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Narrative- Based Contextualized Learning Material in Enhancing Student's Scientific Communication Skills and Performance in Science

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Abstract*—This study, titled "Narrative-Based Contextualized Learning Materials in Enhancing Student's Scientific Communication Skills and Performance in Science," aims to assess the content structure and design features of narrative-based contextualized learning materials. It evaluates students' scientific communication skills and performance in science. The study determines the relationship between the use of narrative-based contextualized learning materials, students' scientific communication skills, and science performance. The researcher employed a descriptive-experimental research method in conducting this study. The respondents of the study are one hundred twenty (120) students who were selected purposively. To analyze the collective data from the respondents, the research instruments, including learning materials, a self-made survey questionnaire, and assessments, were validated by the experts. The instruments used in the study are the Mean, Standard Deviation, Multiple Regression using Pearson-r and T-Test. Results reveal that the content structure and material design feature of the narrative-based contextualized learning material was rated very high. Students demonstrate very high levels of scientific communication skills, while their science performance is Outstanding in both monthly and quarterly examinations. Significant positive relationships are found between iconic content, symbolic content, clear and readable layout, engaging cover design, and scientific communication skills, while enactive content showed no significant relationship. However, no significant relationship is found between the learning material variables and students' science performance. The study concludes that narrative-based contextualized learning materials contribute to the development of scientific communication skills, although they may not directly influence students' examination performance in science. The findings reveal that the content structure and material design features of the narrative-based contextualized learning material is found significantly related to students' scientific communication skills, particularly in iconic and symbolic content, clear and readable layout, and engaging cover design, leading to the rejection of the null hypothesis. However, these features show no significant effect on students' science performance in monthly and quarterly examinations; thus, the null hypothesis is accepted. It is therefore recommended that curriculum developers and school administrators support the creation and implementation of well-designed narrative-based science materials through training, technical assistance, and adequate instructional resources.*

***Keywords*—** *Narrative-based contextualized learning material, scientific communication skills, science performance, contextualized instruction, story-based learning*

I. INTRODUCTION

Science is one of the core learning areas in the secondary education curriculum and is considered fundamental in preparing learners to become critical thinkers, problem-solvers, and effective communicators. It provides students with the knowledge and skills necessary to understand the natural world, develop informed decisions, and apply scientific principles in everyday life. Despite its importance, Science, particularly Physics, is often perceived by students as one of the most difficult subjects due to its abstract concepts, mathematical nature, and requirement for higher-order thinking skills.

One of the challenging topics for Grade 7 learners is the concept of fundamental physics. These concepts require not only accurate computation but also a deep conceptual understanding of how motion is described and represented. In many classroom settings, traditional teaching approaches tend to emphasize rote memorization, formulas, and repetitive problem-solving exercises. While such strategies are useful for skill practice, they may fail to sustain students' engagement and limit their ability to transfer concepts to real-life situations. As a result, learners often struggle to comprehend scientific ideas and to clearly communicate their understanding.

Given these challenges, there is a pressing need for innovative and student-centered teaching strategies that make Science learning more meaningful, relatable, and accessible. One promising approach is the integration of story-based learning in science instruction. Storytelling has long been regarded as an effective pedagogical tool, as it connects new knowledge with learners' prior experiences, stimulates imagination, and provides meaningful contexts for abstract ideas. Jerome Bruner's Narrative Learning Approach underscores that stories allow students to organize and interpret knowledge in ways that make learning more personal, memorable, and applicable.

Beyond engagement, contextualized learning materials (CLMs) have also been shown to cultivate learners' higher-order thinking skills (HOTS) analysis, evaluation, and creation by rooting abstract science ideas in familiar contexts and problems. When students engage with physics ideas like distance, displacement, force, and vector quantities via relevant stories and real-world scenarios, they are prompted to analyze different explanations, defend their reasoning, and implement concepts in novel situations key features of higher-order thinking skills (HOTS). In this study, narrative-driven contextualized learning resources (NDCLRs) act as the

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primary teaching method. These resources incorporate fundamental physics ideas into captivating narratives that challenge students to analyze, assess, and create scientific explanations.

New evidence indicates that NBCLMs are effective in fostering HOTS. For example, in 2025, Fernando et al. discovered that using Tomlinson's model to create contextualized learning resources greatly improved the higher-order thinking skills of Grade 7 students, as well as their interest and involvement in science.

Consistent with this viewpoint, the current research created and implemented a collection of narrative-driven contextualized educational resources centered around third-quarter physics topics, such as distance and displacement, force, balanced and unbalanced forces, and vector quantities. These materials seek to enhance conceptual understanding and improve scientific communication skills, the capability to clearly articulate and explain scientific concepts by incorporating scientific ideas into relatable characters, settings, and situations based on students' everyday experiences. Additionally, they aim to improve students' academic success by offering engaging, relevant, and student-focused educational experiences.

This study highlights that narrative-driven contextual learning resources extend beyond early literacy or language teaching and can be effective tools in secondary science education. By employing narrative-focused and contextually significant methods, the study sought to close understanding gaps, enhance scientific dialogue, develop advanced thinking abilities, and lead to better student performance in science.

1.1 Statement of the Problem

Problem/s which were addressed by the research

This study aimed to determine the effect of the storybook as a narrative-based contextualized learning material anchored on Bruner's Modes of Representation on seventh-grade learners' cognitive, performance, affective, and motivational outcomes.

Specifically, this study sought to answer the following questions:

1. What is the level of assessment on the content structure of narrative -based contextualized learning materials in terms of:
   1.1 Enactive (actions & experiences);
   1.2 Iconic (visuals & illustrations); and
   1.3 Symbolic (formulas & symbols)?
2. What is the level of assessment on the material design feature of narrative -based contextualized learning materials in terms of:
   2.1 Clear and Readable Layout; and
   2.2 Engaging Cover Design?
3. What is the level of student's scientific communication skills in science in terms of:
   3.1 Clarity;
   3.2 Accuracy;
   3.3 Organization;
   3.4 Conciseness; and
   3.5 Engagement?
4. What is the level of student's performance in science in terms of:
   4.1 Monthly examination; and
   4.2 Quarterly examination?
5. Is there a significant relationship on the use of narrative-based contextualized learning material and student's scientific communication skill in science?
6. Is there a significant effect on the use of narrative-based contextualized learning material on student's performance in science?

