



Interpretative Phenomenological Analysis on Difficulties Encountered and Self-Efficacy in Science Lessons with Mathematical Computation among Grade 7 Learners

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ABSTRACT

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This qualitative study investigated the difficulties encountered and the level of self-efficacy of Grade 7 learners in Science lessons containing mathematical computation at Pangdan National High School, Catbalogan IX District, Schools Division of Catbalogan City, during the school year 2023–2024. Anchored on Bandura's Social Cognitive Theory and Achievement Goal Theory, the study aimed to provide an in-depth understanding of learners' experiences in handling computation-based science tasks.

Using an interpretative phenomenological design, fifteen purposively selected



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slow and struggling learners participated in content analysis activities, problem-solving tasks based on Polya's method, and focus group discussions. Findings revealed that mathematical computation appeared only in selected Grade 7 Science topics, particularly motion, motion graphs, and light characteristics, while topics such as sound characteristics, heat transfer, and charging processes lacked computational components. Learners exhibited varied proficiency levels: some demonstrated strength across all stages of Polya's framework, whereas others struggled in understanding problems, planning solutions, performing computations, and verifying results. Thematic analysis showed that self-efficacy was influenced by curiosity in science, difficulties with computation-heavy topics, effective teaching strategies, and strong support from teachers, peers, and family. The study concludes that integrating computation in underrepresented topics, reinforcing verification practices, and applying targeted instructional strategies are essential to enhance problem-solving skills and self-efficacy in science.

INTRODUCTION

Science education played a crucial role in enhancing scientific literacy and preparing learners for an increasingly complex world. Recent research by Erduran et al. (2015), emphasized the significance of argumentation in Science education, highlighting its role in fostering reasoning skills and scientific understanding. Argumentation, as a form of discourse, was instrumental in building scientific knowledge and explanations, aligned with the broader goal of developing scientific competence. Moreover, the incorporation of argumentation in Science education aligned with international curriculum recommendations and standards, and emphasized its importance in developing scientific practices and competencies. Calma and Davies (2015), pointed out that by focusing on innovative practice and embracing new technologies, Science education research aimed to advance knowledge in the field and promoted a deeper understanding of scientific concepts among learners. This emphasis on argumentation and innovative practice illustrated the evolving nature of Science education and its critical role in nurturing scientific literacy and critical thinking skills among students.

However, Science education in the Philippines faced challenges evidenced by low learner performance in Science and Math according to international assessments (Bernardo et al., 2023; Calleja et al., 2023). This poor performance posed concerns for the nation's scientific and technological progress. Factors included students' limited metacognitive reading awareness, social experiences, aspirations, and family factors. Teacher preparation mismatched due to the K-12

curriculum presented another issue. Interventions proposed included programs for struggling students, improved literacy training, positive Science perceptions, a better school climate, and increased ICT access. Further, some learners faced difficulties in learning Science, especially if it involved mathematical problem-solving. These learning difficulties may have caused them to experience difficulties. Difficulties encountered and self-efficacy played significant roles in the context of Science lessons that involved mathematical computation. Students may have experienced difficulties when faced with mathematical tasks within Science education due to various factors such as the complexity of calculations and fear of making mistakes, or a lack of confidence in their mathematical abilities. These difficulties encountered could hinder their overall learning experience and impede their performance in Science subjects.

On the other hand, self-efficacy, which referred to students' belief in their capacity to succeed in a particular task, could greatly influence their motivation, persistence, and performance in Science lessons with mathematical computation. Consequently, the relationship between difficulties encountered and self-efficacy in the context of Science lessons with mathematical computation was complex among Filipino students. As indicated by Dullas (2018), high levels of difficulties encountered could negatively impact Filipino students' self-efficacy beliefs, leading to decreased confidence and a higher likelihood of avoiding or disengaging from challenging mathematical tasks. Conversely, students with higher self-efficacy tended to approach these tasks with greater confidence, resilience, and motivation, which could reduce difficulties encountered and enhance their overall learning experience as cited by Blanco et al. (2020). Additionally, providing students with opportunities to build their mathematical skills, offering clear instructions and feedback, and promoting a growth mindset can all contribute to reducing difficulties encountered and enhancing self-efficacy in Science education. By doing so, students can develop a positive attitude towards mathematical computation in Science lessons, leading to improved learning outcomes and increased interest in (Science, Technology, Engineering and Mathematics) STEM subjects.

The academic landscape concerning difficulties encountered and self-efficacy among Filipino learners in the realm of Science education offered valuable insights into the psychological factors influencing academic performance. Several studies explored the intricate relationship between difficulties encountered, self-efficacy, and academic outcomes among students in the Philippines. Delving into the realm of mathematics difficulties encountered among young Filipino learners, a study by Delgado and Kassim (2019), examined junior high school students, revealing moderate levels of difficulties encountered toward Math. Furthermore,

some literature disclosed information on the performance of Grade 7 learners in Science education, revealing significant insights and trends. Studies such as those by Smith et al. (2015), and Chen and Wang (2018), emphasized the importance of inquiry-based learning approaches in enhancing scientific understanding among seventh graders. Conversely, findings from the research conducted by Johnson and Lee and (2021), Park highlighted the influence of socioeconomic factors on academic achievement in Science at this educational level. Overall, these studies underscored the multifaceted nature of factors influencing Grade 7 learners' performance in Science education, advocating for tailored instructional strategies and targeted interventions to address diverse learning needs and challenges.

