and Abilities in Science In terms of Multidimensional Scientific Literacy.

Indicators	M	SD	VI
1. I can relate science topics to real-life issues or problems I encounter.	3.13	0.72	MH
2. I can use science knowledge to make informed choices.	3.08	0.73	MH
3. I can explain how science helps in health, technology, and the environment.	3.09	0.63	MH
4. I can connect science lessons to my community or personal experiences.	3.01	0.70	MH
5. I can use what I learned in science to understand issues in the world around me.	3.08	0.66	MH
6. I can suggest solutions to everyday problems using what I learned in science.	2.92	0.73	MH
7. I can explain how science concepts affect people, nature, or society.	2.84	0.63	MH
8. I can apply science knowledge to new situations I encounter in daily life.	2.83	0.70	MH
MEAN	**2.64**	**0.34**	**MH**

Legend: 1.00–1.49 (Low) (L); 1.50–2.49 (Moderate) (M); 2.50–3.49 (Moderately High) (MH); 3.50–4.49 (High) (H); 4.50–5.00 (Very High) (VH)

Table 5 shows the result of perceived scientific literacy of learners in terms of multidimensional scientific literacy. The overall mean score of 2.64 (SD=0.34) implies that learners view themselves as having a moderately high level of multidimensional scientific literacy. They were somewhat confident in applying scientific knowledge to real-life situations, making informed decisions, and understanding how science affects health, technology, the environment, and society. Among the indicators, students gave the highest rating on indicator 1, with a mean score of 3.13. This shows that learners are moderately confident using scientific knowledge in familiar situations, drawing on prior knowledge and daily experiences. Indicator 8, on the other hand, obtained the lowest average score of 2.83. This shows that students still find it difficult to use their knowledge in new situations, pointing out a shortcoming in their ability to apply what they have learned in different settings and to engage in critical thinking. Therefore, although students can effectively apply science in situations they know well, they find it challenging to transfer their understanding to new or unfamiliar scenarios.

In conclusion, learners' perceived abilities across all levels of scientific literacy were moderately high, with multidimensional scientific literacy being the lowest. These led the researcher to strengthen multidimensional scientific literacy seen in every part of the developed contextualized lesson exemplar.

Perception of Experts on the Developed Contextualized Lesson Exemplars.

Prior to implementation, the lesson exemplar was reviewed to guarantee its quality and to identify any potential errors. The expert panel, which included one head teacher, two master teachers, and three science subject teachers, offered ratings, feedback, and recommendations to improve the contextualized lesson exemplar regarding its content, format, presentation, and organization, as well as its accuracy and up-to-dateness.

Table 6. Perception of Experts on the Developed Contextualized Lesson Exemplars in Terms of Content.

Indicators	M	SD	VI
1. suitable to the student's level of development.	4.90	0.20	HA
2. contributes to the achievement of specific objectives of the subject area and grade/year level for which it is intended.	4.90	0.20	HA
3. provides for the development of higher cognitive skills such as critical thinking, creativity, learning by doing, inquiry, problem solving, etc.	4.89	0.16	HA
4. free of ideological, cultural, religious, racial, and gender biases and prejudices	4.91	0.14	HA
5. enhances the development of desirable values and traits	4.96	0.05	HA
MEAN	**4.94**	**0.09**	**HA**

Legend: 1.0-1.49 (Not Acceptable) (NA); 1.50-2.49 (Slightly Acceptable) (SA); 2.50-3.49 (Moderately Acceptable) (MA); 3.50-4.49 (Acceptable) (A); 4.5-5.0 (Highly Acceptable) (HA)

Table 6 summarizes the experts' perceptions of the developed contextualized lesson exemplars in terms of content. The data reveal that with an overall mean score of 4.94 (SD=0.09), indicating that the content of the contextualized lesson exemplars was highly acceptable. The result shows that the expert strongly agreed on the quality, relevance, and appropriateness of the content of the contextualized lesson exemplar. Of all the indicators, indicator 5 received the highest mean score of 4.96. This states that it enhances the development of desirable values and characteristics. This high rating may arise from lessons being deeply rooted in the socio-cultural, historical, and environmental context of Nagcarlan, covering its local history, everyday life, heritage landmarks, local foods and delicacies, customs, and natural surroundings. These help learners relate to the topics while dealing with the lessons. However, the lowest score was obtained by indicator 3, which suggests the development of higher cognitive skills such as critical thinking, creativity, learning by doing, inquiry, and problem solving. This outcome indicates that the material successfully shares its information, but still needs to be revised and include more activities that encourage questioning, examining, and problem solving, to help develop learners' higher-order thinking skills.

