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Mechanistic Reasoning, Learning Engagement, Scientific Learning Skills and Content Knowledge in Science Among Grade 10 Students in the Division of Aklan: Basis for Learning Enhancement Program

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Abstract

Aim: The study primarily evaluated the mechanistic reasoning skills, learning engagement, scientific learning skills, and content knowledge in Science among Grade 10 students in the Division of Aklan, providing a basis for a Learning Enhancement Program (LEP).

Methods: This survey-correlational research design using researcher-made tests and checklists was utilized as a tool on gathering data needed for the study. The study involved 370 out of 9,587 Grade 10 students. Descriptive statistics used in the study were frequency, percentage, mean, and standard deviation and for inferential analyses were ANOVA, Pearson r, and linear regression.

Results: The findings indicated that mechanistic reasoning skills were "moderately evident," with decomposing systems, causality and evidence, building frameworks, and applying and refining understanding all rated similarly. However, metacognition and curiosity were rated as "highly evident." Learning engagement and scientific learning skills were also "moderately evident," with high ratings in taking notes, reading textbooks, memorizing, and preparing tests. Content knowledge in Science was rated as "moderate." Significant difference in content knowledge were observed across the levels of mechanistic reasoning and scientific learning skills, but no significant difference was found concerning learning engagement. Relationships were established between mechanistic reasoning, learning engagement, scientific learning skills, and content knowledge. Mechanistic reasoning skills, learning engagement, and scientific learning skills were identified as significant predictors of content knowledge. To address the identified gaps, a Learning Enhancement Program (LEP) was developed, focusing on improving mechanistic reasoning skills, learning engagement, and scientific learning skills to content knowledge in Science among Grade 10 students in the Division of Aklan.

Conclusion: The results revealed that overall proficiency of Grade 10 students in the Division of Aklan in Science demonstrates a moderate level across mechanistic reasoning skills, learning engagement, scientific learning skills, and content knowledge. While students exhibit strengths in metacognition, curiosity, and foundational study practices such as note-taking and test preparation, their engagement and deeper comprehension of scientific concepts remain areas for improvement. The moderate level of content knowledge and mechanistic reasoning skills suggests the need for targeted strategies to enhance their ability to apply scientific understanding to complex problems. Strengthening learning engagement, time management, and higher-order reasoning can further support their scientific literacy and overall academic performance.

Keywords: *Mechanistic Reasoning, Learning Engagement, Scientific Learning, Content Knowledge*

INTRODUCTION

Science education is vital in the development of individuals' critical thinking, problem-solving skills and scientific literacy necessary to understand, explain and address the complexities of life. There are many critical components of science education, and one of the most critical is mechanistic reasoning (Bachtiar et al, 2022).

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Mechanistic reasoning is the cognitive process through which people examine and make sense of natural occurrences by figuring out and appreciating the underlying mechanics or causal processes that underlie them. It is dissecting intricate events or systems into their component parts and explaining how these parts work together to generate observable results. Scientific investigation relies heavily on mechanistic reasoning because it helps scientists create hypotheses, plan experiments, and properly analyze data (King, 2015).

Moreover, according to Fredricks et al. (2014), by breaking down complex systems into understandable parts it empowers learners to uncover patterns, recognize connections, and confidently predict outcomes based on their grasp of the fundamental principles governing nature. In doing so, it transforms scientific inquiry into an engaging and accessible journey of discovery, fostering curiosity, critical thinking, and a deeper appreciation for the wonders of the natural world.

On the other hand, learning engagement as defined by Fredricks et al. (2014), describes the level of interest, motivation, and active participation that a learner exhibits during the learning process. Engaged learners are more likely to be deeply involved in their educational activities, demonstrating behaviors such as persistence, effort, and enthusiasm in learning tasks.

In connection, this may also help improve the scientific competence of the students. In the framework for K-12 Science Education Practices, scientific learning skills encompass a range of cognitive and practical abilities essential for effective scientific inquiry and problem-solving. These skills include critical thinking, analytical reasoning, experimental design, data interpretation, communication, and collaboration. Proficiency in scientific learning skills enables individuals to engage in rigorous scientific investigation, analyze data, draw evidence-based conclusions, and communicate findings effectively (Spires et al., 2022).

According to Kaui et al. (2023) and Carvajal, et al. (2025), content knowledge is the concepts, principles, process, relationships and application that a student should know in a given subject appropriate for his or her ability and level of learning. Content knowledge also helps improve the learners' over-all performance by understanding of the subject matter that educators are required to teach, and students are expected to learn. It encompasses the facts, concepts, theories, and principles within a specific domain or discipline (Dizon & Sanchez, 2020; Muńoz & Sanchez, 2023).