II. Methodology

The researcher employed a descriptive-experimental research method in conducting this study. The respondents of the study are one hundred twenty (120) students who were selected purposively. To analyze the collective data from the respondents, the research instruments, including learning materials, a self-made survey questionnaire, and assessments, were validated by the experts. The instruments used in the study are the Mean, Standard Deviation, Multiple Regression using Pearson-r and T-Test.

III. Results and Discussion

This part presented, analyzed, and interpreted the data gathered in this research regarding the use of narrative-based contextualized learning materials in teaching science. The results were organized in tables to answer the specific questions stated in Chapter 1.

The chapter discussed the students' assessment of the content structure of the materials in terms of enactive, iconic, and symbolic elements, as well as the material design features such as clear and readable layout and engaging cover design. It also described the level of students' scientific communication skills in terms of clarity, accuracy, organization, conciseness, and engagement, together with their academic performance in science based on their monthly and quarterly examination results.

Furthermore, the chapter examined the relationship among students' assessment of the learning materials, their scientific communication skills, and their academic performance in science. The findings highlighted how the use of narrative-based contextualized learning materials supported students' understanding, communication skills, and overall academic outcomes. The chapter also compared the results to existing literature and highlighted key implications for classroom instruction, curriculum planning, and future research.

Overall, the results provided evidence that integrating narrative-based contextualized learning materials can enhance students' engagement and improve their learning experience in science. These findings serve as a basis for strengthening instructional strategies and developing more effective learning resources.

Level of Content Structure of Narrative Based Contextualized Learning Material

In this study, the level of using Narrative Based Contextualized Learning Material in terms of Content Structure refers to Enactive (Actions & Experiences), Iconic

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(Visuals & Illustrations), and Symbolic (Formulas & Symbols).

The level of using Narrative Based Contextualized Learning Material in terms of Content Structure is revealed in the following table, which shows the statement, Mean, Standard Deviation, remarks, and verbal interpretation.

Table 1. Level of Content Structure of Narrative Based Contextualized Learning Material in terms of Enactive (Actions and Experiences)

Statement The learning materials provide enactive (actions and experiences that…	Mean	SD	Remarks
…involves me in the lesson through the story.	4.33	0.74	Strongly Agree
…includes tasks that help me understand the lesson more clearly.	4.20	0.76	Moderately Agree
…prompts me to perform hands-on activities.	4.37	0.69	Strongly Agree
…promotes learning through doing rather than only reading.	4.25	0.76	Strongly Agree
…connects activities to real-life situations.	4.37	0.69	Strongly Agree
Weighted Mean	4.30		
SD	0.73		
Verbal Interpretation	Very High		

Table 1 shows the student-respondents' level of assessment towards the content structure of the Narrative-based Contextualized Assessment Learning Material under enactive contents. The statements with the highest level of assessment were observed with the items "prompts me to perform hands-on activities." and "connects activities to real-life situations.", both of which got a mean of (M= 4.37, SD = 0.69, interpreted as "Strongly Agree" and verbally interpreted as Very High. On the other hand, the statement "includes tasks that help me understand the lesson more clearly." Obtained the lowest mean of 4.20 (SD= 0.76), which is still interpreted as "Moderately Agree".

The overall mean measured is 4.30 with a standard deviation of 0.73 which is still interpreted as "Strongly Agree" and verbally interpreted as Very High. The small SD shows that the respondents' responses are not highly varied and thus, shows that the students have a clear agreement about the presence of enactive content on the learning material. This result shows that the students observed that the activities inside the learning material contains hands-on activities, clearly relates to real-life scenarios and promotes clarity and involvement of the task to the learners.

Table 2 presents the evaluation of narrative-based contextualized learning materials specifically regarding their Content Structure in terms of Iconic elements, such as visuals and illustrations. The data highlights how these iconic components contribute to student engagement, conceptual clarity, and memory retention, ultimately providing a quantitative measure of their effectiveness in the learning process.

The table shows the student-respondents' level of assessment towards the content structure of the Narrative-based Contextualized Assessment Learning Material under iconic contents. The statement "simplify difficult concepts" obtained the highest mean of (M=4.43) (SD= 0.72), interpreted as "Strongly Agree" and verbally interpreted as Very High. Conversely, the statement "strengthen my memory of the lesson." garnered the lowest mean of 4.30 and standard deviation of 0.72 yet it is still considered as "Strongly Agree".

Table 2. Level of Content Structure of Narrative Based Contextualized Learning Material in terms of Iconic (Visuals & Illustrations)

Statement The learning materials include iconic elements that…	Mean	SD	Remarks
…display illustrations that are clear and easy to understand.	4.36	0.74	Strongly Agree
…make the content more attractive and engaging.	4.31	0.70	Strongly Agree
…explain concepts through visuals and pictures.	4.38	0.70	Strongly Agree
…strengthen my memory of the lesson.	4.30	0.72	Strongly Agree
simplify difficult concepts	4.43	0.72	Strongly Agree
Weighted Mean	4.35		
SD	0.71		
Verbal Interpretation	Very High		

Overall, the presence of iconic contents is deemed to be "Strongly Agree" as the overall mean of the sub variable is 4.35 (SD= 0.71). Again, this very high overall mean and small standard deviation suggests that the respondents show a strong agreement about their observation to the learning material, particularly on its iconic contents. This result reflects that the learners saw the visual and illustrative components of the learning material and they fully agree that it can simplify and present difficult concepts through visual guides and clarity.

Table 3 details the level of utilization of narrative-based contextualized learning materials focusing on Content Structure through Symbolic imagery, including formulas and notations. The data provides a comprehensive breakdown of how these symbolic elements assist students in problem-solving, understanding variable relationships, and grasping the technical accuracy of the lesson.