Table 7. Perception of Experts on the Developed Contextualized Lesson Exemplars in Terms of Format.

Indicators	M	SD	VI
1. The text (font style, size, spacing) is readable and appropriate for teacher use.	4.83	0.28	HA
2. The illustrations or visual aids are clear, relevant to the content, and culturally appropriate.	4.85	0.24	HA
3. The design and layout of the exemplar are organized, visually appealing, and not distracting.	4.85	0.23	HA
4. The structure and formatting (headings, sections, tables, bullets) support ease of use and navigation.	4.85	0.24	HA
5. The overall format of the lesson exemplar allows for easy adaptation and implementation in actual classroom teaching.	4.93	0.13	HA
MEAN	**4.86**	**0.22**	**HA**

Legend: 1.0-1.49 (Not Acceptable) (NA); 1.50-2.49 (Slightly Acceptable) (SA); 2.50-3.49 (Moderately Acceptable) (MA); 3.50-4.49 (Acceptable) (A); 4.5-5.0 (Highly Acceptable) (HA)

Table 7 presents the experts' perception of the developed contextualized lesson examples in terms of format. The table revealed that it yielded an overall mean score of 4.86 with a standard deviation of 0.22, indicating that the format of the lesson exemplars was rated as highly acceptable. The validators then perceived that the format of the material provides learners with a well-designed, easy-to-read, and practical lesson for classroom use.

Based on the data, indicator 5, which states that the overall format of the lesson exemplar allows for easy adaptation and implementation in actual classroom teaching, obtained the highest mean score of 4.93. This implies that teachers found the format flexible and teacher-friendly, making it suitable for real classroom settings. It also makes it easy for teachers to use, promoting student engagement and better learning outcomes. Meanwhile, indicator 1, which refers to the readability and appropriateness of the text in terms of font style, size, and spacing, obtained the lowest mean score of 4.83. This was still considered highly acceptable, although it is the lowest mean score among all indicators. Hunsu et al. (2023) highlighted that well-structured text not only improves comprehension but also enhances learners' engagement and cognitive processing of content. Thus, teachers must consider this in crafting instructional materials. In summary, Table 8 indicates that the contextualized lesson exemplar format shows appropriateness in students' needs with a minimal improvement in text presentation.

Table 8. Perception of Experts on the Developed Contextualized Lesson Exemplars in Terms of Presentation and Organization.

Indicators	M	SD	VI
1. Presentation is engaging, interesting, and understandable.	4.93	0.11	HA
2. There is a logical and smooth flow of ideas.	4.94	0.09	HA
3. Vocabulary level is adapted to the target reader's likely experience and level of understanding.	4.94	0.09	HA
4. Length of sentences is suited to the comprehension level of the target reader.	4.93	0.13	HA
5. Sentences and paragraph structures are varied and interesting to the target reader.	4.91	0.18	HA
MEAN	**4.93**	**0.11**	**HA**

Legend: 1.0-1.49 (Not Acceptable) (NA); 1.50-2.49 (Slightly Acceptable) (SA); 2.50-3.49 (Moderately Acceptable) (MA); 3.50-4.49 (Acceptable) (A); 4.5-5.0 (Highly Acceptable) (HA)

Based on Table 8, which shows the experts' perception of the developed contextualized lesson exemplars in terms of presentation and organization, it is clear that the expert respondents strongly agreed on the quality of the lesson exemplars. The overall mean score of 4.93 (SD=0.11) depicts that the presentation and organization of the lesson exemplars were rated as highly acceptable. This means that the lesson exemplars are well-presented, well-organized, and easy for the intended users to understand. One expert also commented that the lesson exemplar shows a logical presentation of localized content, which makes the lessons more interesting and engaging and suitable to the students' level of understanding.