On the other hand, scientific understanding involves both conceptual understanding and inquiry skills. According to Mok and Tan (2024) in the context of investigation, domain-specific knowledge and domain-general strategies "bootstrap" one another, such that there is an interdependent relationship between these two types of knowledge. However, there is evidence that as is the case of intellectual skills in general, the development of the component skills of scientific reasoning "cannot be counted on to routinely develop". That is, young children have many requisite skills needed to engage in scientific thinking, but there are also ways in which even adults do not show full proficiency in investigative and inference tasks. Although all students do not pursue careers in science, the thinking skills used in scientific inquiry can be related to other formal and informal thinking skills.

Understanding the dynamic connection and interaction of mechanistic reasoning with learning engagement, scientific learning skills, and science content knowledge is very important in the efforts to advance scientific literacy and competence among learners. The researcher is convinced that mechanistic reasoning as well as learning engagement would help in offering open, equitable and motivating learning experiences. Engaged learners are highly motivated, more curious and relentless as such, they deepen understanding and facilitate the retention of scientific ideas. Besides, the growth of scientific learning skills such as critical thinking, experimental design, and data analysis enables scientists to utilize the scientific process of investigation and problem-solving. Perhaps the most crucial to engagement and the growth of mechanistic reasoning and scientific learning skills are content knowledge. Scientific content comprehension, including concept and rules, lies the foundation for science, which learners build.

Despite the recognized importance of these factors, different research investigating their relationships among students in the Division of Aklan remains limited. Because of this, the study sought to address this gap by examining how mechanistic reasoning, learning engagement, scientific learning skills, and content knowledge intersect and influence one another in the context of science education among Grade 10 students in Aklan. By elucidating these relationships, this research aimed to assess the level of mechanistic reasoning skills, learning engagement, scientific learning skills, and content knowledge in Science among Grade 10 Students in the Division of Aklan which was the bases for the Learning Enhancement Program.

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Research Questions

This study was conducted to determine the level of mechanistic reasoning skills, learning engagement, scientific learning skills, and content knowledge in Science among Grade 10 Students in the Division of Aklan as the basis for the Learning Enhancement Program, School Year 2024-2025.

Specifically, the study sought to answer the following questions:

1. What is the level of mechanistic reasoning skills in Science among the Grade 10 students in the Division of Aklan as a whole and in terms of decomposing systems; causality and evidence, building frameworks, applying and refining understanding, metacognition and curiosity?
2. What is the level of learning engagement in Science among the Grade 10 students in the Division of Aklan?
3. What is the level of scientific learning skills in Science among the Grade 10 students in the Division of Aklan as a whole and in terms of studying, managing time, taking notes, reading textbooks, memorizing, and preparing for tests?
4. What is the level of content knowledge in Science among the Grade 10 students in the Division of Aklan?
5. Is there a significant difference in content knowledge in science among the levels of mechanistic reasoning skills in Science of Grade 10 students in the Division of Aklan?
6. Is there a significant difference in content knowledge in science among the levels of learning engagement in Science of Grade 10 students in the Division of Aklan?
7. Is there a significant difference in content knowledge in science among the levels of scientific learning skills in Science of Grade 10 students in the Division of Aklan?
8. Are there significant relationships among the mechanistic reasoning skills, learning engagement, scientific learning skills, and content knowledge in Science of Grade 10 students in the Division of Aklan?
9. Are mechanistic reasoning skills, learning engagement and scientific learning skills significant predictors of content knowledge in Science among the Grade 10 students in the Division of Aklan?
10. What Learning Enhancement Program in Science can be created based on the result of the study?

Hypothesis

Based on the statement of the problem mentioned above, the following hypotheses were tested:

1. There is no significant difference on the content knowledge among the level of mechanistic reasoning skills in Science among the Grade 10 students in the Division of Aklan.
2. There is no significant difference between the levels of content knowledge and the level of learning engagement in Science among the Grade 10 students in the Division of Aklan
3. There is no difference between the levels of content knowledge and the level of scientific learning skills in Science among the Grade 10 students in the Division of Aklan
4. There are no significant relationships among the level of mechanistic reasoning skills, learning engagement, scientific learning skills and content knowledge in Science among the Grade 10 students in the Division of Aklan
5. Mechanistic reasoning skills, learning engagement and scientific learning skills are not significant predictors of content knowledge in Science among the Grade 10 students in the Division of Aklan.

METHODS

Research Design

This survey-correlational method of research study was conducted to determine the level of mechanistic reasoning skills, learning engagement, scientific learning skills, and content knowledge in Science among Grade 10 Students in the Division of Aklan which was the basis for the Learning Enhancement Program.