In general, Science education emphasized argumentation and innovative practices to foster scientific literacy and reasoning skills. However, challenges persisted, like those seen in the Philippines, where low Science performance, limited metacognition, and teacher preparation mismatches existed. Additionally, student difficulties encountered, and self-efficacy related to mathematical problem-solving within Science education could impact learning outcomes. While Science education prioritized argumentation and innovation to promote scientific competency, factors like student difficulties encountered, metacognitive skills, and the educational landscape significantly influenced achievement. With this, the present study aimed to explore the difficulties encountered and self-efficacy in Science lessons with Mathematical computation among Grade 7 learners in Pangdan National High School, Catbalogan IX District, Schools Division of Catbalogan City for the school year 2023–2024.

FRAMEWORK

This study was anchored on Bandura's Social Cognitive Theory (1986) and Achievement Goal Theory. These theories provided a lens for understanding the difficulties encountered and self-efficacy of Grade 7 learners in Science lessons involving mathematical computation.

Bandura's Social Cognitive Theory emphasizes that learning occurs through the dynamic interaction of personal factors, behavior, and environmental influences. A central component of the theory is self-efficacy, which refers to an individual's belief in his or her capability to successfully perform a particular task. According to Bandura (1986), learners with high self-efficacy tend to approach challenging tasks with confidence, persistence, and resilience, while those with low self-efficacy are more likely to avoid difficult tasks and experience anxiety or self-doubt. In the context of this study, learners' experiences in solving Science problems involving mathematical computation may influence their confidence,

motivation, and willingness to engage in future computation-based activities. Difficulties encountered during problem-solving may affect their perceptions of competence, which in turn shape their self-efficacy in Science learning.

Achievement Goal Theory further explains how learners' goals and motivations influence their engagement and performance in academic tasks. The theory suggests that students who adopt mastery-oriented goals focus on understanding concepts, improving skills, and overcoming challenges, whereas those with performance-oriented goals are primarily concerned with demonstrating competence or avoiding failure. In Science lessons involving mathematical computation, learners' responses to challenging tasks may be influenced by their achievement goals. Those who view difficulties as opportunities for learning may demonstrate greater persistence and confidence, while those who fear failure may experience reduced motivation and lower self-efficacy. Thus, Achievement Goal Theory helps explain variations in learners' attitudes and behaviors when confronted with computational Science activities.

Guided by these theories, the study explored the Science lessons with mathematical computation covered during the third quarter, examined the difficulties encountered by Grade 7 learners in solving computation-based Science problems, and investigated their self-efficacy in performing such tasks. Through the lens of Interpretative Phenomenological Analysis, the study sought to understand how learners make sense of their experiences, challenges, and support systems in relation to mathematical computation in Science. The findings served as the basis for identifying implications and developing interventions that may strengthen learners' problem-solving skills and self-efficacy in Science education.

OBJECTIVES OF THE STUDY

This study explored the difficulties encountered and self-efficacy in Science lessons with mathematical computation among Grade 7 learners in Pangdan National High School, Catbalogan IX District, Schools Division of Catbalogan City for the school year 2023-2024.

Specifically, the study sought to answer the following questions: (1) identify the Science lessons with mathematical computation covered during the third quarter of Grade 7 Science. (2) Determine the difficulties encountered by Grade 7 learners in Science lessons involving mathematical computation. (3) Explore the self-efficacy of Grade 7 learners in answering Science lessons with mathematical computation. (4) Derive implications from the findings of the study for improving the teaching and learning of Science lessons involving mathematical computation.

METHODOLOGY

Research Design

The research design employed in this study was an interpretative phenomenological research design. Interpretative phenomenological research design involved an in-depth exploration of participants' lived experiences, emphasizing their subjective perspectives and interpretations (Alase, 2017). It sought to understand how individuals made meaning of their experiences and aimed to uncover the underlying meanings and structures that shaped their understanding of a particular phenomenon. In this study, the design allowed the researcher to investigate the experiences of Grade 7 learners in their Science lessons with Mathematical computation. By employing an interpretative phenomenological research design, the researcher could explore the complex interplay between difficulties encountered and self-efficacy in Grade 7 Science. This design was particularly suited to uncovering the experiences of the participants. The researcher engaged in a qualitative analysis of the data collected through methods such as interviews. By closely examining the participants' accounts, the researcher identified common themes, patterns, and meanings that emerged from their experiences.

Participants and Sampling Procedure

The participants for this study were the Grade 7 learners in Pangdan National High School, Catbalogan IX District, Schools Division of Catbalogan City for the school year 2023 – 2024. The researcher selected fifteen (15) participants, five from each section of the Grade 7 Science classes handled by the researcher. There were three (3) sections of Grade 7 being handled by the researcher where the participants were drawn. The criteria used by the researcher in selecting participants were as follows: (1) had to be in Grade 7 Science class of the researcher; (2) had to be considered as slow learners in the class as pre-determined by the researcher based on their Third Quarter grade in Science; (3) they were also considered as struggling learners in the class; (4) with no absences more than 10 days from the start of the school year classes; and (5) must not have been reported as learners with learning needs. Those characteristics of the learners were considered as participants of this study, beyond those criteria, the learners were excluded from the selection process.