Table 3. Level of Content Structure of Narrative Based Contextualized Learning Material in terms of Symbolic (Formulas & Symbols)

Statement The learning materials utilize symbolic imagery that…	Mean	SD	Remarks
…explains ideas in a clear and understandable manner.	4.38	0.74	Strongly Agree
…guides me through step-by-step solutions to problems.	4.27	0.72	Strongly Agree
…models the correct and accurate use of formulas and notations.	4.34	0.70	Strongly Agree
…shows the relationships between variables and quantities.	4.26	0.68	Strongly Agree
…boosts my understanding of the entire lesson.	4.33	0.69	Strongly Agree
Weighted Mean	4.32		
SD	0.70		
Verbal Interpretation	Very High		

Table 3 shows the student-respondents' level of assessment towards the content structure of the Narrative-based Contextualized Assessment Learning Material under symbolic contents. The statement with the highest level of assessment was observed with the item "models the correct

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and accurate use of formulas and notations." which got a mean of 4.34 and standard deviation of 0.70, interpreted as "Strongly Agree" and verbally interpreted as Very High. But the statement "shows the relationships between variables and quantities." obtained the lowest mean of 4.26 and (SD = 0.68), which is still interpreted as "Strongly Agree" and verbally interpreted as Very High.

In general, the overall mean measured is 4.32 (SD = 0.70) which is still interpreted as "Strongly Agree" and verbally interpreted as Very High. The small standard deviation reflects the low variation of responses among students and thus shows that the respondents have a unanimous agreement about the very high presence of symbolic content on the learning material. This result emanates that the learners observed that the learning material is rich in explaining concepts and ideas in a clear and understandable step-by-step format. The learning material also has correctly used formulas and shown the relationship among these symbols

Level of Using Narrative Based Contextualized Learning Material

In this study, level of using Narrative Based Contextualized Learning Material in terms of Material Deign Feature refers to Clear and Readable Layout and Engaging Cover Design.

The level of using Narrative Based Contextualized Learning Material in terms of Material Deign Feature is revealed in the following table, which shows the statement, mean, standard deviation, remarks, and verbal interpretation.

Table 4. Level of Material Design Feature of Narrative Based Contextualized Learning Material in terms of Clear and Readable Layout

Statement The learning materials feature clear and readable layout that..	Mean	SD	Remarks
…display text that is easy to read.	4.40	0.68	Strongly Agree
…select appropriate font size and style for better visibility.	4.23	0.74	Strongly Agree
…arrange spacing between texts and images properly.	4.34	0.65	Strongly Agree
…balance text and visuals on each page.	4.33	0.71	Strongly Agree
…enhance my overall learning experience.	4.35	0.68	Strongly Agree
Weighted Mean	4.33		
SD	0.69		
Verbal Interpretation	Very High		

Table 4 shows the student-respondents' level of assessment towards the material design features of the Narrative-based Contextualized Assessment Learning Material, specifically on clear and readable layout. The statement which obtained the highest mean is the item "display text that is easy to read." (M = 4.40), (SD= 0.68), interpreted as "Strongly Agree" and verbally interpreted as Very High. On the other hand, the statement "select appropriate font size and style for better visibility." garnered the lowest mean of 4.23 (SD = 0.74) yet it is still interpreted as "Strongly Agree" and verbally interpreted as Very High.

Overall, the presence of iconic contents is deemed to be "Strongly Agree" as the overall mean is 4.33 (SD= 0.69) and verbally interpreted as Very High. The low standard deviation indicates strong respondent agreement regarding the material's clarity and readability. This reflects effective visual organization achieved through consistent styling and font selection.

Table 5 outlines the evaluation of the narrative-based contextualized learning materials in terms of their Material Design Feature, specifically focusing on the impact of an Engaging Cover Design. The data reflects how the aesthetic and representational quality of the cover serves as an initial point of interest, gauging its ability to capture student attention and inspire further exploration of the content.

Table 5. Level of Material Design Feature of Narrative Based Contextualized Learning Material in terms of Engaging Cover Design

Statement The learning materials incorporate engaging cover design that..	Mean	SD	Remarks
…attracts my attention at first glance	4.42	0.72	Strongly Agree
…features images related to the topic	4.35	0.63	Strongly Agree
…displays appealing colors that make the page stand out.	4.38	0.72	Strongly Agree
…represents the actual content of the lesson accurately.	4.32	0.67	Strongly Agree
…inspires me to read and explore the material.	4.33	0.76	Strongly Agree
Weighted Mean	4.36		
SD	0.70		
Verbal Interpretation	Very High		

Table 5 shows the student-respondents' level of assessment towards the material design features of the Narrative-based Contextualized Learning Material, specifically on engaging cover design. The statement with the highest level of assessment was the statement "attracts my attention at first glance" which got a mean of 4.42 and standard deviation of 0.72, interpreted as "Strongly Agree" and verbally interpreted as Very High. On the other hand, the statement "represents the actual content of the lesson accurately." obtained the lowest mean of 4.32 and standard deviation of 0.67, which is still interpreted as "Strongly Agree".

In general, the overall mean measured is 4.36 with a standard deviation of 0.70 which is still interpreted as "Strongly Agree". The small SD shows the low variation of responses among students. This low variation shows that the respondents have a united agreement about the highly engaging cover design of the learning material. This result reflects that the learning material captured learners' attention on the first glance, yet still relevant and encouraging to be opened and used for the lessons.

Level of Student's Scientific Communication Skills in Science

In this study, the level of Student's Scientific Communication Skills refers to Clarity, Accuracy, Organization, Conciseness and Engagement.

The level of Student's Scientific Communication Skills refers is shown in the following table, which shows the mean, standard deviation, and verbal interpretation.

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Table 6 assesses the Level of Student's Scientific Communication Skills with a specific focus on Clarity. The data evaluates how effectively students can translate complex scientific concepts into understandable language, ensuring clear comprehension for both peers and audiences new to the subject matter.