A survey- correlational study was used. Survey research is a systematic method used to collect data about people and their preferences, thoughts, and behaviors (Loveys et al., 2018). Conversely, correlational research examines correlations between variables without the researcher's intervention or control of any of them. The direction and/or strength of the relationship between two or more variables are reflected in a correlation. A correlation may have a positive or negative direction (Baker et al., 2017).

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Population and Sampling

There were 370 out of 9,857 students who participated in this study, identified using the Rao soft sample size calculator. Furthermore, the sample size of each school in different districts was determined using stratified random sampling. They were selected at random using the stratified proportional sampling.

Instrumentation

As used in this study, in order to gather relevant information needed, a set of questionnaire checklists was used. The questionnaire was made up of four (4) parts. Part I, determined the Level of Mechanistic Reasoning Checklist Questionnaire. Part II, was the Level of Learning Engagement Checklist Questionnaire. Part III, the level of Scientific Learning Skills Checklist Questionnaire, and Part IV, was the Content Knowledge in Science 10 Test.

On Mechanistic Reasoning, Learning Engagement, Scientific Learning Skills questionnaire, the following scoring procedure was used:

Rating	Range	Verbal Interpretation
5	4.20 – 5.00	Very Highly Evident
4	3.40 – 4.19	Highly Evident
3	2.60 – 3.39	Moderately Evident
2	1.80 – 2.59	Less Evident
1	1.00 – 1.79	Least Evident

On Content Knowledge in Science, the mean was arbitrarily categorized as follows:

Mean Score	Verbal Interpretation
32.01 – 40.00	Extremely High
24.01 – 32.00	High
16.01 – 24.00	Moderate
8.01 – 16.00	Low
0.00 – 8.00	Very Low

Data Collection

The following procedures were made in gathering the pertinent data. The researcher obtained the necessary permissions from Filamer Christian University, Inc., and the Department of Education, Division of Aklan, along with letters of support from school heads to facilitate the study. After approval, consent forms were distributed to students via their teachers, signed by the students' parents or guardians, and collected by the researcher. An orientation session was conducted to inform Science teachers and students about the study's purpose, ethical considerations, and benefits. Questionnaires, attached with the approved request letter, were personally administered by the researcher during Science classes, with guidance provided to ensure accurate responses. Completed questionnaires were retrieved, coded, and processed using SPSS software.

Treatment of Data

The following statistical tools for each statement of problems were applied in analyzing the data gathered.

1. Mean and Standard Deviation were used to determine the level of Mechanistic Reasoning in Science.
2. Mean and Standard Deviation were used to determine the level of Learning Engagement in Science.
3. Mean and Standard Deviation were used to determine the level of Scientific Learning Skills in Science.
4. Mean and Standard Deviation were used to determine the level of Content Knowledge in Science.
5. Analysis of Variance was used to determine the significant difference of Content Knowledge in Science Among the Levels of Mechanistic Reasoning in Science.
6. Analysis of Variance was used to determine the significant difference of Content Knowledge in Science Among the Levels of Learning Engagement in Science.
7. Analysis of Variance was used to determine the significant difference of Content Knowledge in Science Among the Levels of Scientific Learning Skills in Science.
8. Pearson r was used to determine the significant relationship between Mechanistic Reasoning, Learning Engagement, Scientific Learning Skills and Content Knowledge in Science.
9. Regression Analysis was used to determine as the predictors of Content Knowledge in Science Among Mechanistic Reasoning, Learning Engagement, and Scientific Learning Skills in Science.

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Ethical Considerations

The following ethical guidelines were observed for the research period:

1. Protected the dignity and wellbeing of participants at all times.
2. The researcher obtained the participants' permission to use their responses in the research report.
3. Confidentiality was ascertained to the respondents adhering to Republic Act 10173 or the Data Privacy Act of 2012.

RESULTS AND DISCUSSION

This part presents the tabulated data of the study with corresponding analysis and interpretation.

The presentation of the significant findings followed the sequence of the statement of the problem. This presentation is divided into two parts: (1) Descriptive Data Analysis, and (2) Inferential Data Analysis. The first part, Descriptive Data Analysis, presents the descriptive data along with their analysis and interpretation, while the second part, Inferential Data Analysis, presents the inferential data together with their corresponding analysis and interpretation. Data necessary for this study were gathered using researcher-made, adopted, and modified questionnaires. To analyze the data, the statistical tools employed included percentage, mean, standard deviation, Pearson r, and regression analysis.

Level of Mechanistic Reasoning Skills in Science of Grade 10 Students

Table 1 below shows the mean and standard deviation result of level of mechanistic reasoning skills in Science of Grade 10 students in the Division of Aklan.

Table 1.