Research Locale

The study was conducted at Pangdan National High School, Catbalogan IX District, Schools Division of Catbalogan City. Pangdan National High School

was a rural type and medium-sized school with school ID 313706 that was located 8 kilometers away from Catbalogan City. The school could be reached through a thirty-minute motorboat ride from Barangay Ubanon, Catbalogan City. Additionally, from National Road (Maharlika Highway), the place could also be reached through a single motorcycle ride or a 15-minute ride via Barangay Ibol Catbalogan City. At that time, Pangdan National High School had one (1) School Head, two (2) Master Teacher, two (2) administrative staff, and three (3) job contracts. Furthermore, it had a teaching force of sixteen (16) junior high school teachers, three (3) Science teachers, two (2) Mathematics teachers, three (3) English teachers, and two (2) Filipino teachers under the Academic Department. It also had the remaining two (2) Araling Panlipunan (AP) teachers, two (2) TLE teachers, and two (2) MAPEH teachers under Makabayan Department, while there were seven (7) Senior High School teachers. Pangdan National High School had a total number of students of 276 from the Junior High School, consisting of 136 male and 139 female students. Additionally, it had a total of 381 students from the Junior and Senior High Schools.

Research Instrumentation

The study made use of three (3) types of research tools. The first tool was the analysis guide framework, and this was used to dissect the identified learning competencies in Third Quarter Grade 7 Science as to “with mathematical problem”, without mathematical problem”, and as to what problem-solving content was present on those learning competencies. On the other hand, the second research instrument was the problem sets that were to be answered by the learners using the Polya’s Method Checklist and then the researcher checked whether the learners were able to execute the various steps of problem-solving using the said Polya’s framework. Then, the third tool was the Focus Group Discussion (FGD) Protocol that entailed questions on the experiences and difficulties encountered by the Grade selected 7 learners in learning Science with mathematical computations.

Validation and Reliability of Instrumentation

The research instruments were subjected to inter-coder validation by three (3) teachers in Science and Mathematics who checked the content of the research instruments to be used in the study. These validators had been teaching Science and Mathematics for more than five (5) years, and they had expertise and in-depth pedagogical knowledge in Science and Mathematics. In case the validators had comments and suggestions, they were integrated by the researcher for the refinement and improvement of the research tools of this study.

Data Gathering Procedure

The researcher initially secured the necessary communication letters, permission was obtained from the Schools Division Superintendent, and school head and parents permit to allow the researcher to conduct the study, and also an informed consent from participants was provided. Data collection included a structured analysis guide, observations using Polya's Problem-Solving Framework, and FGD protocol. Moreover, ethical considerations were considered by asking the participants to sign the participants' consent, and their participation in the study was voluntary. Further, participant confidentiality, anonymity, and secured data management were strictly maintained by the researcher to ensure the integrity of the research findings.

Data Analysis

Initially, for the researcher to assess the presence of mathematical computations and content in Science lessons, researchers likely employed a content analysis framework. This approach involved systematically categorizing instances of mathematical concepts and problem-solving within the lesson materials. By defining coding categories, developing coding guidelines, and coding the data, researchers could analyze the frequency and distribution of mathematical content. Secondly, content analysis was employed for the researcher to determine the difficulties encountered in doing problem solving in Science involving mathematical computation. And for this part, the researcher adopted a problem-solving approach inspired by George Polya's problem-solving principles.

Lastly, to analyze data from Focus Group Discussions (FGDs) on the difficulties encountered and self-efficacy of Grade 7 learners in Science lessons with mathematical computations, a combined approach of content analysis and thematic analysis was employed. Content analysis systematically categorized and quantified discussion elements, revealing the frequency of specific difficulty types (conceptual, procedural, etc.) and expressions of self-efficacy. Thematic analysis using Braun and Clarke's six-phase approach. This approach involved familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the final report. Researchers began by immersing themselves in the data from the FGDs, then systematically coded segments of text related to difficulties and self-efficacy. Next, they identified broader patterns or themes within the coded data, refining and revising these themes through iterative review and discussion. Finally, researchers defined, named, and interpreted the identified themes, providing a comprehensive understanding of the experiences and self-efficacy of learners regarding problem-solving in Science.

Ethical Consideration

This study adhered to established ethical standards in educational research to ensure the protection of participants' rights, dignity, and well-being. Prior to data collection, formal permission was secured from the Schools Division Superintendent, the school head of Pangdan National High School, and the participants' parents or guardians. Each participant received a clear explanation of the study's objectives, procedures, potential benefits, and any possible risks. Informed consent was obtained in writing from both the learners and their parents or guardians, emphasizing that participation was entirely voluntary and that they could withdraw from the study at any stage without any academic or personal repercussions.

Confidentiality and anonymity were strictly maintained by assigning pseudonyms or participant codes in all data records, transcripts, and reports to prevent the identification of individuals. All research materials, including interview recordings, written outputs, and observation notes, were stored securely in password-protected files accessible only to the researcher. The study ensured that no participant was subjected to harm, discrimination, or undue stress. Sensitive responses were treated with utmost care, and discussions during focus group interviews were conducted in a respectful and non-judgmental manner to create a safe environment for honest sharing.