The data shows that two indicators had the highest average score of 4.94. These indicators were indicator 2, which refers to the logical and smooth flow of ideas, and indicator 3, which focuses on the appropriateness of the vocabulary level to the target readers' experience and understanding. These results show that the contextualized lesson exemplars explain ideas clearly and utilize language that students can understand. The smooth flow is likely due to the use of the 4Cs framework, which includes Content, Connection, Collaboration, and Creativity. For example, Lesson 4 – Parts and Functions of Plant and Animal Cells began with an engaging picture prompt activity to open students' prior knowledge. This was done by incorporating the Church of San Bartolome Parish in Nagcarlan, which assisted them in understanding the concept of cell structure.

As the lesson progressed, activities like storytelling, visual illustrations, digital exercises, group role-playing, and creative tasks were used, which enabled students to learn gradually and prevented them from feeling overwhelmed. In addition, familiar words and simple local analogies were used in the lesson, such as "magbabalot," a local term for candy and bread wrappers in Nagcarlan, to explain the function of the Golgi apparatus. The discussion of protein synthesis was also highlighted in the lesson exemplar, but using santol harvesting steps such as mamimitas, maghuhugos, magsasako, and maghahakot. These helped students in visualizing and connecting with the complex activities of cells by incorporating local experiences, which in turn improved the relevance and learners' engagement in the lesson.

Meanwhile, Indicator 5, which states that sentences and paragraph structures are varied and interesting to the target reader, obtained the lowest mean score of 4.91. Though this indicator received the lowest rating among the indicators, it was still evaluated as highly acceptable, revealing that the presentation remains engaging, with only minimal room for further improvement. This is also stressed by Zagoto, Laia, and Wau (2023), who emphasized that well-structured sentences and paragraphs reduce errors, improve clarity, and make written content more understandable for learners.

Overall, Table 8 indicates that developed contextualized lesson exemplars were highly effective in terms of presentation and organization. This demonstrates that the material is clear, coherent, and easy to read, which helps in meaningful learning among students.

Table 9. Perception of Experts on the Developed Contextualized Lesson Exemplars in Terms of Accuracy and Up-To-Date-ness.

Indicators	M	SD	VI
1. Free from conceptual errors.	4.94	0.14	HA
2. Without factual errors	4.94	0.14	HA
3. Free from grammatical errors	4.94	0.14	HA
4. No obsolete information	4.94	0.14	HA
5. Without typographical and other minor errors (e.g., inappropriate or unclear illustrations, missing labels, wrong captions, etc.).	4.94	0.14	HA
MEAN	**4.94**	**0.14**	**HA**

Legend: 1.0-1.49 (Not Acceptable) (NA); 1.50-2.49 (Slightly Acceptable) (SA); 2.50-3.49 (Moderately Acceptable) (MA); 3.50-4.49 (Acceptable) (A); 4.5-5.0 (Highly Acceptable) (HA)

Table 9 presents the expert's view about the Accuracy and Up-to-Datedness of the developed contextualized lesson exemplars. The data reveal that the material was rated highly acceptable, with an overall mean score of 4.94 (SD = 0.14). This suggests that the developed contextualized lesson exemplars were accurate, current, and reliable.

It can also be gleaned from the data that all indicators achieved a mean score of 4.94. This reflects consistent expert judgement that the lesson exemplars are accurate, reliable, and contain no conceptual or factual errors, and that the materials were found to be free of grammatical, spelling, and other minor mistakes, promoting clear and effective communication. The lack of outdated information demonstrates that the lesson content is current and aligns with modern educational standards. These results support existing research demonstrating that instructional materials with high expert validation scores are considered valid and appropriate for classroom use, confirming their value and quality for educational purposes (Fauziah, 2025).