Mean and Standard Deviation of Mechanistic Reasoning in Science

Variable	Mean	Description	SD
Mechanistic Reasoning in Science	3.23	Moderately evident	0.46
Decomposing Systems	3.29	Moderately evident	0.56
Causality and Evidence	3.08	Moderately evident	0.55
Building Frameworks	3.10	Moderately evident	0.54
Applying and Refining Understanding	3.08	Moderately evident	0.53
Metacognition and Curiosity	3.57	Highly evident	0.63

Generally, the "moderately evident" level of mechanistic reasoning result implies that Grade 10 students in the Division of Aklan have a foundational understanding of mechanistic reasoning, but they are required for more additional instructional support to deepen their comprehension and application of complex scientific concepts in daily life.

In addition, some of the students have low foundation in scientific knowledge making it difficult to apply the mechanistic reasoning in the real world problem such as understanding cause and effect, predicting outcomes, building and even understanding scientific laws, frameworks and theories.

Moreover, the result also suggests that some of the Science teachers in the Division of Aklan, that their instructional approaches focus mostly in memorization and procedural learning rather than applying the inquiry based learning or critical thinking approach.

Level of Learning Engagement in Science of Grade 10 Students

Table 2 presents the mean and standard deviation result of the level of learning engagement in Science of Grade 10 students in the Division of Aklan.

Table 3

Mean and Standard Deviation of Learning Engagement in Science

Variable	Mean	Description	SD
Learning Engagement in Science	3.02	Moderately evident	0.32

Generally, the result means that some of the Grade 10 students show positive engagement through efforts to ensure their work is accurate, exploring various problem-solving strategies, and connecting new concepts to prior knowledge.

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Additionally, if students perceive science as irrelevant to their everyday lives, their interest in the subject can diminish. Traditional teaching methods that lack interactive and engaging elements can also contribute to boredom, resulting in passive learning and difficulty maintaining focus. Addressing these issues is crucial for fostering a more motivating and engaging science learning environment.

Level of Scientific Learning Skills of Grade 10 Students

Table 3 shows the mean and standard deviation result of the level of scientific learning skills of Grade 10 students in the Division of Aklan.

Table 3

Mean and Standard Deviation of Scientific Learning Skills in Science

Variable	Mean	Description	SD
Scientific Learning Skills in Science	3.39	Moderately evident	0.55
Studying	3.36	Moderately evident	0.71
Managing your time	3.14	Moderately evident	0.63
Taking notes	3.46	Highly evident	0.73
Reading textbooks	3.41	Highly evident	0.67
Memorizing	3.45	Highly evident	0.72
Preparing tests	3.51	Highly evident	0.65

Over all, the a "moderately evident" level of scientific learning skills in Science means that some of the Grade 10 students demonstrate proficient and awareness in their study habits. However, some of the Grade 10 students find difficulties in creating structured study plans and managing their schedules effectively.

Among the indicators, preparing for the test is the highest with a "highly evident" level. This means that students are doing their very best to prepare for a science exam. Additionally, this high level of scientific learning skills preparation may reflect students' awareness of the content and skills they need to master, as well as their ability to prioritize exam-related tasks over other academic responsibilities.

In terms of studying and managing time, they are both "moderately evident". This suggests that students demonstrate a reasonable but not fully consistent effort in managing their study habits and time effectively. It indicates that students generally engage in studying and time management but not the most demonstrated skills. Some of the students there may be inconsistencies in their habits, depth of engagement, organization of schedules or even the use of effective strategies to balance their studying and as well as time management.

Level of Content Knowledge in Science of Grade 10 Students

Table 4 presents the level of content knowledge in Science of Grade 10 students in the Division of Aklan.

Table 4

Mean and Standard Deviation of Content Knowledge in Science

Variable	Mean	Description	SD
Content Knowledge in Science	20.23	Moderate	8.96

A moderate level of content knowledge simply means that students have the intermediate grasp of a subject matter such as in Gas Laws, Biomolecules, and Chemical reaction. This also means that students in this level are not fully comprehensive; they may lack in depth understanding, and even analysis of the key concepts, principles, and terminology.

Moreover, the content knowledge tests covered topics such as Gas Laws, Biomolecules, and Chemical reaction that often involve abstract concepts and complex theories that may be challenging for students to fully grasp without adequate instructional support. These topics require not only rote memorization but also the ability to apply concepts to real-life scenarios, something that may not be emphasized enough in the teaching approach.

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Significant Difference in Content Knowledge in Science among the Levels of Mechanistic Reasoning in Science of Grade 10 Students

Table 5 below shows the Analysis of Variance result of the difference in content knowledge in science among the levels of mechanistic reasoning in Science of Grade 10 students in the Division of Aklan.