The researcher upheld principles of honesty, transparency, and integrity throughout the research process, avoiding any form of data fabrication, falsification, or plagiarism. Ethical guidelines set forth by the American Educational Research Association (AERA) and relevant institutional protocols were observed, ensuring that the study met both local and international standards for responsible conduct of research involving human participants.

AI Policy

The authors declare that Artificial Intelligence (AI)-assisted technology was utilized solely to support language refinement, grammar checking, sentence restructuring, and the improvement of manuscript readability during the preparation of this research paper. Specifically, ChatGPT (OpenAI) was used as a writing assistance tool to enhance clarity, coherence, and academic presentation of selected sections of the manuscript.

The AI tool was not used in the collection, generation, analysis, interpretation, or validation of research data. All research procedures, methodological decisions, data analyses, findings, interpretations, conclusions, and recommendations were conducted, reviewed, and verified solely by the authors. The authors take full responsibility for the accuracy, integrity, originality, and scholarly content

of the manuscript and have carefully reviewed all AI-assisted outputs to ensure compliance with ethical research and publication standards.

The use of AI in this study adhered to the principles of transparency, accountability, and academic integrity, and no AI-generated content was included without human evaluation and revision.

RESULTS AND DISCUSSION

Science Lessons with Mathematical Computation Covered During the Third Quarter of Grade 7 Science

Table 1
Science Lessons with Mathematical Computation Covered During the Third Quarter of Grade 7 Science

Competencies	Reasons for No Mathematical Content	Mathematical Problem Content
Describe the motion of an object in terms of distance or displacement, speed or velocity, and acceleration		Distance and Displacement
Create and interpret visual representations of the motion of objects such as tape charts and motion graphs		Positive charging velocity
Infer those waves carry energy		Waves
Describe the characteristics of sound using the concepts of wavelength, velocity, and amplitude	Limited to the presentation of concepts without the computation of wavelength, velocity, and amplitude.	
Explain the color and intensity of light in terms of its wave characteristic		Characteristics of Color Light
Infer the conditions necessary for heat transfer to occur	Presence and absence of heat transfer in a material, without any computations involved.	
Describe the different types of charging processes	Description of the charging process concepts without computations yet	

The results indicate that mathematical computations are integrated into specific areas of the Grade 7 Science curriculum. These areas include describing the motion of objects (distance and displacement), creating and interpreting motion graphs (positive charging velocity), and explaining the characteristics

of light (characteristics of color light). However, several competencies, such as describing the characteristics of sound, inferring heat transfer conditions, and describing charging processes, do not involve mathematical computations. This highlights potential areas for curriculum enhancement to better incorporate mathematical concepts and improve student understanding of these topics.

Difficulties Encountered in Grade 7 Science Lessons with Mathematical Computation

5.2.1 Distance and Displacement

Table 2
Difficulties Encountered in Grade 7 Science Lessons with Mathematical Computation for the Topic Distance and Displacement

Participant	Polya's Problem Solving Framework								Remarks
	(A)		(B)		(C)		(D)		
	Understanding the Problem		Devising a Plan		Carrying out the Plan		Checking the Result		
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	
	Clearly define the problem statement and identify the key information provided.	Break down the problem into smaller, manageable parts or sub-problems.	Consider different solving strategies or approaches that can be applied to the given problem.	Choose an appropriate mathematical computation method or formula to solve the problem.	Perform the necessary mathematical computations accurately and systematically.	Show all the intermediate steps and calculations to ensure clarity in the solution process.	Verify the obtained solution by re-evaluating the problem if it aligns with the given conditions or requirement.	Check for any potential errors or mistakes in the calculations or steps taken during the problem-solving process.	
1	O	O	O	O	O	O	O	O	Strong problem-solving skills.
2	NT	O	NT	NT	NT	NT	NT	NT	Needs more practice in problem understanding and planning.
3	O	O	NT	O	O	O	O	O	Strong understanding and execution but weak in planning and checking.

4	O	NT	O	O	NT	O	O	O	Needs improvement in planning and error checking.
5	O	O	O	O	O	O	NT	NT	Needs practice in result verification.
6	O	O	O	NT	O	O	O	O	Occasionally skips steps in execution.
7	O	O	NT	NT	O	O	NT	NT	Needs work on planning and verification.
8	O	O	O	O	O	O	O	O	Strong problem-solving skills.
9	NT	NT	O	O	O	O	O	NT	Struggles with understanding and verification.
10	O	O	O	O	O	O	O	O	Consistent proficiency in all areas.
11	O	O	O	O	O	O	O	O	Strong skills across all stages.
12	O	O	NT	O	O	O	NT	NT	Needs improvement in planning and verification.
13	O	O	NT	O	O	O	O	O	Performs well but weak in planning
14	NT	O	NT	O	O	O	NT	O	Needs foundational practice in understanding and planning.
15	O	O	O	O	NT	O	O	O	Needs to improve in final verification.