Table 10. The Level of Learners' Scientific Literacy Before and After the Use of Contextualized Lesson Exemplar

	Pretest		Posttest		Legend
	F	%	F	%	
49-60		0	6	7.5	Advanced
37-48	1	1.25	27	33.75	Proficient
25-36	31	38.75	30	37.5	Approaching Proficient
13-24	42	52.5	17	21.25	Developing
1-12	6	7.5		0	Beginning
Total	**80**	**100**	**80**	**100**	

Table 10 shows the distribution of learners' scientific literacy levels before and after the use of the contextualized lesson exemplar, based on their pretest and posttest performance. The legend classifies learners' levels into Beginning, Developing, Approaching Proficient, Proficient, and Advanced. Beginning learners are those who exhibit a limited grasp of scientific concepts and find it difficult to use them in known situations. Developing learners display some understanding but need support to apply concepts accurately. Approaching Proficient describes students who can grasp and utilize ideas but may sometimes make mistakes or provide partial explanations. Proficient levels, on the other hand, are those learners who understand and apply scientific concepts correctly in various contexts, and Advanced represents learners who demonstrate a deep understanding, can apply concepts to new situations, and make connections to real-life contexts beyond what is taught.

Before the intervention, most learners were at the Developing level (52.50%), implying that they had a partial understanding of scientific concepts but required guidance to apply them accurately. The second largest portion of learners (38.75%) was at the Approaching Proficient level, meaning they could understand and apply concepts but occasionally made errors or provided incomplete explanations. Only 1.25% of the learners reached the Proficient level, demonstrating that few students consistently applied scientific concepts correctly in various contexts. However, 7.50% of learners were at the Beginning level, showing minimal understanding and difficulty applying scientific knowledge even in familiar situations, and none were classified as Advanced. This condition may be attributed to the learners' limited exposure to contextualized and activity-based learning strategies before the intervention.

Following the introduction of the contextualized lesson exemplar, with the elements of socio-cultural, historical, and environmental, and the use of the 4Cs framework- Content, Connection, Collaboration, and Creativity. The structure of the 4Cs framework also provided a smooth flow of learning activities. In Content, participants were familiarized with the essential scientific ideas of the lesson. Connection acted as a link connecting the learners' existing knowledge to the new ideas introduced in the lesson, using local context. Collaboration fostered a team-oriented environment through group discussions and activities, enhancing cooperation and a stronger connection to the subject matter. Finally, creativity demonstrates learners' understanding by making creative outputs and engaging in practical activities that help them to gain scientific understanding.

As was evident, during the lessons, learners actively engaged in different activities of the contextualized lesson exemplar. In Lesson 3, learners learned about unicellular and multicellular organisms and studied the historical Nagcarlan Underground Cemetery, connecting it to the cell structures first identified by Robert Hooke. Students also gained knowledge of observing unicellular and multicellular organisms under the microscope. The researcher also simplified scientific terminology by relating it to well-known local examples. For example, the term mushroom was connected to kabute, a type commonly cultivated in Nagcarlan and used in many local recipes. The lebadura or yeast, which is a substance commonly used in community bakeries and pastry shops, was also used in the lesson. Additionally, lumot or algae, which are commonly found in the rivers and lakes of Nagcarlan, were included in the contextualized lesson exemplar. During Lesson 4, learners gained knowledge about cell organelles, relating their functions to local community workers, and created cell models using local sweets and delicacies.

After the intervention, there was a clear improvement. Learners in the Proficient level increased to 33.75%, while 7.50% achieved the Advanced level. This shows that many learners can apply scientific ideas to different situations and even broaden their comprehension to new scenarios. Learners at the Developing level decreased to 21.25%, and none remained at the Beginning level, suggesting that students who previously struggled were able to grasp the lessons more effectively. The Approaching Proficient category slightly dropped to 37.50%, suggesting that many learners moved to higher levels of understanding. This improvement can be due to the inclusion of socio-cultural, historical, and environmental context in the lessons, combined with practical activities, teamwork opportunities, and creative projects that follow the 4Cs framework. This approach helped students connect scientific ideas to their everyday lives, boosting their overall involvement and comprehension.