Table 6. Level of Student's Scientific Communication Skills in terms Clarity

Statement As a student I can…	Mean	SD	Remarks
…define scientific terms clearly for people who are new to the topic.	4.42	0.71	Strongly Agree
…write clear explanations of how scientific things happen.	4.36	0.68	Strongly Agree
…use straightforward language when I speak during presentations.	4.27	0.74	Agree
…explain complex science ideas using very simple terms.	4.25	0.70	Agree
…communicate science in a way that my classmates understand right away.	4.44	0.71	Strongly Agree
Weighted Mean	4.35		
SD	0.71		
Verbal Interpretation	Very High		

Table 6 shows the student-respondents' level of scientific communication skills, particularly on clarity. The statement which obtained the highest mean is the item "communicate science in a way that my classmates understand right away." at 4.40 with a standard deviation of 0.71, which is viewed as "Strongly Agree". On the other hand, the statement "explain complex science ideas using very simple terms." garnered the lowest mean of 4.25 and standard deviation of 0.70 yet it is still translated as "Strongly Agree".

Overall, the student-respondents' clarity in communication skills in science is deemed to be "Strongly Agree" as the overall mean is 4.35 with a standard deviation of 0.71. The low variability of scores shows that the respondents show a solid agreement about their clarity in communicating scientific concepts. This result implies that the learners have the ability to clearly convey scientific knowledge to other in ways that is understandable to them.

Table 7 presents the results regarding the Level of Student's Scientific Communication Skills in terms of Accuracy. The data illustrates students' proficiency in using precise terminology, verifying data sources, and ensuring that their scientific conclusions are consistently supported by evidence.

Table 7. Level of Student's Scientific Communication Skills in terms Accuracy

Statement As a student I can…	Mean	SD	Remarks
…use precise scientific terminology correctly when I speak and write.	4.41	0.65	Strongly Agree
…double-check my data and sources to ensure they are correct before presenting them.	4.28	0.69	Strongly Agree
…make sure my conclusions are supported by the evidence I present.	4.46	0.66	Strongly Agree
…produce reports and scientific essays that are free from factual errors.	4.45	0.68	Strongly Agree
…be confident in the accuracy of the scientific information I share.	4.41	0.68	Strongly Agree
Weighted Mean	4.40		
SD	0.67		
Verbal Interpretation	Very High		

Table 7 shows the student-respondents' level of scientific communication skills, specifically on accuracy. The statement with the highest level of assessment was the statement "make sure my conclusions are supported by the evidence I present." which got a mean of 4.46 and standard deviation of 0.66, interpreted as "Strongly Agree". But the statement "double-check my data and sources to ensure they are correct before presenting them." obtained the lowest mean of 4.28 and standard deviation of 0.69, which is still interpreted as "Strongly Agree".

Summing up, the overall mean measured is 4.40 with a standard deviation of 0.67 which is still interpreted as "Strongly Agree". The small SD signifies the low variation of responses among students' responses. This reflects that the respondents have a strong belief that they possess very high level of scientific accuracy. This result shows that the learners are capable of finding supporting evidence to their claims or conclusions. They also highlight the importance correct information on their reports, essays, and presentations and as much as possible, double-checking their data and sources before they present it in class. High accuracy in scientific communication ensures that the observations, ideas, data and inferences shared by learners are correct, well-corroborated to support proper judgment on experiments and concepts being engaged.

Table 8 examines the Level of Student's Scientific Communication Skills in terms of Organization. This section evaluates the students' ability to structure their scientific work through logical sequencing, the use of smooth transitions, and the creation of coherent presentations that are easy for an audience to follow.

Table 8. Level of Student's Scientific Communication Skills in terms Organization

Statement As a student I can…	Mean	SD	Remarks
…create scientific presentations with a clear introduction, body, and conclusion.	4.43	0.68	Strongly Agree
…present my ideas in a logical sequence.	4.33	0.78	Strongly Agree
use transitions to smoothly connect one idea to the next.	4.29	0.74	Strongly Agree
…make my arguments and explanations build on each other in a coherent manner.	4.33	0.69	Strongly Agree
…make the flow of my scientific explanations easy for others to follow.	4.47	0.65	Strongly Agree
Weighted Mean	4.37		
SD	0.71		
Verbal Interpretation	Very High		

Table 8 shows the student-respondents' level of scientific communication skills, particularly on organization. The statement with the highest mean is the statement "make the flow of my scientific explanations easy for others to follow." at 4.47 with a standard deviation of 0.65, interpreted as "Strongly Agree". On the other hand, the statement "use transitions to smoothly connect one idea to the next." obtained the lowest mean of 4.29 and standard deviation of 0.74, yet it is still translated as "Strongly Agree".

In general, the student-respondents' organization in communication skills in science under organization is deemed

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to be "Strongly Agree" as the overall mean is at 4.37 with a standard deviation of 0.71. The low measure of SD shows that the respondents see themselves consistently to possess very high organizational skills in accomplishing scientific endeavors. This means that the learners can express scientific concepts that their peers can easily follow and understand as they can clearly present the concept and ideas logically with coherence and order.

Table 9 outlines the level of students' scientific communication skills in terms of conciseness. In scientific communication, conciseness refers to the ability of learners to express ideas clearly and efficiently while focusing only on the essential information needed to convey a concept or explanation.

Conciseness is an important component of effective scientific communication because it allows students to present ideas in a straightforward and organized manner. By using precise language and avoiding unnecessary details, learners can communicate scientific concepts more effectively and ensure that their explanations are easily understood by others.

In the context of science learning, developing conciseness also helps students structure their thoughts and highlight key ideas when presenting information. This skill supports both written and oral communication, enabling learners to summarize scientific concepts, present observations, and explain findings in a clear and direct manner.