Legend: Observed (O); Not Observed (NT)

Acceleration

Table 3
Difficulties Encountered in Grade 7 Science Lessons with Mathematical Computation for the Acceleration

Participant	Polya's Problem Solving Framework								Remarks
	(A) Understanding the Problem		(B) Devising a Plan		(C) Carrying out the Plan		(D) Checking the Result		
	(1) <i>Clearly define the problem and identify the key information provided.</i>	(2) <i>Break down the problem into smaller, manageable parts or sub-problems.</i>	(1) <i>Consider different strategies or approaches that can be applied to the given problem.</i>	(2) <i>Choose an appropriate mathematical computation method or formula to solve the problem.</i>	(1) <i>Perform the necessary mathematical computations accurately and systematically.</i>	(2) <i>Show all the intermediate steps and calculations to ensure clarity in the solution process.</i>	(1) <i>Verify the obtained solution by re-evaluating the problem and checking if it aligns with the given conditions or requirement.</i>	(2) <i>Check for any potential errors or mistakes in the calculations or steps taken during the problem-solving process.</i>	
1	O	O	O	O	O	O	O	O	Strong problem-solving skills.
2	O	O	O	O	O	O	O	O	
3	O	O	O	O	O	O	O	O	
4	O	O	O	O	O	O	O	O	
5	O	O	O	O	O	O	O	O	
6	O	O	O	O	O	O	O	O	
7	O	O	O	O	O	O	O	O	
8	O	O	O	O	O	O	O	O	
9	O	O	O	O	O	O	O	O	
10	O	O	O	O	O	O	O	O	
11	O	O	O	O	O	O	O	O	
12	O	O	O	O	O	O	O	O	
13	O	O	O	O	O	O	O	O	
14	O	O	O	O	O	O	O	O	
15	O	O	O	O	O	O	O	O	

Legend: Observed (O); Not Observed (NT)

In devising a plan, all participants showed competency by breaking down problems into smaller, manageable parts and considering different

problem-solving strategies. This indicates that the students are well-versed in strategic planning and are able to approach problems methodically.

When it came to carrying out the plan, every participant performed the necessary computations accurately and systematically, showing all intermediate steps and calculations. This suggests that the students have a solid grasp of executing their plans and ensuring clarity in their solution process.

Verification of results was another area where all participants excelled. They consistently checked their results, re-evaluating the problem and ensuring that their solutions aligned with the given conditions. This demonstrates a strong understanding of the importance of verification in the problem-solving process.

The performance of all participants was exemplary, showing strong problem-solving skills across all stages of Polya's Problem Solving Framework. Participants 1 through 15 exhibited perfect performance, highlighting their comprehensive abilities in mathematical computations related to acceleration. This uniform proficiency suggests that the instructional methods and practice exercises employed were highly effective in equipping students with the necessary skills to tackle these types of problems.

The high level of competence observed across all participants underscores the success of the educational approach in teaching mathematical computations for acceleration in science lessons. Continuing to build on these strategies will likely further enhance students' abilities and confidence in handling complex mathematical problems in their science coursework.

Velocity

Table 4
Difficulties Encountered in Grade 7 Science Lessons with Mathematical Computation for the Topic Velocity

Participant	Polya's Problem Solving Framework								Remarks
	(A)		(B)		(C)		(D)		
	Understanding the Problem		Devising a Plan		Carrying out the Plan		Checking the Result		
	(1) <i>Clearly define the problem state ment and iden tify the key infor mation provi ded.</i>	(2) <i>Break down the problem into smaller, mana geable parts or sub-problems.</i>	(1) <i>Consider different problem-solving strate gies or appro aches that can be applied to the given problem.</i>	(2) <i>Choose an appro priate mathe matical compu tation method or formula to solve the problem.</i>	(1) <i>Perform the necessary mathe matical comput ations accu rately and systema tically.</i>	(2) <i>Show all the inter mediate calcu lations to ensure clarity in the solution process.</i>	(1) <i>Verify the obtained solution by re-evalu ating the problem and checking if it aligns with the given conditions or requi rement.</i>	(2) <i>Check for any potential errors or mistakes in the calculations or steps taken during the problem-solving process.</i>	
1	O	O	O	O	O	O	O	O	Strong problem-solving skills.
2	O	O	O	O	NT	NT	NT	NT	Needs more practice in checking and verification.
3	O	O	O	O	O	O	O	O	Strong problem-solving skills
4	O	O	O	O	O	O	O	O	Strong problem-solving skills
5	O	O	O	O	O	O	O	O	Strong problem-solving skills
6	O	O	O	O	NT	NT	NT	NT	Needs more practice in checking and verification.

7	O	O	O	O	NT	NT	NT	NT	Needs more practice in checking and verification.
8	O	O	O	O	O	O	O	O	Strong problem-solving skills.
9	O	O	O	O	NT	NT	NT	NT	Needs more practice in checking and verification.
10	O	O	O	O	O	O	O	O	Strong problem-solving skills
11	O	O	O	O	NT	NT	NT	NT	Needs more practice in checking and verification.
12	O	O	O	O	NT	NT	NT	NT	Needs more practice in checking and verification.
13	O	O	O	O	O	O	O	O	Strong problem-solving skills
14	O	O	O	O	NT	NT	NT	NT	Needs more practice in checking and verification.
15	O	O	O	O	O	O	O	O	Strong problem-solving skills

Legend: Observed (O); Not Observed (NT)

The students exhibited strong foundational skills in understanding, planning, and executing mathematical problems related to velocity. However, there is a clear need for improvement in the verification phase. Emphasizing the importance of checking results and identifying errors will help students develop more comprehensive problem-solving skills. This targeted focus on verification

practices will enhance their overall proficiency in mathematical computations in science lessons.

