International Journal of Research Studies in Education
2026 Volume 15 Number 10, 133-151

Teaching strategies, STEM students' attitude and academic performance in Physics

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ISSN: 2243-7703
Online ISSN: 2243-7711

OPEN ACCESS

Received: 29 March 2026 **Revised**: 23 April 2026 **Accepted**: 25 April 2026
Available Online: 29 April 2026 **DOI**: 10.5861/ijrse.2026.26709

Abstract

This exploratory sequential study analyzed the relationship among various teaching strategies, STEM students' attitude and academic performance at Divine Word College of San Jose and Philippine Central Islands College. Colaizzi's method was applied to identify recurring themes in qualitative data. At the same time, both descriptive and inferential statistics, particularly Pearson's r and Structural Equation Modeling (SEM), served as tools for quantitative data. The study identified the five most common teaching strategies used in teaching Physics: the lecture method, context-based instruction, the problem-solving method, inquiry-based learning, and activity-based learning. The findings indicated that despite the implementation of these teaching strategies, students' attitudes toward Physics remained moderate in interest, perceived difficulty, relevance to real-life situations, and self-efficacy. Of all the identified teaching strategies, activity-based learning, context-based instruction, and problem-solving methods showed significant relationships with students' attitudes, highlighting the importance of interactive, contextualized, and hands-on practices in developing students' positive attitudes toward Physics. Context-based instruction emerged as a very powerful teaching strategy for developing meaningful learning activities. On the contrary, the lecture method and inquiry-based learning exhibited no significant correlation with students' attitudes. In summary, the study found that teaching strategies that actively engage students and relate Physics content to real-life situations are more effective at developing positive attitudes and fostering students' interest in the subject. These findings emphasize the importance of developing student-centered, context-based teaching strategies in Physics education to foster deeper understanding and more meaningful learning experiences.

Keywords: teaching strategies, students' attitude toward Physics, STEM students at private secondary schools, academic performance, context-based instruction

Teaching strategies, STEM students' attitude and academic performance in Physics

1. Introduction

Physics is often cited as one of the most difficult STEM subjects due to its abstract nature; however, integrating STEM-oriented activities, such as interactive simulations and project-based learning, has been shown to improve both attitudes and scores significantly. In science education, particularly in Physics, the process is critical to shaping how students think, reason, and communicate with their surroundings (Doharey et al., 2023). Physics is the scientific discipline that investigates the structure of matter and the interactions of the fundamental constituents of the observable universe (Weidner & Brown, 2025). It is offered as a separate subject in senior high school because it provides balanced instructional opportunities that enable students to develop the scientific knowledge, skills, values, and concepts required for their personal growth and contribution to a scientific and technological world (Rao, 2016). To support the Science education, the Department of Education (DepEd), under DepEd Memorandum No. 006, s. 2026 supports student participation in scientific research and innovation through programs such as the National Science and Technology Fair (NSTF), thereby enhancing science education (DepEd, 2026). This highlights the relevance of improving students' interest, participation, and competence in science, including physics.

Despite its importance, Physics is still perceived as one of the most challenging subjects for students because it is regarded as abstract, mentally demanding, and highly computational (Wangchuk et al., 2023). These difficulties reinforce the common perception of Physics as a "hard subject" which reduces student interest and affects performance. Attitudes toward Physics, such as interest, perceived difficulty, relevance to real-life situations, and self-efficacy, have a crucial impact on whether students approach the topic with curiosity or hesitation (Schreiner & SjØberg, 2019; Wangchuk et al., 2023; Hu et al., 2022).