All in all, the findings showed that the contextualized lesson exemplar improved learners' scientific literacy. As noted by Marchese and Joe Mar (2022), students perform better when science lessons are relevant to their experiences, and similarly, Hadiprayitno et al. (2024) found that linking science concepts to everyday situations helps learners to know and apply concepts more effectively. The rise in posttest scores and the greater number of learners achieving Proficient and Advanced levels further show the effectiveness of the contextualized lesson exemplar in enhancing students' scientific literacy.

Table 11. Test of Significant Difference in Students' Scientific Literacy Levels Before and After the Implementation of the Contextualized Lesson Exemplars.

	Paired Differences				t	df	Sig.(2-tailed)
	Pretest		Posttest				
	M	SD	M	SD			
Scientific literacy	22.43	6.80	34.46	9.71	-16.984	79	0.000

Legend: p > 0.05 Not Significant; p < 0.05 Significant

Table 11 shows the significant difference in students' scientific literacy levels before and after the implementation of the contextualized lesson exemplars. The mean pretest score was 22.43 (SD=6.80), which indicates that students could mostly recall basic facts and recognize terms but had limited ability to apply, analyze, or relate concepts. After the lessons, the mean posttest score increased to 34.46 (SD=9.71). The computed t-value of –16.984 with 79 degrees of freedom resulted in a p-value of 0.000, which is below 0.05, revealing that there is a significant difference between the pretest and posttest scores. As a result, the null hypothesis that there is no significant difference is rejected, demonstrating that the contextualized lesson exemplars were effective in improving students' scientific literacy.

The increase in posttest scores can be attributed to the design and implementation of the contextualized lesson exemplar, crafted using the rich culture and local context of Nagcarlan and guided by the 4Cs framework, which has greatly influenced learners' understanding of unicellular and multicellular as well as cell structures and functions. During the implementation of the lessons, learners' interest was heightened because the exemplars employed familiar and well-known scenarios directly connected to the concepts being taught, allowing students to engage more deeply with the subject matter.

The lesson started by engaging students' existing knowledge through well-known historical sites, including the Nagcarlan Underground Cemetery and the San Bartolome Parish Church, to explain ideas such as the discovery of cells, the roles of organelles, and the structure of cells. Links were drawn to the students' everyday experiences and local jobs, like making candy, preparing espasol, and harvesting fruits like santol and lanzones, to enhance the relevance and understanding of the lessons about the topic.

As the lesson progressed, the learners took part in group-based, practical, and imaginative tasks, including microscopy using local specimens, creating cell models using local sweets and delicacies, role-playing of cell structures connecting to local workers, and writing brief poems. Learners also enjoyed the different structures of unicellular and multicellular organisms observed under the microscope, and their creativity was enhanced through the edible cell model tasks using local sweets and treats. These experiences assisted students in enhancing their understanding of science from nominal to functional, and further to conceptual, procedural, and multidimensional levels.

The lesson models empowered students to relate science to their surroundings and day-to-day experiences, promoting enhanced significant education. Abad (2020) mentioned that learning tied to real-life situations increases students' involvement and understanding. Fitriani et al. (2023) also stressed the importance of lessons connected to known experiences. Similarly, the OECD (2023) mentioned that teaching based on real-life situations helps in grasping and using scientific ideas in a significant way. Overall, the contextual lesson exemplars provided interesting and successful educational experiences, as indicated by the significant improvement in students' scientific literacy reflected in the results of the posttest.

4. Conclusion

Based on the study's findings, the results show a significant difference between the pre-test and post-test scores of the respondents' scientific literacy after using the contextualized lesson exemplars. Therefore, the null hypothesis, which states that there is no significant difference, is rejected.

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References

Graham, S. (2024). The importance of scientific literacy in modern classrooms. Learning to Teach Language Arts, Mathematics, Science, and Social Studies Through Research and Practice, 13(1).

Bybee, R. W. (1997). Toward an understanding of scientific literacy. In W. Gräber & C. Bolte (Eds.), Scientific Literacy. Kluwer Academic Publishers.