Waves

Table 5
Difficulties Encountered in Grade 7 Science Lessons with Mathematical Computation for the Topic Waves

Participant	Polya's Problem Solving Framework								Remarks
	(A)		(B)		(C)		(D)		
	Understanding the Problem		Devising a Plan		Carrying out the Plan		Checking the Result		
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	
	Clearly define the problem state ment and identify the key information provided.	Break down the problem into smaller, manageable parts or sub-problems.	Consider different problem-solving strategies or approaches that can be applied to the given problem.	Choose an appropriate mathematical computation method or formula to solve the problem.	Perform the necessary mathematical computations accurately and systematically.	Show all the intermediate steps and calculations to ensure clarity in the solution process.	Verify the obtained solution by re-evaluating the problem and checking if it aligns with the given conditions or requirement.	Check for any potential errors or mistakes in the calculations or steps taken during the problem-solving process.	
1	O	O	O	O	O	O	O	O	Strong problem-solving skills.
2	NT	NT	NT	NT	NT	NT	NT	NT	Needs foundational practice in understanding, planning, execution, and verification.
3	O	O	O	O	O	O	O	O	Strong problem-solving skills
4	NT	NT	NT	NT	NT	NT	NT	NT	Needs foundational practice in understanding, planning, execution, and verification.

5	NT	NT	NT	NT	NT	NT	NT	NT	Needs foundational practice in understanding, planning, execution, and verification.
6	O	O	O	O	O	O	O	O	Strong problem- solving skills.
7	O	O	O	O	O	O	O	O	Strong problem- solving skills
8	O	O	O	O	O	O	O	O	Strong problem- solving skills.
9	NT	NT	NT	NT	NT	NT	NT	NT	Needs foundational practice in understanding, planning, execution, and verification.
10	O	O	O	O	O	O	O	O	Strong problem- solving skills
11	O	O	O	O	O	O	O	O	Strong problem- solving skills
12	O	O	O	O	O	O	O	O	Strong problem- solving skills
13	NT	NT	NT	NT	NT	NT	NT	NT	Needs foundational practice in understanding, planning, execution, and verification.
14	NT	NT	NT	NT	NT	NT	NT	NT	Needs foundational practice in understanding, planning, execution, and verification.
15	O	O	O	O	O	O	O	O	Strong problem- solving skills

Legend: Observed (O); Not Observed (NT)

Overall Results Across Competencies

Table 6
Difficulties Encountered in Grade 7 Science Lessons with Mathematical Computation Across Competencies

Participant	Remarks per Topic				Overall Remarks
	Distance and Displacement	Acceleration	Velocity	Waves	
1	Strong problem-solving skills.	Strong problem-solving skills.	Strong problem-solving skills.	Strong problem-solving skills.	Demonstrated strong problem-solving skills across all topics, consistently showing a comprehensive understanding and execution of mathematical computations.
2	Needs more practice in problem understanding and planning.		Needs more practice in checking and verification.	Needs foundational practice in understanding, planning, execution, and verification.	Needs more foundational practice in understanding, planning, execution, and verification across all topics. There is a consistent need for improvement in checking and verification.
3	Strong understanding and execution but weak in planning and checking.		Strong problem-solving skills	Strong problem-solving skills	Exhibited strong problem-solving skills overall, although there was some weakness in planning and checking in the topic of Distance and Displacement.
4	Needs improvement in planning and error checking.		Strong problem-solving skills	Needs foundational practice in understanding, planning, execution, and verification.	Shows strong problem-solving skills but needs significant foundational practice in understanding, planning, execution, and verification, especially in the topics of Distance and Displacement and Waves.
5	Needs practice in result verification.		Strong problem-solving skills	Needs foundational practice in understanding, planning, execution, and verification.	Demonstrates strong problem-solving skills in Acceleration and Waves but needs more foundational practice in understanding, planning, execution, and verification, especially in the topics of Distance and Displacement and Velocity.
6	Occasionally skips steps in execution.		Needs more practice in checking and verification.	Strong problem-solving skills.	Exhibited strong problem-solving skills in the topic of Waves, but needs more practice in checking and verification and occasionally skips steps in execution
7	Needs work on planning and verification.		Needs more practice in checking and verification.	Strong problem-solving skills	Shows strong problem-solving skills in Waves but requires more practice in checking and verification and needs work on planning and verification for other topics.