The Sustainable Development Goals also highlighted the importance of improving the quality of education through proactive, inclusive instructional approaches, particularly in science and technology. Research shows that effective technology-integrated physics lessons can promote student participation and improve conceptual understanding, supporting this claim (Prayogi & Verawati, 2024). Various teaching strategies have been evaluated in scientific education to address difficulties in learning physics. Inquiry-based learning and problem-based instruction were among the strategies and approaches researched for their ability to strengthen student engagement and attitudes (Kanyesigye et al., 2022). At the same time, researchers have differentiated active learning methods from traditional lecture-based methods, highlighting differences in student engagement and performance across STEM disciplines (Djordjevic et al., 2015). These findings demonstrate that teaching strategies may influence not only knowledge but also students' cognitive and affective experiences, underscoring the need for further studies of their participation in Physics learning. Moreover, learning strategies and attitudes clearly predict senior high school STEM students' problem-solving abilities in General Physics (Sauro, 2024). Based on the study, students who value Physics more and use effective learning strategies are better able to apply concepts to solve problems. This indicates that learners' cognitive outcomes and overall performance in Physics are strongly influenced by the relationship between teaching strategies and students' attitudes.

Even though previous research, such as the study of Assem et al. (2023) entitled "A Review of Students' Academic Performance in Physics: Attitude, Instructional Methods, Misconceptions, and Teachers' Qualifications" and Sauro (2024) entitled "Learning Strategies and Attitudes as Predictors of Problem-Solving Abilities of STEM Students in General Physics" has explored into teaching strategies, student attitude, and academic performance in Physics. These variables are commonly explored individually or in limited combined studies. In addition, teachers often argue that students struggle significantly in learning Physics. There remains a lack of research that simultaneously explores these factors, particularly from the perspective of senior high school STEM students in the Philippine context. This gap is particularly noticeable in private institutions in regional areas such as Occidental Mindoro, which the current research intends to address. This study focuses on determining the relationships among teaching strategies, students' attitudes, and academic performance in Physics. It aimed to determine how teaching strategies influence students' attitudes, learning engagement, and experiences, and how these variables affect their academic performance. The study included senior high school STEM students from two private schools in Occidental Mindoro, namely Divine Word College of San Jose and Philippine Central Islands College, with the aim of presenting findings that could inform the development of more effective Physics instructional methods.

Statement of the Problem - This study aimed to investigate the effects of teaching strategies on students' attitudes and their academic performance. Specifically, it sought to answer the following questions: (1) What are the most commonly employed teaching strategies in Physics classes for Science, Technology, Engineering, and Mathematics (STEM) strand students? (2) What is the extent of the teaching strategies employed by the teachers in Physics in terms of lecture method, context-based instruction, problem-solving method, inquiry-based learning, and activity-based learning? (3) What is the level of STEM students' attitude toward Physics in terms of interest, perceived difficulty, relevance to real-life situations, and self-efficacy? (4) What is the level of STEM students' academic performance in Physics? (5) Is there a significant relationship between teaching strategies employed by the teachers and students' attitude toward Physics in terms of interest, perceived difficulty, relevance to real-life situations, and self-efficacy? (6) Is the level of academic performance of STEM students in Physics significantly affected by teaching strategies and students' attitudes? (7) What developmental action plan may be proposed to enhance the academic performance of STEM students in Physics?

Significance of the Study - This study was conducted to determine the relationship among teaching strategies, STEM students' attitudes, and academic performance in Physics. The findings are specifically significant to various stakeholders. For students, the study provides insights into how their attitude toward Physics and the teaching strategies they experience can influence their academic performance, helping them select suitable learning strategies. Physics teachers can use the findings to identify and implement teaching strategies that effectively meet the diverse needs of STEM students. School administrators/Principals can use the results to develop professional development initiatives and institutional guidelines that promote effective, student-centered teaching strategies in Physics. The Local Government Unit of San Jose may use the study as a guide to support local Science educational programs and strengthen collaborations with schools to enhance science education. The Department of Education (DepEd) MIMAROPA Region may benefit from the results by using them to enhance curriculum implementation and improve teaching strategies in STEM education. Likewise, the Department of Science and Technology (DOST-MIMAROPA) can utilize the findings to improve science promotion campaigns for programs, scholarships, and initiatives that encourage students to pursue science-related disciplines. Curriculum developers can use the insights to refine Physics curricula by integrating strategies that strengthen positive student attitudes and improve academic performance. Finally, future researchers may use this study as a reference to further explore the relationships among teaching strategies, students' attitudes, and academic performance across diverse learning fields, contributing to the ongoing development of Physics education.