Table 5

Analysis of Variance of Content Knowledge in Science Among the Levels of Mechanistic Reasoning in Science

Source of Variation	SS	df	MS	F	Sig.
Between Groups	4593	3	1531	22.367*	0.000
Within Groups	25054	366	68.5		
Total	29647	369			

* p<0.05 significant @ 5% alpha level

ns p>0.05 not significant @ 5% alpha level

The result suggests that the ability of the Grade 10 students to make reason mechanistically gives a critical role in understanding the science concept. In addition, the result implies that those Grade 10 students who can think mechanistically tend to engage in deeper learning processes, which allows them to make sense of how scientific phenomena occur and predict outcomes. Conversely, students with weaker mechanistic reasoning may be limited to recalling facts without fully understanding the underlying processes.

Significant Difference in Content Knowledge in Science among the Levels of Learning Engagement in Science of Grade 10 Students

Table 6 presents the Analysis of Variance on the difference in content knowledge in science among the levels of learning engagement in Science of Grade 10 students in the Division of Aklan.

Table 6

Analysis of Variance of Content Knowledge in Science Among the Levels of Learning Engagement in Science

Source of Variation	SS	Df	MS	F	Sig.
Between Groups	150.6	3	50.2	0.623^{ns}	0.601
Within Groups	29496	366	80.6		
Total	29647	369			

* p<0.05 significant @ 5% alpha level

ns p>0.05 not significant @ 5% alpha level

The findings of this study indicate that there is no significant difference in content knowledge in Science among Grade 10 students with varying levels of learning engagement. Whether students exhibit low, moderate, or high engagement, their grasp of scientific concepts such as Gas Laws, Biomolecules, or Chemical Reactions remains relatively similar.

In addition, this result challenges the common assumption that higher levels of engagement automatically lead to better content knowledge. While engagement is often highlighted as a critical component of effective learning in Science, the result suggests that mere participation or involvement in learning activities, regardless of varying levels, may not be enough to ensure superior content knowledge in Science. Students with higher engagement in learning Science may not necessarily outperform those with lower engagement when it comes to understanding content knowledge.

Significant Difference in Content Knowledge in Science among the Levels of Scientific Learning Skills in Science of Grade 10 Students

Table 7 shows the Analysis of Variance result on the difference in content knowledge in science among the levels of scientific learning skills in Science of Grade 10 students in the Division of Aklan.

Table 7

Analysis of Variance of Content Knowledge in Science Among the Levels of Scientific Learning Skills in Science

Source of Variation	SS	df	MS	F	Sig.
Between Groups	1788	4	447	5.856*	0.000

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Within Groups	27859	365	76.3	
Total	29647	369		

* p<0.05 significant @ 5% alpha level
ns p>0.05 not significant @ 5% alpha level

The significant result means that Grade 10 students with different levels of scientific learning skills have varying levels of content knowledge in science. In simpler terms, the ability of Grade 10 students to apply scientific learning skills affects how well they understand and retain scientific concepts.

Students who employ effective study habits, such as organizing their study materials, breaking down complex topics into manageable parts, and using active learning techniques, are more likely to engage deeply with the content. By managing their time well, these students can prioritize their tasks, allocate sufficient time for review, and avoid last-minute cramming, which enhance their ability to grasp and internalize scientific concepts.

Significant Relationships among the Mechanistic Reasoning Skills, Learning Engagement, Scientific Learning Skills, and Content Knowledge in Science of Grade 10 Students

Table 8 depicts the Pearson r result about the relationships among the mechanistic reasoning skills, learning engagement, scientific learning skills, and content knowledge in Science of Grade 10 students in the Division of Aklan.

Table 8
Pearson r Among Mechanistic Reasoning, Learning Engagement, Scientific Learning Skills and Content Knowledge in Science

Variables	r	Sig
Mechanistic Reasoning and Learning Engagement in Science	0.485*	0.000
Mechanistic Reasoning and Scientific Learning Skills in Science	0.622*	0.000
Mechanistic Reasoning and Content Knowledge in Science	0.385*	0.000
Learning Engagement and Scientific Learning Skills in Science	0.589*	0.000
Learning Engagement and Content Knowledge in Science	0.062^{ns}	0.234
Scientific Learning Skills and Content Knowledge in Science	0.275*	0.000

* p<0.05 significant @ 5% alpha level
ns p>0.05 not significant @ 5% alpha level

There is a significant relationship between mechanistic reasoning and learning engagement in science of Grade 10 students in the Division of Aklan. This means that as students' ability to engage in mechanistic reasoning improves, their level of engagement in science learning also increases.

The positive correlation indicates that students who are better at understanding and explaining the mechanisms behind scientific concepts are more likely to be actively involved and interested in learning science. The result also suggests that fostering mechanistic reasoning skills activities in teaching and learning process could enhance the learning engagement in Science of the students.