8	Strong problem-solving skills.	Strong problem-solving skills.	Strong problem-solving skills.	Demonstrated strong problem-solving skills consistently across all topics
9	Struggles with understanding and verification.	Needs more practice in checking and verification.	Needs foundational practice in understanding, planning, execution, and verification.	Needs more foundational practice in understanding, planning, execution, and verification, particularly in the topics of Distance and Displacement, Velocity, and Waves. Also needs improvement in checking and verification.
10	Consistent proficiency in all areas.	Strong problem-solving skills	Strong problem-solving skills	Consistent proficiency in all areas and topics, showing strong problem-solving skills throughout.
11	Strong skills across all stages.	Needs more practice in checking and verification.	Strong problem-solving skills	Exhibited strong problem-solving skills in most areas but needs more practice in checking and verification, particularly for the topic of Acceleration.
12	Needs improvement in planning and verification.	Needs more practice in checking and verification.	Strong problem-solving skills	Needs improvement in planning and verification, with strong problem-solving skills in the topic of Waves but requiring more practice in checking and verification overall.
13	Performs well but weak in planning	Strong problem-solving skills	Needs foundational practice in understanding, planning, execution, and verification.	Performs well in general but shows a need for foundational practice in understanding, planning, execution, and verification, particularly in the topics of Distance and Displacement and Waves.
14	Needs foundational practice in understanding and planning.	Needs more practice in checking and verification.	Needs foundational practice in understanding, planning, execution, and verification.	Consistently needs foundational practice in understanding, planning, execution, and verification across all topics, with particular emphasis on improving checking and verification.
15	Needs to improve in final verification.	Strong problem-solving skills	Strong problem-solving skills	Demonstrated strong problem-solving skills across all topics but needs to improve in the final verification steps.

Overall, participants 1, 3, 8, 10, and 15 demonstrated strong problem-solving skills across all topics, consistently showing a comprehensive understanding and execution of mathematical computations. These students exhibited proficiency in all stages of Polya's Problem Solving Framework, from understanding the problem to verifying their solutions.

Participants 6 and 7 displayed a mix of strong problem-solving skills and areas needing improvement. While they performed well in some topics, they occasionally skipped steps in execution or required more practice in verification. This inconsistency suggests a need for targeted support to help them achieve a more uniform level of proficiency.

Participants 11 and 12 also showed strong problem-solving skills in most areas but need more practice in verification, particularly for the topic of Acceleration. Their performance indicates that while they have a good grasp of understanding and planning, reinforcing verification practices would enhance their overall problem-solving abilities.

While a subset of students excels in problem-solving, there is a clear need for focused instructional strategies to support those who struggle. Emphasizing foundational practices and verification techniques will be crucial in ensuring all students develop a solid foundation in mathematical computations related to science lessons. This targeted support will help bridge the performance gaps and enhance the overall proficiency of students in mathematical problem-solving.

Self-Efficacy of Grade 7 Learners in Answering Science Lessons with Mathematical Computation

This section presents the findings from the thematic analysis of interviews with Grade 7 learners regarding their self-efficacy in answering science lessons that involve mathematical computation. The analysis, conducted using Braun and Clarke's six-phase approach (*process shown in Attachment F*), reveals several key themes that shed light on the learners' experiences, challenges, and support mechanisms. The themes identified include curiosity and interest in science, challenges with mathematical computation, self-efficacy and confidence, effective teaching methods, and support systems. These themes provide a comprehensive understanding of the factors influencing students' self-efficacy and offer insights into potential areas for improvement in science education. The following sections detail each theme with illustrative quotes from the participants (*see Appendix E- Transcriptions*)

Theme 1: Curiosity and Interest in Science

Many participants expressed curiosity and interest in specific science activities and lessons. These activities often sparked their curiosity and motivated them to learn more.

“Microscope, Sir. Because I learned how to use the microscope and also learned its parts. The solute and solvent or the types of solutions.”

– Participant 1 (Answer to Question No. 1, Lines 5 – 6)

“The experiment. You will learn how to combine cells and tissues. Velocity, speed, distance, and displacement.”

– Participant 2 (Answer to Question No. 1, Lines 5 – 6)

“About the Earth, Sir, because I want to learn what is happening here, and the parts of the microscopes, Sir.”

– Participant 14 (Answer to Question No. 1, Lines 4 – 5)

Theme 2: Challenges with Mathematical Computation

Participants highlighted specific topics in science that they found challenging, particularly those involving mathematical computations such as distance, displacement, velocity, and acceleration.

“Distance and displacement...I really didn’t understand the problem. Waves, Sir, when computing, I often make mistakes.”

– Participant 1 (Answer to Question No. 2, Lines 15 – 19)

“Topic 3 Velocity, Sir, because I still get confused about velocity... Topic 2 Velocity and acceleration because I don’t know, Sir, how to answer it.”

– Participant 3 (Answer to Question No. 3, Lines 4 – 6)

“Velocity and acceleration, I found it difficult to solve the problem of velocity and acceleration.”

– Participant 10 (Answer to Question No. 3, Lines 20 – 21)

Theme 3: Effective Teaching Methods

Effective teaching methods and activities were identified as crucial in helping students understand and enjoy science. Hands-on activities and thorough explanations were

particularly beneficial.

“Yes, we did an experiment with water and sugar, Sir. We mixed it and heated it. I learned its melting point.”

– Participant 5 (Answer to Question No. 5, Lines 16 – 17)

“I listen and then I score high. We answer and listen to be able to answer. They teach so we can score.”

– Participant 7 (Answer to Question No. 5, Lines 11 – 13)

“They teach us, Sir. We do experiments. They discuss. So, we know how it is done.”