Scope and Delimitation of the Study - This study focused on determining the effects of teaching strategies on STEM students' attitudes and academic performance in Physics. It specifically explored Physics teachers' teaching strategies, including the lecture method, context-based instruction, the problem-solving method, inquiry-based learning, and activity-based learning. The five strategies were recognized as sub-variables of teaching strategies to determine their extent of implementation and their influence on students' attitudes and academic performance. The study also examined STEM students' attitudes toward Physics, including interest, perceived difficulty, relevance to real-life situations, and self-efficacy, as well as their academic performance. Moreover, it tested whether there is a significant relationship between teaching strategies and students' attitudes, and whether these factors significantly affect students' academic performance. The study's respondents were the grade 11 STEM students from PCIC and grade 12 STEM students from DWCSJ enrolled in Physics for School Year 2025-2026. This study was limited to the identified variables: teaching strategies and students' attitudes. Other variables that may affect students' academic performance were not included in this study. Also, findings may not be related to other strands, subjects, schools, or academic years within the scope of the study.

2. Methodology

Research Design - This study utilized an exploratory sequential design, with a qualitative phase followed by a quantitative phase. This design is appropriate for studies that intend to carefully investigate an idea before carrying out a systematic assessment. By using this mixed-methods approach, the researcher may examine a phenomenon qualitatively and identify essential themes and patterns that may guide the development of a quantitative tool (Creswell, 2021). In the qualitative phase, the researcher focused primarily on exploring the various teaching strategies used in Physics classes as viewed by students. The responses were examined to identify prevalent strategies, common themes, and significant ideas that reflect current teaching strategies in Physics education. Following the qualitative interview, a survey questionnaire on teaching strategies was created based on the results and common patterns determined in the responses of 15 participants.

Respondents of the Study - The respondents of this study were the grade 11 STEM students of Philippine Central Islands College and grade 12 STEM students of Divine Word College of San Jose for the Academic Year 2025-2026. In the qualitative phase of the study, 15 STEM participants were purposively selected. In the quantitative phase, complete enumeration was used to survey all 74 Grade 11 STEM students from Philippine Central Islands College and all 106 Grade 12 STEM students from Divine Word College of San Jose, not including the 15 participants from the qualitative phase, for a total of 180 respondents that comprise the whole accessible population of STEM students enrolled in Physics. However, the final sample, which comprised the entire population of STEM students enrolled in Physics, included only 166 respondents after 14 students were unable to participate due to scheduling conflicts.

Research Instrument - In the qualitative phase, a total of 15 participants, eight from Divine Word College of San Jose and seven from Philippine Central Islands College, were given a question using an open-ended interview guide. The interview was conducted to determine the teaching strategies implemented by their Physics teachers during classes. This approach facilitated participants' open discussion of their experiences in class, which helped the researcher identify the most widely used teaching strategies in physics lessons. The outcomes of the qualitative phase were used immediately to construct the survey instrument for the quantitative stage. In particular, the researcher developed a survey questionnaire on teaching strategies, informed by responses from 15 interview participants, to identify the most common and important strategies.

Furthermore, an additional survey instrument was adapted from Adams et al.'s (2006) Colorado Learning Attitudes about Science Survey (CLASS) and modified to align with the context of Physics learning among STEM students, specifically for analyzing students' attitudes toward Physics. The researcher asked permission from PhysPort.Org, which has access to the CLASS, and was granted permission to access, download, and modify the survey instrument. This study involved developing a survey questionnaire to analyze teaching strategies used in Physics discussions, informed by the major themes and strategies identified in qualitative interview responses from 15 participants. The research instrument consisted of two parts: a researcher-developed questionnaire to assess Physics teachers' teaching strategies and a modified version of the Colorado Learning Attitudes about Science Survey (CLASS). Using a four-point Likert scale and its interpretation, the researcher-made questionnaire asked STEM students how they perceived various teaching strategies used by their Physics teacher. The original CLASS was modified by adding and revising selected items for clarity and by changing the scale to a four-point scale to obtain a more accurate measurement of students’ attitudes. These two instruments underwent expert validation and reliability testing to ensure their suitability and effectiveness for this study.