Predictors of Content Knowledge in Science from Mechanistic Reasoning Skills, Learning Engagement, and Scientific Learning Skills in Science of Grade 10 Students

Table 9 presents the regression analysis of the predictors of content knowledge in Science from mechanistic reasoning skills, learning engagement, and scientific learning skills in Science of Grade 10 students in the Division of Aklan.

Table 9
Regression Analysis of Content Knowledge in Science Among Mechanistic Reasoning, Learning Engagement, and Scientific Learning Skills in Science

	Unstandardized Coefficients	Standardized Coefficients	T	Sig.
Predictor	B	Beta		
(Constant)	5.306		1.279	0.202
Mechanistic Reasoning in Science	7.641	0.392	6.386*	0.000

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Learning Engagement in Science	-6.218	-0.225	(-)3.779*	0.000
Scientific Learning Skills in Science	2.665	0.164	2.466*	0.014

* p<0.05 significant @ 5% alpha level
ns p>0.05 not significant @ 5% alpha level

Mechanistic reasoning in Science is a significant predictor of Content knowledge of Grade 10 students in the Division of Aklan. The result suggests that students who excel in mechanistic reasoning are likely to have a much higher level of content knowledge.

This implies that when students engage in activities that enhance their mechanistic reasoning, such as problem-solving exercises, hands-on experiments, or discussions that encourage analytical thinking, they are not only learning facts but also understanding how these facts interrelate within the broader context of science.

Learning Enhancement Program

Based on the study aimed at determining the levels of mechanistic reasoning skills, learning engagement, scientific learning skills, and content knowledge in Science among Grade 10 students in the Division of Aklan, the following Learning Enhancement Program (LEP) is proposed. This program will address the identified needs in these key areas to improve science education outcomes.

This Learning Enhancement Program (LEP), "Mastering Chemistry through Reasoning, Engagement, and Skills," is crafted based on the findings from a study that assessed the levels of mechanistic reasoning skills, learning engagement, scientific learning skills, and content knowledge among Grade 10 students in the Division of Aklan. The study identified specific gaps in students' ability to decompose systems, understand causality, engage in learning activities, and apply scientific learning skills effectively in Chemistry topics such as gas laws, biomolecules, and chemical reactions.

Title	Objectives	Activities	Expected Outcomes
Enhancing Mechanistic Reasoning in Chemistry	Improve students' ability to decompose systems, understand causality, and apply knowledge in Chemistry topics such as gas laws and biomolecules.	Activity 1: Investigating Gas Laws through Interactive Simulations	Students understand how gas laws work through direct manipulation and observation of variables, practicing the decomposition of systems into understandable parts.
		Activity 2: Biomolecule Structure-Function Analysis	Students will gain a deeper understanding of how biomolecular structures relate to their functions, improving their mechanistic reasoning skills.
Active Learning Engagement in Chemistry	Improve learning engagement through effective study habits, time management, note-taking, and test preparation in Chemistry.	Activity 1: Chemistry Memorization Techniques – "Mnemonic Magic"	Students will improve their ability to memorize key Chemistry concepts, enhancing retention and recall during exams and class discussions.
		Activity 2: Collaborative Note-Taking Workshop	Students will improve their note-taking skills, leading to better content retention and a more effective review process for tests.
Strengthening Scientific Learning Skills	Improve scientific learning skills such as reading comprehension, summarization, and note organization in Chemistry.	Activity 1: Reading and Summarizing Chemistry Texts	Students will develop skills in extracting and summarizing critical information from complex Chemistry texts, improving comprehension.

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		Activity 2: Experiment Design Challenge	Students will deepen their understanding of chemical reactions by designing and conducting experiments, improving their problem-solving skills and scientific reasoning.
Deepening Content Knowledge in Chemistry	Improve students' understanding of gas laws, biomolecules, and chemical reactions through hands-on activities and assessments.	Activity 1: Gas Law Relays	Students will demonstrate a reinforced understanding of gas laws by accurately solving scenarios related to gas behavior and collaborating with peers during the relay activity.
		Activity 2: Biomolecule Modeling	Students will accurately identify and articulate the structures and functions of key biomolecules while creating informative 3D models and presentations.
		Activity 3: Types of Chemical Reactions Lab Investigation	Students will effectively classify and analyze different types of chemical reactions through hands-on experimentation, accurately documenting their observations and balancing chemical equations in their lab reports.