– Participant 13 (Answer to Question No. 5, Lines 8 – 9)

Theme 4: Support Systems

Participants relied on various support systems when they encountered difficulties in understanding science lessons. These included teachers, family members, friends, and online resources.

“To my older sisters, to you Sir. Yes Sir. They give advice and opinions regarding the topic and how to answer.”

– Participant 1 (Answer to Question No. 6, Lines 9 – 10)

“To the teacher. Sometimes we rely on others but I also rely on myself if I can, if I can answer it. Teaching how to process it.”

– Participant 2 (Answer to Question No. 6, Line 25; Lines 1 – 2)

“Sometimes to the teacher, sometimes to my parents and relatives. Yes. They help me understand the topic.”

– Participant 11 (Answer to Question No. 6, Lines 5 – 6)

The thematic analysis revealed that Grade 7 learners’ self-efficacy in answering science lessons with mathematical computation is influenced by their curiosity and interest in science, the challenges they face with specific topics, their self-assessed confidence, the effectiveness of teaching methods, and the support systems they rely on. Addressing these themes through targeted interventions can help improve student outcomes in science education.

Implications

The findings of this study highlight several key implications for the Grade 7 Science curriculum and instructional strategies. The integration of mathematical computations is effective in areas like describing the motion of objects, interpreting motion graphs, and explaining the characteristics of light. However, topics such as sound characteristics, heat transfer, and charging processes lack mathematical content, indicating a need for curriculum enhancement to include these computations and strengthen students’ understanding.

The analysis revealed that while some students, notably participants 1, 8, 10, and 11, exhibit strong problem-solving skills, others, including participants 2, 4, 5, 9, 13, and 14, consistently struggle with understanding, planning, execution, and verification. This underscores the necessity for targeted instructional strategies to build foundational skills and improve verification practices. Emphasizing

these areas in the curriculum can help students develop more reliable and comprehensive problem-solving abilities.

Moreover, students' self-efficacy in science lessons involving mathematical computation is influenced by their curiosity, challenges with specific topics, effective teaching methods, and support systems. Engaging and interactive teaching methods, along with strong support networks involving teachers, family, and peers, are crucial for enhancing student learning and confidence. By addressing these aspects, educators can create a more supportive and effective learning environment that bolsters students' problem-solving skills and overall proficiency in mathematical computations within science lessons.

CONCLUSIONS

The findings revealed that mathematical computations were integrated into specific areas of the Grade 7 Science curriculum, including describing the motion of objects, interpreting motion graphs, and explaining the characteristics of light. However, certain topics such as sound characteristics, heat transfer, and charging processes lacked mathematical content, suggesting a need for curriculum enhancement. In terms of difficulties, the study found that while some students exhibited strong problem-solving skills, many struggled with understanding, planning, execution, and verification of mathematical problems. This indicates the necessity for targeted instructional strategies to build foundational skills and improve verification practices. Furthermore, the self-efficacy of Grade 7 learners in answering science lessons with mathematical computation was influenced by their curiosity and interest in science, challenges with specific topics, effective teaching methods, and support systems. Addressing these themes through targeted interventions can help improve student outcomes in science education.

RECOMMENDATIONS

Based on the results of the study, the following recommendations are made:

1. Integrate mathematical computations into topics currently lacking such content, such as sound characteristics, heat transfer, and charging processes. This will help strengthen students' understanding and application of mathematical concepts in science.
2. Provide additional support and targeted instruction for students who struggle with understanding, planning, execution, and verification of mathematical problems. This can include step-by-step problem-solving exercises

and peer tutoring.

3. Emphasize the importance of checking results and identifying errors in the curriculum. Teaching students systematic verification practices will enhance their problem-solving abilities and ensure accuracy.

4. Incorporate more hands-on activities, experiments, and interactive lessons to engage students and make learning more enjoyable. Diverse teaching methods should be utilized to cater to different learning styles.

5. Encourage collaboration among students and involve parents and peers in the learning process. Providing access to online resources and guidance on seeking help effectively will build a robust support system for learners.

6. Address factors influencing students' self-efficacy, such as their interest in science, confidence in mathematical computations, and the challenges they face. Implementing effective teaching methods and ensuring strong support networks will boost students' confidence and proficiency.

TRANSLATIONAL RESEARCH

The findings of this study may be translated into the development of a Science Computation Enhancement Module (SCEM) designed for Grade 7 learners. The module may contain contextualized lessons, guided problem-solving activities based on Polya's Problem-Solving Framework, practice exercises, verification checklists, and self-efficacy enhancement activities that will assist learners in overcoming difficulties encountered in Science lessons involving mathematical computation. Special emphasis may be given to competencies related to distance and displacement, velocity, acceleration, waves, and other Science topics requiring computational skills.

Furthermore, the module may serve as an instructional support material for Science teachers in implementing differentiated and scaffolded learning strategies for struggling learners. The proposed material may also include learner reflection sheets, peer-assisted learning activities, and parental support guides to strengthen the support systems identified in the study. Upon development, the module may be subjected to expert validation and pilot implementation to determine its acceptability, effectiveness, and impact on learners' problem-solving skills and self-efficacy in Science. Through this intervention, schools may provide a more responsive learning environment that promotes confidence, mathematical reasoning, and improved academic performance among Grade 7 learners.

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