The instrument used in this study was validated by five experts from Divine Word College of San Jose to ensure its accuracy, significance, and applicability to the study's objectives. The survey instrument on teaching strategies and students’ attitudes toward Physics was checked and validated to ensure it accurately reflected the qualitative results and aligned with the study's objectives. The final measurement tool was conceptually coherent and contextually relevant to the study, informed by input from these experts, and this input also guided item modification and the computation of content validity indicators.

The research instrument was tested for reliability at San Jose National High School, specifically in the Senior High School STEM strand, under the guidance of the Senior High School Assistant Principal II and STEM strand advisers. 30 STEM students participated in the survey questionnaire as part of an initial trial. The instrument, constructed from qualitative interviews and based on a modified version of the Colorado Learning Attitudes about Science Survey (CLASS), comprised 54 indicator items and was tested for reliability to verify its accuracy and reliability in measuring its intended variables. The reliability of the research instrument was tested using the Split-Half method, with a pilot group of 30 students, as it was administered only once. To determine the internal consistency of the nine scales, the instrument was split into two halves using the odd-even number scheme. Table 1 summarizes the reliability of each scale using the Spearman-Brown coefficient of equal length, the standard metric for split-half reliability when parts are of equal size.

Table 1
Reliability Analysis Results

Variables	Number of Items	Reliability Coefficients*	Analysis
I. Teaching Strategies in Physics (6 items each)			
1. Lecture Method	6	0.808	High Reliability
2. Context-Based Instruction	6	0.888	High Reliability
3. Problem-Solving Method	6	0.863	High Reliability
4. Inquiry-Based Learning	6	0.818	High Reliability
5. Activity-Based Learning	6	0.745	High Reliability
II. Student Attitude Toward Physics (6 items each)			
1. Interest	6	0.816	High Reliability
2. Perceived Difficulty	6	0.946	Very High Reliability
3. Relevance to Real-life Situations	6	0.885	High Reliability
4. Self-Efficacy	6	0.792	High Reliability

The results reveal that all five teaching methodologies tested exhibit strong internal consistency, confirming that the items effectively measure the intended instructional constructs. The constructs related to students' attitudes toward Physics also exceeded the required reliability threshold. Based on the results, all scales utilized are statistically reliable, as every Spearman-Brown coefficient exceeds the 0.70 threshold. Hence, the instrument is considered ready for full-scale administration to the target population.

Data Gathering Procedure **-** Before conducting this research, the researcher sought permission from her thesis adviser and obtained signed letters of endorsement from the administrators of Philippine Central Islands College and Divine Word College of San Jose. The researcher sent formal request letters to the corresponding schools. These letters included the following: (a) a request for the total number of STEM students enrolled in Physics; (b) a request for the permission to interview a selected number of students; (c) a request to administer the survey questionnaire; and (d) a request for permission to obtain the students' first and second quarter Physics grades with the aim to evaluate their academic performance. Following approval, the qualitative part of the research was conducted through interviews with 15 selected respondents, eight from Divine Word College of San Jose and seven from Philippine Central Islands College, over three days. Using Colaizzi's Method of Qualitative Data Analysis, the interview responses were recorded and evaluated to identify prominent themes, meanings, and key statements relevant to physics teaching strategies. For the quantitative part of the study, the remaining 166 respondents were provided with a survey questionnaire based on the qualitative interviews and a modified version of the Colorado Learning Attitudes about Science Survey (CLASS) (Adams et al., 2006). The data-gathering process for the quantitative part was conducted over three days. In addition, the researcher obtained the first two quarters of the STEM students' reported grades of the School Year 2025 from their respective school administrators. The data gathered were tabulated, encoded, and examined using inferential statistics to assess relationships among teaching strategies, students' attitudes toward Physics, and academic performance, and using descriptive statistics to summarize teaching strategies, students' attitudes, and academic performance. The researcher also sought assistance with the statistical treatment of the data to validate its accuracy and reliability.