Table 9. Level of Student's Scientific Communication Skills in terms Conciseness

Statement As a Students I can…	Mean	SD	Remarks
…use bullet points or lists to keep my information short and organized.	4.44	0.75	Strongly Agree
…state the main point of my explanation quickly.	4.38	0.70	Strongly Agree
…select only the information that belongs in my science reports.	4.33	0.70	Strongly Agree
…draft my reports in a direct and to-the-point manner.	4.43	0.63	Strongly Agree
…edit my work to remove unnecessary words or sentences.	4.38	0.72	Strongly Agree
Weighted Mean	4.39		
SD	0.70		
Verbal Interpretation	Very High		

Table 9 shows the student-respondents' level of scientific communication skills, specifically on conciseness. The statement "use bullet points or lists to keep my information short and organized." got the highest level of assessment mean of 4.44 and standard deviation of 0.75, interpreted as "Strongly Agree". Conversely, the statement "select only the information that belongs in my science reports." obtained the lowest mean of 4.33 and standard deviation of 0.70, which still translates to "Strongly Agree".

To sum up, the overall mean measured under conciseness is 4.39 with a standard deviation of 0.70 which is still interpreted as "Strongly Agree". The small SD signifies the low dispersion of responses among students' responses. This shows that the respondents have a strong belief that they apply conciseness in communicating scientific concepts. This result signifies that the learner-respondents can organize information into shorter yet meaningful manner using bullet points or lists. This also tells that the learners choose to be more direct and briefer in communicating scientific information for faster and more efficient relay of information.

Table 10 presents the Level of Student's Scientific Communication Skills regarding Engagement and Impact. This evaluation measures the students' ability to maintain audience interest through confident delivery, effective use of visual aids, and the capacity to handle follow-up questions with ease.

Engagement and impact are important components of effective communication because they reflect how well students connect with their audience through clear delivery, appropriate tone, and supportive materials such as visual aids. These elements help make scientific explanations more understandable and meaningful to listeners or readers.

Table 10. Level of Student's Scientific Communication Skills in terms Engagement and Impact

As a student I can…	Mean	SD	Remarks
…use a clear and confident speaking voice.	4.46	0.65	Strongly Agree
…maintain eye contact with my audience during a presentation.	4.33	0.73	Strongly Agree
…show visuals like slides or diagrams to keep my audience interested.	4.33	0.71	Strongly Agree
…feel confident when presenting science information to a group.	4.35	0.69	Strongly Agree
…answer questions from the audience about my topic with ease.	4.50	0.64	Strongly Agree
Weighted Mean	4.40		
SD	0.68		
Verbal Interpretation	Very High		

Table 10 shows the student-respondents' level of scientific communication skills, particularly on engagement. The statement with the highest mean is the statement "answer questions from the audience about my topic with ease." at 4.50 with a standard deviation of 0.64, interpreted as "Strongly Agree". On the other hand, the statements "maintain eye contact with my audience during a presentation." and "show visuals like slides or diagrams to keep my audience interested." obtained the lowest mean of 4.33 with standard deviation of 0.73 and 0.71 respectively. However, both statements still fall under the remarks as "Strongly Agree".

Overall, the student-respondents' organization in communication skills in science under engagement is deemed to be "Strongly Agree" as the overall mean is at 4.40 with a standard deviation of 0.68. The variability of responses shows that the respondents see themselves consistently to possess very high engagement skills in presenting scientific endeavors. This means that the learners see themselves as very good scientific communicators as they are aware of their audience and how to engage with them to properly relay information to them. The respondents believe that they possess a clear speaking voice, ample eye contact with the audience, and able to sustain audience interest and answer their questions with confidence.

Level of Students' Performance in Science

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In this study, level of Students' Performance in Science refers to Monthly and Quarterly Examination.

The level of Students' Performance in Science is revealed in the following table, which shows the raw score, Frequency, Percentage, Mean, Standard Deviation, and verbal interpretation.

This table provides a distribution of the students' Raw Scores and their corresponding Descriptive Equivalents. It illustrates the overall academic performance of the 120 respondents, categorizing their results into proficiency levels ranging from "Needs Improvement" to "Outstanding."

Table 11. Level of Students' Performance in Science in terms of Monthly Examination

Raw Score	Frequency (f)	Percentage (%)	Descriptive Equivalent
33-40	84	70	Outstanding
25-32	36	30	Very Satisfactory
17-24	0	0	Satisfactory
9 -16	0	0	Fair
1-8	0	0	Needs Improvement
	120	100	Very Satisfactory

Mean= 33.66 SD=2.84 VI=O

Table 11 shows the score distribution of the learner-respondents on their monthly examination in science. Out of 120 total samples, 84 or 70% of the students got the highest interval of scores from 33 to 40 while the remaining 36 learners or 30% of the distribution got a score from 25 to 32. These results show that the students generally got a very satisfactory to outstanding performance in their monthly examination in science. This distribution of scores indicates that the learners' performance is consistently found to be at the higher performance band.

And since the distribution did not have scores in the lower 3 score categories, the scores of the learners are found to be positively skewed. It can mean that the learners have shown a strong grasp of the competencies covered in the monthly examination which are force, Newton's laws of motion, vectors, distance, displacement, speed and velocity. And based on the nature of questions, students can recognize scientific concepts, interpret simple physics problems, and apply lesson ideas to real-life situations.

Table 12 presents the Level of Students' Performance in Science based on their Quarterly Examination scores. The data categorizes student achievement into specific proficiency levels, providing a statistical overview of how effectively the learners have mastered the science curriculum during this assessment period.

Table 12. Level of Students' Performance in Science in terms of Quarterly Examination

Raw Score	Frequency (f)	Percentage (%)	Descriptive Equivalent
33-40	85	70.83	Outstanding
25-32	35	29.17	Very Satisfactory
17-24	0	0	Satisfactory
9 -16	0	0	Fair
1-8	0	0	Needs Improvement
	120	100	Very Satisfactory

Mean= 33.83 SD=2.86 VI=O

Table 12 shows the score distribution of the learner-respondents on their quarterly examination in science. Out of 120 total samples, 85 or 70.83% of the students got the highest interval of scores from 33 to 40 while the remaining 35 learners or 29.17% of the distribution got a score from 25 to 32. These results show that the students generally still got a very satisfactory to outstanding performance in their quarterly examination in science. This distribution of scores indicates that the learners' performance is consistently found to be at the higher performance band, same with the monthly examination results.