Aquino, J., Caingcoy, W., Zamora, R., & Diquito, T. J. (2025). Scientific literacy assessment using Bybee's scientific model: Towards a more sustainable science education. Journal of Arts, Humanities and Social Science, 2(1), 8–21.

OECD. (2025). PISA 2025 science framework (Second draft). Organisation for Economic Co-operation and Development.

OECD. (2022). PISA 2022 results: What students know and can do. OECD Publishing.

Schaeffer, H., & Shapiro, B. (2017). Promoting scientific literacy through the use of adapted primary literature in secondary science. Alberta Science Education Journal, 45, 39–44.

Shahzadi, I., & Nasreen, A. (2020). Assessing scientific literacy levels among secondary school science students of District Lahore. Bulletin of Education and Research, 42(3), 1–21.

Bantillo, R. B., & Ngag, J. B. J. U. (2024). Changing landscape of Filipino education: Teachers' perspectives on traditional vs. modernized approaches to teaching Filipino. Ignatian International Journal for Multidisciplinary Research, 2(6), 2409–2420.

Department of Education. (2023). MATATAG curriculum guide. Department of Education, Philippines.

Department of Education. (2023). MATATAG curriculum: General shaping paper 2023. https://www.deped.gov.ph/matatag-curriculum/general-shaping-paper-2023/

Department of Education. (2024). Contextualized instruction guidelines under the MATATAG curriculum.

Gaña, M. (2022). Development and validation of InfoSIM for Grade 1 mathematics instruction. International Journal of Advanced Multidisciplinary Studies, 2(1).

Thomas, L. (2020). Cluster sampling: A simple step-by-step guide with examples. Scribbr.

Learning Resources Management and Development System (LRMDS). (2009). Learning resource management and development system handbook. Department of Education, Philippines.

Uno, G. E., & Bybee, R. W. (1994). Understanding the dimensions of biological literacy. BioScience, 44(8), 553-557.

Fauziah, M., Fauziah, Y., & Dzulkurnain, M. I. (2025). Development of lesson study-based learning materials to enhance the reading skills of elementary school students. Multidisciplinary Science Journal, 7(1), 2025062.

Fitriani, F., Krismanto, W., & Usman, U. (2023). Improving science learning process and outcomes in elementary schools through contextual teaching and learning. Education and Human Development Journal, 8(1), 38–46.

Grancharova, D. (2025). Enhancing scientific literacy through STEM-based lessons. International Journal of Environmental Sciences, 247–254. https://doi.org/10.64252/absmv813

Hadiprayitno, G., Raksun, A., Artayasa, I. P., & Sukri, A. (2024). Developing context-based teaching materials and their effects on students' scientific literacy skills. Pegem Journal of Education and Instruction, 14(1), 226–233.

Hunsu, N. J., Adesope, O., & McCrudden, M. T. (2023). The effects of text structure on students’ use of comprehension strategies and cognitive outcomes during science text processing. Frontiers in Education, 8, 1112804.

Marchee, T., & Joje Mar, P. (2022). Effectiveness of contextualization in science instruction to enhance science literacy in the Philippines: A meta-analysis. International Journal of Learning, Teaching and Educational Research, 21(1), 140–156.

Novak, A. M., & Treagust, D. F. (2022). Supporting the development of scientific understanding when constructing an evolving explanation. Disciplinary and Interdisciplinary Science Education Research, 4(1), 3.

OECD. (2023). PISA 2025 science framework (Draft). https://pisa-framework.oecd.org

Schaeffer, H., & Shapiro, B. (2017). Promoting scientific literacy through adapted primary literature. Alberta Science Education Journal, 45, 39–44.

Tilo, L., Yeung, M., Eugene, L., & Leung, B. (2021). How formative are assessments for learning activities towards summative assessment? International Journal of Teaching and Education, 9(2), 42–57.

Ulmiyah, D., Sumantri, M. S., Rahmawati, Y., & Iasha, V. (2022). An analysis of the science literacy ability of elementary school students. Journal Basicedu, 6(3), 3544–3553.

Zagoto, I., Laia, R. D., & Wau, S. (2023). Sentence structure error in writing a narrative paragraph. Journal MathEdu, 6(2), 247–251.