Statistical Treatment of the Data **-** This study used both quantitative and qualitative data analysis methods. In the qualitative phase, Colaizzi's data analysis method was used to interpret data collected through interviews with 15 selected STEM students. This method provides a structured approach for recording the accuracy and depth of respondents' experiences (Gumarang et al., 2021). This process included seven steps. This method is appropriate for educational research since it reflects the variety and depth of students' experiences, providing the researcher with a better understanding of how teaching strategies affect attitudes and performance in physics. In the quantitative phase, descriptive and inferential statistics were used to analyze correlations among teaching strategies, students' attitudes, and Physics academic performance in a sample of 166 STEM students. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were used to measure the extent of teaching strategies, students' attitudes, and academic performance. Pearson's r correlation and Structural Equation Modeling (SEM) were utilized to determine the level and pattern of relationships among variables. To obtain an accurate estimation of structural relationships, the structural model was created using WarpPLS version 7.0, which employed Partial Least Squares (PLS).

Ethical Considerations **-** This study adheres to ethical guidelines to protect individuals' rights and ensure the credibility of the research. Informed consent was obtained when the purposes, methods, and possible risks of research were explained, and participation was completely optional. Respondents were also reminded that they were free to withdraw from the study at any given time without penalty or legal consequences. The privacy and anonymity of all responses were upheld by protecting them and excluding any identifying information. During data collection, the researcher implemented safety measures to protect against potential harm and promote an orderly, safe environment. Plagiarism, data manipulation, and falsification were also avoided to adhere to ethical standards in information handling and reporting. The research procedure was carefully monitored to ensure adherence to generally recognized ethical standards, and all findings were communicated truthfully and transparently.