And since the distribution still did not have scores in the lower 3 score categories, the scores of the learners are found to be positively skewed. It can mean that the learners retained a strong grasp of the competencies covered in the quarterly examination which are the same competencies covered from the monthly examinations under Physics. Consequently, students still possess the same level of performance and skills as much as before.

Quarterly assessments also help identify specific strengths and weaknesses of students, allowing for targeted interventions and support. They encourage students to engage consistently with the subject matter, promoting steady learning rather than last-minute preparation. Additionally, the results from these assessments can inform curriculum adjustments, ensuring that teaching strategies align with learners' needs and improve overall academic outcomes.

Significant Relationship between Narrative-Based Contextualized Learning Material to the Students' Scientific Communication Skill in Science

Table 13 presents the significant relationship between the use of Narrative-Based Contextualized Learning Materials (NBCLM) and students' scientific communication skills in science. The NBCLM includes content structure (enactive, iconic, and symbolic) and material design features (clear and readable layout and engaging cover design), while scientific communication skills cover clarity, accuracy, organization, conciseness, and engagement.

The significant relationship between using narrative-based contextualized learning material to the students' scientific communication skill in science is revealed in the following table, which shows the Multiple Regression Analysis using Pearson Product Moment Correlation Coefficient or Pearson-r, p-value, and number of observations.

In the context of this study, examining the relationship between these variables provides insight into how instructional materials may support the development of learners' communication skills in science. It also highlights the importance of integrating different forms of representation and design elements to facilitate meaningful learning experiences. The use of narrative-based contextualized learning materials provides learners with meaningful contexts that make scientific concepts more relatable and easier to understand.

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Table 13. Significant Relationship between Using Narrative-Based Contextualized Learning Material to the Students' Scientific Communication Skill in Science

Using Narrative-Based Contextualized Learning Material		Students' Scientific Communication Skill in Science				
		Clarity	Accuracy	Organization	Conciseness	Engagement
Enactive (Actions & Experiences)	Pearson Correlation	0.006	0.010	0.154	0.154	0.032
	Sig. (2-tailed)	0.949	0.915	0.094	0.094	0.731
	N	120	120	120	120	120
Iconic (Visuals & Illustrations)	Pearson Correlation	0.356*	0.299*	0.308*	0.308*	0.182*
	Sig. (2-tailed)	0.000	0.001	0.001	0.001	0.046
	N	120	120	120	120	120
Symbolic (Formulas & Symbols)	Pearson Correlation	0.365*	0.264*	0.427*	0.427*	0.325*
	Sig. (2-tailed)	0.000	0.004	0.000	0.000	0.000
	N	120	120	120	120	120
Clear and Readable Layout	Pearson Correlation	0.395*	0.236*	0.333*	0.333*	0.400*
	Sig. (2-tailed)	0.000	0.009	0.000	0.000	0.000
	N	120	120	120	120	120
Engaging Cover Design	Pearson Correlation	0.479*	0.442*	0.384*	0.384*	0.374*
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000
	N	120	120	120	120	120

Table 13 presents the significant relationship between the use of Narrative-Based Contextualized Learning Materials (NBCLM) and students' scientific communication skills in science in terms of clarity, accuracy, organization, conciseness, and engagement.

Table 13 shows the test of relationship between the level of content structure and material design features of the Narrative-based Contextualized Learning Material to the learners' level of scientific communication skills. The determination of correlation strengths was based from the meta-analytic study results of Schober, Boer and Schwarte (2018) concerning appropriate use and interpretation of correlation coefficients.

For the Enactive Content Structure, all of the 5 scientific communication skills were found to have negligible to weak correlation at all as the correlation coefficients measured were around -.032 (negligible negative correlation strength) to .154 (weak positive correlation strength). Also, the p-values obtained, ranging from .094 to .949 to be greater than the level of significance set at a = .05. These results show that there is no significant linear relationship found between the learners' assessment of enactive content of the learning material to any of their scientific communication skills. One of the possible reasons as to why this is the case is that hands-on or experience-based activities used in the learning material may improve learning involvement and overall participation of the learners but it did not directly affect the scientific communication skills as those 5 components need more reflective, report-based and discussion-heavy activities among the learners. This is supported by the study of Arini et al. (2019) which stated that students' communication skills in science will be more improved if given more diverse learning activities such as group discussion and questioning, writing essays, and other oral and written interactions.

For the Iconic Content Structure, all 5 components under students' scientific communication skills were found to only have weak level of positive correlation coefficient, ranging from .182 to .356. However, all the pairs were found to have p-values less than the level of significance set at a = 0.05. These results show that the level of iconic content structure observed by the respondents were significantly related to each of the 5 scientific communication skills albeit only negligible to weak level only individually, but these 5 skills were working hand in hand and not in isolation with each other. A possible reason for this relationship is that illustrations and visuals provided by the iconic content structure provides an easier avenue for learners to mentally organize and process scientific concepts more easily and thus, supporting them in correctly explaining and communicating such concepts. This observation is consistent to the research study done by Estrada and Davis (2015) where they emphasized that images and illustrations are important means of communicating science concepts and ideas much easier. They further stated that visual elements, when integrated also to the whole communication state can support individuals to process complex scientific texts which in turn help them present a clearer explanation of the concepts.

As for the Symbolic Content Structure, all 5 sub variables under students' scientific communication skills were found to have correlation coefficient values ranging from 0.182 (weak positive correlation) to 0.427 (moderate positive correlation). And all the 5 pairs got a p-value less than the level of significance set at 0.05. These show that although the symbolic content structure only possesses weak to moderate positive correlation individually to the 5 components of scientific communication skills, in total, the symbolic content directly relates to the overall scientific communication skill level of the learners. One of the possible key insights as to why the relationship exists is that the symbolic contents from the learning materials require the learners to process information or concepts in structured, systematic and logical manner which is directly connected to the organizational skills of the learners. Also, processing and using scientific symbols and formulas require apt but precise interpretation which promotes clarity, conciseness and engagement as well. Through multiple regression analysis, it was found out that including symbols and formulas as ways to represent scientific

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information has found to have strong correlation (r = .61) to scientific communication skills and contribute to the 37% of the total regression model in conjunction to other representations.