Conclusion

Based on the findings of the study stated above, the following conclusions were drawn:

1. The overall level of mechanistic reasoning skills in Science was moderately evident. In terms of decomposing systems, causality and evidence, building frameworks, applying and refining understanding were moderately evident and metacognition and curiosity was highly evident among of Grade 10 students in the Division of Aklan. Therefore, the result indicates that while students have a foundational capability in these critical areas, there is room for further enhancement to reach higher levels of proficiency. Notably, metacognition and curiosity are areas of strength, as they are highly evident among students. This may also lead to actively engaging in self-reflection and maintaining a strong sense of inquiry, targeted strategies to strengthen their mechanistic reasoning skills in other aspects can support their comprehensive scientific literacy.
2. The level of learning engagement in Science of Grade 10 students in the Division of Aklan was moderately evident. Therefore, this may lead to potential limitations in the depth of their understanding and retention of scientific concepts. It indicates that while students may be participating in learning activities, there is a need for enhanced strategies to stimulate their interest, motivation, and active participation to have deeper learning and stronger academic performance in Science.
3. The overall level of scientific learning skills in Science of Grade 10 students in the Division of Aklan was moderately evident. In terms of the studying and managing time, both were moderately evident. While highly evident results in taking notes, reading textbooks, memorizing, and preparing tests. Therefore, these strengths may lead to have proficiency in foundational study practices that support knowledge acquisition. To build on this, students may continue reinforcing time management and studying strategies could help enhance their overall learning process and contribute to more comprehensive scientific proficiency.
4. The level of content knowledge in Science was moderate. This indicates that while students possess a basic understanding of scientific concepts, their depth of knowledge is not comprehensive. Therefore, this moderate level of content knowledge may lead to challenges in applying their understanding to complex scientific problems and real-world situations.
5. There is a significant difference in the content knowledge in science among the levels of mechanistic reasoning in Science of Grade 10 students in the Division of Aklan. This indicates that students with higher mechanistic reasoning skills tend to have better content knowledge in Science, while those with lower reasoning skills may struggle with content understanding. Therefore, this may lead to a disparity in academic performance, with students who have more developed mechanistic reasoning skills being better equipped to comprehend and apply scientific concepts effectively.

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6. There is no significant difference in content knowledge in science among the levels of learning engagement in Science of Grade 10 students in the Division of Aklan. Therefore, this may lead to the realization that engagement alone may not be sufficient to improve content knowledge; other factors, such as teaching methods, curriculum design, and individual study habits, may play a more critical role. It emphasizes the need for a comprehensive approach that combines enhancing engagement with strategies that strengthen content comprehension to ensure meaningful and effective science learning.
7. There is a significant difference in content knowledge in science among the levels of scientific learning skills in Science of Grade 10 students in the Division of Aklan. This indicates that students with more developed scientific learning skills tend to have stronger content knowledge, while those with less developed learning skills may have weaker content knowledge. Therefore, this may lead to variations in students' academic performance, with those possessing stronger learning skills being better equipped to understand, retain, and apply scientific content effectively.
8. There are significant relationships between mechanistic reasoning, learning engagement, scientific learning skills, and content knowledge in science. There is a significant relationship between mechanistic reasoning and learning engagement in Science of Grade 10 students in the Division of Aklan. The significant relationship between mechanistic reasoning and learning engagement indicates that when students are more engaged, they tend to develop better reasoning skills. This, in turn, can boost their understanding of scientific content. Therefore, this may lead to a reinforcing cycle where higher engagement fosters improved reasoning skills, which in turn supports better understanding and application of content knowledge.
9. The mechanistic reasoning skills, learning engagement, and scientific learning skills are significant predictors of content knowledge in Science of Grade 10 students in the Division of Aklan. Students who exhibit stronger reasoning abilities, higher levels of engagement, and well-developed learning skills are more likely to have better content knowledge in Science. Therefore, this may lead to targeted educational strategies focusing on these key areas to enhance students' understanding and academic performance.

Recommendations

Based on the findings and conclusions, the following recommendations are requested:

1. Learners develop mechanistic reasoning skills which involve diving into activities that require breaking down complex ideas and understanding how different parts of a system connect. It is also suggested that they practice problem-solving exercises about cause-and-effect relationships, such as solving puzzles or working through scientific scenarios. Engaging in group discussions or debates on science topics allows the learners to strengthen their critical thinking skills by considering different perspectives. Teachers may also use tools like diagrams or flowcharts to map out complex processes can also make abstract ideas easier to grasp. Moreover, teachers can help students develop these skills by providing hands-on activities that encourage them to break down complex problems and think through systems. Activities like case studies or simulations can help students apply their reasoning skills in real-world contexts. Assignments that challenge students to use mechanistic reasoning in problem-solving will encourage them to apply these skills more effectively, helping them understand the "why" behind scientific concepts.
2. For learners, to becoming more engaged in learning, practice asking questions, participating in class discussions, and exploring additional resources like videos, articles, or experiments outside the classroom. Setting clear learning goals and tracking their progress can help keep them motivated and focused. Moreover, having study groups or collaborative projects can make learning more enjoyable and interactive. Teachers can enhance students' engagement by creating a dynamic classroom environment, contextualized activities that includes relatable and interactive lessons, group activities, and hands-on experiences. When students feel encouraged to share their ideas and explore topics that interest them, they are more likely to stay engaged and invested in their learning.
3. For learners, may continue to apply effective study habits. This includes practicing good time management, taking organized notes, and actively reading scientific material. Staying on top of their notes and reviewing them regularly can help reinforce what they have learned and make it easier to connect key concepts. It is also helpful to try out different study techniques, like summarizing what they have learned in their own words or teaching the material to a peer. Teachers can support students in developing strong scientific learning skills by offering guidance on how to organize time, take effective notes, and prepare for exams. Workshops or trainings during In-Service Training for Teachers can provide practical tools to help students become more efficient in their learning. Encouraging students to experiment with various study strategies, such as group

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discussions or self-quizzing, can help them discover what works best for them. Teachers may also provide regular feedback so students can fine-tune their learning methods and continue to improve over time.

4. Learners may focus on understanding the core scientific concepts rather than simply memorizing facts. Connecting what they learn in real-life situations can help make abstract concepts more relatable and easier to remember. Regularly reviewing and testing yourself on the material will help reinforce their understanding. Collaborating with classmates to explain difficult concepts or discuss challenging topics is also an effective way to deepen your knowledge, as teaching others is one of the best ways to learn. Teachers may use Inquiry-based teaching methods, where students explore scientific concepts through questions and hands-on activities. This can lead to a deeper understanding of the material. Using assessments that encourage students to think critically about what they have learned, rather than just recalling facts, can help them solidify their knowledge.
5. Schools in the Division of Aklan may enhance strategies to develop students' mechanistic reasoning skills. Implementing instructional techniques such as inquiry-based learning and hands-on experiments can encourage students to explore causal relationships and understand processes in science more deeply. Differentiated instruction is also essential, allowing students to engage in activities that match their levels of reasoning and support progressive learning. To strengthen this approach, professional development for teachers should be prioritized, focusing on effective methods like model-based instruction and using analogies to teach complex scientific ideas.
6. Teachers may continue to employ a variety of methods such as collaborative learning, gamification, and interactive media to keep students interested. Regular evaluation of these strategies through surveys and feedback sessions can ensure they remain effective and aligned with students' needs. Individualized support may be provided for students who may have difficulty staying engaged, ensuring they are included and can benefit fully from science lessons.
7. Science teachers in the Division of Aklan may prioritize activities that build key scientific skills like observation, hypothesis formation, experimentation, and data analysis. More frequent lab sessions and problem-solving workshops can be particularly effective. Teaching approaches that integrate scientific inquiry will help students think critically and apply their skills to solve real-world problems. Providing additional resources such as science fairs, mentorships, and extracurricular clubs can enhance learning outside the traditional classroom. Continuous formative assessments that provide ongoing feedback will enable students to recognize areas for improvement and build confidence in their scientific capabilities.
8. Teachers may integrate activities that simultaneously foster these interconnected areas. For instance, lessons that emphasize real-world problem-solving can enhance both mechanistic reasoning and engagement. Collaborative projects and inquiry-based tasks that require students to apply their learning skills while engaging with content can deepen their understanding and maintain interest. Professional development should also include training teachers on creating lesson plans that connect these domains, ensuring that mechanistic reasoning and learning engagement are emphasized to maximize learning outcomes.
9. The schools may focus on comprehensive instructional strategies that nurture students' abilities in each predictor. This includes structured classroom discussions that develop mechanistic reasoning, interactive activities and multimedia resources to foster engagement, and hands-on laboratory experiences to enhance scientific learning skills. Additionally, teachers may be equipped with assessment tools that help monitor students' progress in these areas, allowing for early intervention and tailored support when needed. Encouraging a learning environment that values critical thinking, curiosity, and active participation will help improve students' overall science performance.
10. To address the needs identified in mechanistic reasoning skills, learning engagement, and scientific learning skills, the crafted Learning Enhancement Program (LEP) may be strategically implemented to improve science education outcomes. The program may include a variety of resources, such as workshops, instructional modules, and student-centered projects that reinforce these key skills. Collaborative training sessions can equip teachers with innovative methods to seamlessly integrate the LEP into their teaching practices. Furthermore, the Education Program Supervisor (EPS) in Science may continue the evaluation and monitoring of the program's effectiveness feedback and performance assessments to make necessary adjustments. By ensuring the LEP is adaptable and responsive to student needs, it can effectively boost content knowledge and promote sustained academic achievement in science.

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