3. Results and Discussions

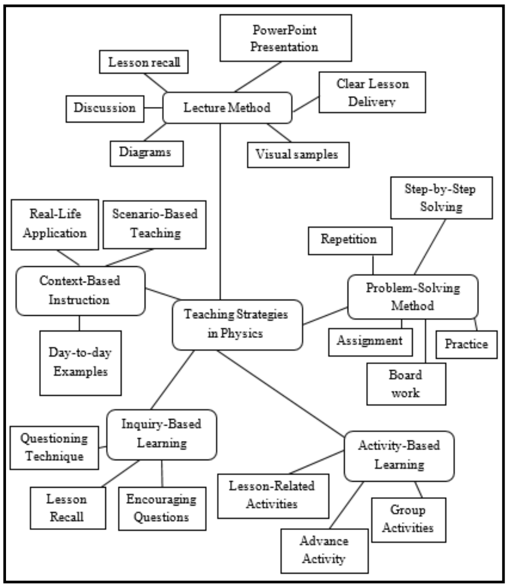

Figure 1. Initial Thematic Map for Teaching Strategies in Physics

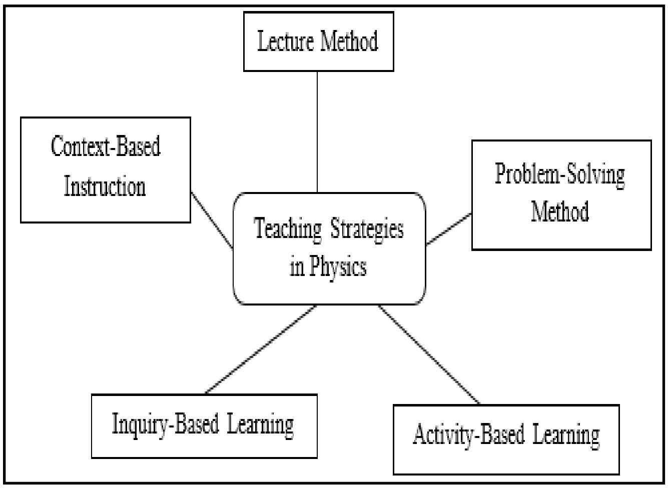

Figure 2. Final Thematic Map for Teaching Strategies in Physics

Following a thematic analysis, the initial and final thematic maps identified five major teaching strategies in Physics: the lecture method, context-based instruction, the problem-solving method, inquiry-based learning, and activity-based learning. The initial map displayed a broad clustering of answers, while the final map categorized them into clearly defined strategies commonly experienced by students. The lecture method, clear lesson delivery, discussion, and the use of diagrams and visual samples are commonly used to explain fundamental concepts (Kapur, 2020; Commeford et al., 2021; Dancy et al., 2022). On the other hand, context-based instruction makes physics concepts more relevant and easier to understand by relating them to real-life situations (Abebe et al., 2022; Hanifah et al., 2023). The problem-solving method emphasizes well-instructed solving, and repetition, improving students' logical and computational skills (Hayatu, 2021; Musengimana et al., 2025) and improving their performance and critical thinking (Argaw et al., 2016; Kanyesigye et al., 2022; Nicholus et al., 2023). Inquiry-based learning promotes questioning and active participation (Qablan et al., 2024), while activity-based learning engages students through interactive and collaborative tasks that improve understanding and attitude (Başerer, 2020; Snětinová et al., 2018; Papalazarou et al., 2023; Masood et al., 2023; Bugingo et al., 2024). Overall, the thematic maps demonstrate that improved student involvement, attitude, and academic performance in physics are encouraged by combining traditional and student-centered methods.

Table 2 shows the mean extent of use of teaching strategies in Physics, namely the lecture method, context-based instruction, and the problem-solving method. Overall, the findings reveal that these teaching strategies are employed to a great extent, indicating that physics teachers apply a combination of guided problem-solving, real-life applications, and organized instruction to enhance students' learning. For the Lecture Method, the composite mean of 3.48, interpreted as High, indicates that teacher-directed discussions, visual aids, and structured presentations remain common in Physics lectures. PowerPoint presentations received the highest rating (3.83) from students, indicating that visual, structured instruction strengthens understanding and aligns with findings that digital tools promote student retention and comprehension (Baker et al., 2018; Ugwuanyi & Okeke, 2020). However, the lowest mean score was for summarizing lessons, with a weighted mean of 3.23 (interpreted as Moderate), indicating that summarizing important concepts at the end of discussions can be improved. This is consistent with research suggesting that summaries increase conceptual organization and learning retention (Li et al., 2023). In contrast, continued use of lecture-based methods is supported by research demonstrating their efficacy in delivering fundamental concepts (Dancy et al., 2022).

Table 2
Mean Extent of Teaching Strategies in Physics in terms of Lecture Method, Context-Based Instruction, and Problem-Solving Method

Lecture Method	Weighted Mean	Interpretation
1. My Physics teacher presents the objectives of the study.	3.31	High
2. They explain lessons in class through oral discussions.	3.69	High
3. They use PowerPoint presentations during class discussions to clearly explain concepts.	3.83	High
4. They understandably explain key concepts.	3.49	High
5. They use visual aids like diagrams in explaining the lessons.	3.32	High
6. They provide summaries at the end of lectures to emphasize important ideas.	3.23	Moderate
Composite Mean	**3.48**	**High**
Context-Based Instruction		
1. My Physics teacher relates the lesson to real-life situations so that we can understand its importance.	3.39	High
2. The lessons are easier to comprehend since they relate to familiar situations.	3.26	High
3. My Physics teacher uses actual everyday examples to capture our interest during class discussions.	3.27	High
4. My physics teacher uses related examples to introduce new concepts.	3.45	High
5. I find it easier to understand complex physics concepts when real-life instances are provided.	3.39	High
6. Problem-solving exercises emphasize how physics is applied in real-life situations.	3.40	High
Composite Mean	**3.36**	**High**