For the clarity and readability of the layout, the Pearson r values obtained ranges from .236 to to .400, which are interpreted as weak to moderate positive correlations. In conjunction to these results, all the 5 bivariate pairs obtained a p-value less than the level of significance set at .05, which means that all 5 detected correlations are deemed significant. This result reflects that all 5 components of scientific communication skills of the students were found to have direct relationship with the level of clarity and readability of the learning material assessed by the learners in combination. This result arises possibly because as the learners engage and interact with materials that is easy to read and follow with an organized layout, the process of information will become more seamless and efficient, supporting concise expression and in turn, clearer and direct reporting of scientific concepts. These helps the learners identify the key concepts more easily and communicate the results in a more direct and focused manner, disregarding non-essential and non-critical information. This result is supported by Yulianti et. al (2020) who found out that learning materials with good level of readability and typography were easier to be read and processed by learners which also improved their communication skills. Also, appropriate language use, and clear presentation help the students engage more actively with content to develop their written and oral communication skills in physics.

Lastly, for the engaging cover design, the correlation coefficients observed were from .374 and .479 which translates to weak to moderate positive correlation. At the same time, the measured p-values from the 5 pairs were all found to be less than the level of significance set at .05, showing that the bivariate pairs have significant positive relationship. This shows that even though the 5 components of scientific communication skills were not highly correlated to the engaging cover design structure on each particular subskills, but in totality, the scientific communication skills as a whole are significantly related to the engaging cover design of the narrative-based contextualized learning material. One of the possible reasons for this result is that as the learning material has a very engaging cover, it positively affects the learner's initial impression and attention thus making the learners more willing and interested in exploring the material.

This initial engagement became a good starting point for the learners to explore and realize that the content themselves is helpful to hone their scientific communication skills as well. Jennifer Anne Ford (2016) argued the same idea that the main function of the book cover is to entice and encourage the learners to pick up and read the material which will serve as the first link between the reader and the textual world. And that continued interaction will provide opportunities for the students to learn how the book communicates with them through written language and in practice, they will also enhance their way of communicating facts and concepts to others.

Moreover, an engaging cover and interactive materials can spark curiosity, motivating students to delve deeper into the content. As learners interact with the text, they develop not only comprehension skills but also the ability to express scientific ideas clearly and confidently. This repeated practice in reading and interpreting content strengthens both their written and oral scientific communication over time.

Furthermore, the use of narrative-based contextualized learning materials provides learners with meaningful contexts that make scientific concepts more relatable and easier to understand. When students encounter scientific ideas presented through stories and real-life situations, they are more likely to connect the concepts with their own experiences. This connection helps learners organize their thoughts and communicate scientific information more clearly and logically. As a result, the narrative approach not only supports comprehension but also encourages students to articulate their ideas using appropriate scientific terms and explanations.

In addition, continuous exposure to well-designed instructional materials allows learners to gradually develop confidence in expressing their scientific understanding. Through guided reading, interpretation of visuals, and discussion of concepts presented in the materials, students are provided with opportunities to practice explaining ideas and responding to questions.

Significant Effect between Narrative-Based Contextualized Learning Material on the Students' Performance in Science

Table 14 shows the Significant Effect between Using Narrative-Based Contextualized Learning Material on the Students' Scientific Communication Skill in Science. In this study, using Narrative Based Contextualized Learning Material in terms of Content Structure in terms of Enactive (Actions & Experiences), Iconic (Visuals & Illustrations), and Symbolic (Formulas & Symbols) and also using Narrative Based Contextualized Learning Material in terms of Material Design Features refers to Clear and Readable Layout and Engaging Cover Design while the Student's Performance in Science Scientific Communication Skills in terms of Monthly Examination and Quarterly Examination.

The significant effect between the use of narrative-based contextualized learning materials and students' performance in science is presented in the following table through multiple regression analysis using the t-test. The table includes the computed t-value (t-cal), p-value, number of respondents, and the critical t-value (t-crit). These statistical measures were used to determine whether each variable significantly influenced students' performance in science. The learning materials alone are insufficient to improve achievement unless combined with sustained instruction, assessment alignment, and higher-order learning integration.

The results in table 14 revealed that all components of the narrative-based contextualized learning materials (NBCLM)enactive, iconic, symbolic, clear and readable layout, and engaging cover design showed no statistically significant relationship with students' performance in science, both in monthly and quarterly examinations ($p > 0.05$). This

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indicates that the use of NBCLM did not significantly influence students' academic achievement in terms of examination scores.

Table 14. Significant Effect between Using Narrative-Based Contextualized Learning Material on the Students' Performance in Science

Using Narrative-Based Contextualized Learning Material		Students' Performance in Science	
		Monthly Examination	Quarterly Examination
Content Structure			
Enactive (Actions Experiences)	& t-value	0.602	0.660
	Sig. (2-tailed)	0.548	0.511
	N	120	120
Iconic (Visuals Illustrations)	& t-value	1.000	0.917
	Sig. (2-tailed)	0.320	0.361
	N	120	120
Symbolic (Formulas Symbols)	& t-value	-1.739	-1.704
	Sig. (2-tailed)	0.085	0.091
	N	120	120
Material Design Feature			
Clear and Readable Layout	t-value	1.345	1.278
	Sig. (2-tailed)	0.181	0.204
	N	120	120
Engaging Cover Design	t-value	0.061	0.208
	Sig. (2-tailed)	0.952	0.835
	N	120	120

The enactive component showed no significant relationship with students' monthly ($t = 0.602$, $p = 0.548$) and quarterly performance ($t = 0.660$, $p = 0.511$). This suggests that hands-on experiences and activity-based learning alone did not directly translate into improved test scores. Although experiential learning promotes engagement, its impact on academic performance depends on how well experiences are processed and connected to conceptual understanding.

Kolb (2017) emphasized that experience must be followed by reflection and conceptualization for learning to become meaningful. Similarly, Prince (2017) noted that active learning improves outcomes only when students are guided to connect activities with formal assessment content. In this study, the absence of significant results may indicate that enactive tasks were not sufficiently aligned with examination-based measures of achievement.

The iconic component also showed no significant relationship with students' performance in monthly ($t = 1.000$, $p = 0.320$) and quarterly examinations ($t = 0.917$, $p = 0.361$). This implies that while visuals and illustrations may enhance understanding, they did not significantly affect test performance in this context.

According to Mayer (2020), multimedia and visual representations improve comprehension by supporting dual-channel processing; however, learning gains may not always immediately reflect in standardized assessments. Ainsworth (2016) also explained that while multiple representations enhance conceptual understanding, transfer to formal testing requires sustained exposure and instructional integration. Thus, although iconic elements may have supported learning, their effect was not strong enough to influence examination results.

The symbolic component showed negative but still non-significant relationships with monthly ($t = -1.739$, $p = 0.085$) and quarterly performance ($t = -1.704$, $p = 0.091$). This suggests that exposure to formulas and symbolic representations did not significantly improve students' test scores, although it showed a slight trend toward possible influence.

The clear and readable layout also showed no significant relationship with monthly ($t = 1.345$, $p = 0.181$) and quarterly performance ($t = 1.278$, $p = 0.204$). This means that although well-designed materials may improve usability and comprehension, they did not significantly affect academic test outcomes.

The engaging cover design showed no significant relationship with students' monthly ($t = 0.061$, $p = 0.952$) and quarterly performance ($t = 0.208$, $p = 0.835$). This indicates that although an attractive design may increase motivation or interest, it does not directly affect academic achievement.

Overall, the findings suggest that while NBCLM components may support engagement, comprehension, and communication skills, they do not significantly influence students' academic performance as measured by monthly and quarterly examinations. This supports the idea that learning materials alone are insufficient to improve achievement unless combined with sustained instruction, assessment alignment, and higher-order learning integration.

Instructional materials such as NBCLM can enhance students' engagement and understanding by presenting content in a more meaningful and structured format. However, according to cognitive theories of learning, the effectiveness of instructional materials depends on how well they manage learners' cognitive load and support processing of information. When instructional design exceeds learners' cognitive capacity, learning gains may not translate into measurable academic performance.

IV. Conclusion and Recommendations

Most indicator of content structure and material design features of the narrative-based contextualized learning material were found to be significantly related to the students' scientific communication skills in science, particularly in terms of iconic content, symbolic content, clear and readable layout, and engaging cover design, while enactive content was not found to have a significant relationship with the five components of scientific communication skills. Thus, the null hypothesis is rejected. This means that the effectiveness of the NBCLM in enhancing scientific communication skills is not uniform across all its components. Instead, only certain features mainly those that are visual, symbolic, and related to the organization and presentation of content contributed significantly to students' ability to communicate scientific ideas, while the enactive component did not show a measurable influence on their communication performance.

The content structure such as enactive (actions and experiences), iconic (visuals and illustrations), and symbolic (formulas and symbols) components and material design

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features such as the clarity and readability of layout and the engaging cover design, of the narrative-based contextualized learning material were found to have no significant effect with the students' performance in science as measured through the monthly and quarterly examinations. Thus, the null hypothesis science is accepted. This means that improvements in students' examination scores cannot be directly attributed to the use of NBCLM, suggesting that other factors such as teaching strategies, prior knowledge, study habits, and assessment alignment may have a stronger influence on academic performance. It indicates that there is no statistically significant relationship between the content structure and material design features of the NBCLM and students' science performance based on their monthly and quarterly examination results.

Based on the findings of this study, several recommendations are suggested and proposed to enhance learners' scientific communication skills and student's performance in science.

Curriculum developers may design more locally contextualized and narrative-driven learning materials for science with clear visual design and layout, more thoughtful symbolic representations, and engaging cover design to further support the development of scientific communication skills of the learners.

School administrators may support the development, reproduction, validation and use of more narrative-based contextualized learning materials through training, technical assistance, and provision of instructional resources for science teachers.

Science teachers may continue to employ and improve narrative-based contextualized learning materials as it is positively related to higher scientific communication skills of the learners. They may consider employing more enactive contents like discussion-based, reflective and collaborative presentation-oriented activities for the development of students' scientific communication skills.

Learners may be encouraged to actively participate and use narrative-based contextualized learning materials not only to learn and master science content and competencies but also improve their ability to explain, discuss, organize and engage in presenting scientific knowledge deliberately and accurately.

Future researchers may conduct similar studies using a wider sample, other grade levels or other experimental or mixed method designs to further examine the effectiveness of narrative-based contextualized learning materials on both communication skills and academic performance in science. They may explore other factors that may relate to assessment performance of the learners.

REFERENCE

[1]. Arini, M., Suratno, & Yushardi. (2019, April). Analysis pattern of student communication skills in science process in inquiry learning: Case study in regional schools Jember coffee plantation. Journal of Physics: Conference Series, 1211(1), 012104. IOP Publishing.

[2]. Estrada, F., & Davis, L. (2017). Improving visual communication of science through the incorporation of graphic design theories and practices into science communication. Science Communication, 37(1), 140–148.

[3]. Ford, J. (2016). What students and teachers can learn by judging a book by its cover. The Australian Library Journal, 65(1), 50–56.

[4]. Kolb, D. (2017). Experiential learning: Experience as the source of learning and development. Pearson. https://doi.org/10.4324/9781315845512

[5]. Mayer, R. E. (2020). Multimedia learning (3rd ed.). Cambridge University Press. https://doi.org/10.1017/9781316941355

[6]. Prince, M. (2017). Does active learning work? A review of the research. Journal of Engineering Education, 93(3), 223–231. https://doi.org/10.1002/jee.20150

[7]. Yulianti, D., Rusilowati, A., & Nugroho, S. (2020, June). Physics teaching materials based on science, technology, engineering, and mathematics to develop communication and collaboration skills. In International Conference on Science and Education and Technology (ISET 2019) (pp. 445–449). Atlantis Press.