Problem-Solving Method		
1. My Physics teacher provides step-by-step instructions for solving Physics problems.	3.73	High
2. Solving problems in class increases my comprehension of Physics concepts.	3.54	High
3. My Physics teacher provides activities that enhance my problem-solving abilities in Physics.	3.64	High
4. When I am given the opportunity to go through problems step-by-step under my Physics teacher's supervision, my confidence in physics increases.	3.37	High
5. My Physics teacher gradually increases the difficulty of problems to help us improve our problem-solving abilities.	3.55	High
6. In Physics class, solving real-life problems improves my understanding of the lessons.	3.38	High
Composite Mean	**3.54**	**High**

Scale: 3.25-4.00 High; 2.50-3.24 Moderate; 1.75-2.49 Low; 1.00-1.74 Very Low

Context-Based Instruction has a composite mean of 3.36, interpreted as High, which reflects that Physics teachers often connect lectures to real-life situations, making learning more meaningful. Students recognized that relating concepts to everyday exercises helps them better understand physics, which is consistent with research showing that context-based instruction enhances comprehension, motivation, and problem-solving skills (Abebe et al., 2022; Hanifah et al., 2023; Bahtaji, 2015; Barrun & Cajurao, 2025). Contextualized instruction significantly increases student engagement and conceptual understanding, as evidenced by consistently high ratings for items featuring real-life situations and relevance to daily life (Bahtaji, 2015; Yalçin & Sadik, 2024).

For the problem-solving method, the composite mean of 3.54, interpreted as High, indicates that guided problem-solving is commonly used and effective in improving students' analytical skills. Students value clear, step-by-step instructions, as indicated by the highest-rated item (3.73), which aligns with structured problem-solving models that promote comprehension, planning, execution, and reflection (Nguyen et al., 2023). Moreover, students reported that solving problems enhanced their comprehension (3.54), which aligns with earlier studies demonstrating that problem-based learning increases conceptual understanding, analytical abilities, and academic performance (Argaw et al., 2016; Nicholus et al., 2023). Overall, the findings show that problem-solving methods enhance students' confidence and comprehension of physics concepts.

Table 3
Mean Extent of Teaching Strategies in Physics in Terms of Inquiry-Based Learning and Activity-Based Learning

Inquiry-Based Learning	Weighted Mean	Interpretation
1. My Physics teacher asks students questions before beginning the discussion to develop critical thinking.	3.37	High
2. My Physics teacher encourages students to ask questions during class discussion.	3.39	High
3. I am encouraged to express my own observations in class.	3.07	Moderate
4. I am more interested in the learning process when I am given the opportunity to ask questions.	3.27	High
5. My Physics teacher gives exercises that encourage learning.	3.48	High
6. My Physics teacher allows us to test our predictions through guided inquiry.	3.34	High
Composite Mean	**3.32**	**High**
Activity-Based Learning		
1. My Physics teacher incorporates hands-on exercises to apply Physics lessons.	3.43	High
2. Hands-on activities in class enhance my interest in Physics.	3.40	High
3. The classroom exercises encourage me to participate more actively.	3.34	Moderate
4. Participating in activities improves my retention of the topics discussed in class.	3.44	High
5. I am provided with the tasks that enable me to apply what I have learned into practice.	3.37	High
6. My Physics teacher gives us activities in advance to help us prepare for the new lessons.	3.19	Moderate
Composite Mean	**3.36**	**High**

Scale: 3.25-4.00 High; 2.50-3.24 Moderate; 1.75-2.49 Low; 1.00-1.74 Very Low

The composite mean of 3.32 for inquiry-based learning, which is considered high, suggests that these methods are generally used effectively in physics lessons. Although the possibilities for students to convey their own observations (3.07), interpreted as Moderate, suggest there is still room to improve engagement, students reported that teachers often encourage questioning, guided inquiry, and logical reasoning. The highest rating (3.48) for item 5 indicates that teachers provide learning activities that promote inquiry, which is supported by studies showing that structured activities enhance conceptual understanding, academic performance, and critical thinking (Abaniel, 2021; Alarcon et al., 2023; Meulenbroeks et al., 2023). In line with results indicating that interactive questions promote deeper comprehension and collaborative reasoning, students also acknowledged that being encouraged to ask questions in item 2 (3.39) improves participation and critical thinking (Gillies, 2023). The activity-based learning, with a composite mean of 3.36, which is regarded as high, indicates that these methods are widely used and effective in encouraging engagement, application, and retention of physics concepts. In line with studies suggesting that activity-based methods increase comprehension and academic performance, students believed that hands-on exercises in item 1 (3.43) helped them apply concepts. Although pre-lesson exercises are sometimes offered, their execution may be inconsistent, particularly for the lowest-rated item, item 6 (3.19), which is classified as Moderate. This is similar to research demonstrating that, if executed well, pre-lesson exploratory activities can improve readiness and conceptual understanding (DeCaro et al., 2023).

In summary, the results suggest that physics teachers employ a variety of teaching methods that support students' comprehension, engagement, and skill development. These results indicate that although the strategies are mostly effective, there is room for improvement in areas such as lesson summaries, fostering student expression, and the regular implementation of pre-lesson activities.

Table 4

Mean Level of Attitude of STEM Students Toward Physics in terms of Interest, Perceived Difficulty, Relevance to Real-Life Situations, and Self-Efficacy

Interest	Weighted Mean	Interpretation
1. I enjoy solving Physics problems.	2.98	Moderate
2. Learning Physics changes my ideas about how the world works.	3.31	High
3. To understand Physics, I sometimes think about my personal experiences and relate them to the topic being analyzed.	3.10	Moderate
4. I am not satisfied until I understand why something works the way it does.	3.40	High
5. I am motivated to learn Physics when the lessons are interesting.	3.57	High
6. I feel excited when I encounter a challenging Physics problem-solving.	2.79	Moderate
Composite Mean	**3.19**	**Moderate**
Perceived Difficulty*		
1. A significant problem in learning Physics is memorizing too much information.	2.64	Moderate
2. Even after I study a topic in Physics, I have difficulty solving problems on the same topic.	2.86	Moderate
3. Knowledge in Physics consists of many disconnected topics.	2.92	Moderate
4. There is usually only one correct approach to solving a physics problem.	2.99	Moderate
5. I cannot learn if the teacher does not explain things well in class.	1.62	Very Low
6. If I get stuck on a Physics problem, there is no chance I will figure it out on my own.	2.78	Moderate
Composite Mean	**2.64**	**Moderate**
Relevance to Real-Life Situations		
1. I can relate what I learn in Physics to my experiences outside of school.	2.97	Moderate
2. I study Physics to gain knowledge that will be useful in my life outside of school.	3.19	High
3. Reasoning skills used to understand Physics can be helpful in my everyday life.	3.21	High
4. The subject Physics has little relation to what I experience in the real world.	2.18	Moderate
5. I believe Physics helps me understand how things around me work.	3.29	High
6. I apply the reasoning I learned in Physics to make decisions in my daily life.	2.95	Moderate
Composite Mean	**2.97**	**Moderate**

Self-Efficacy		
1. If I get stuck on a Physics problem on my first try, I usually find a different way that works.	3.36	High
2. Nearly everyone is capable of understanding Physics if they work at it.	3.41	High
3. I do not spend more than five minutes on a physics problem before seeking help from someone else.	1.98	Low
4. I usually figure out a way to solve Physics problems.	3.25	High
5. There are times I solve a Physics problem in more than one way to help me understand it better.	3.36	High
6. I am confident that I can improve my performance in Physics by practicing problem-solving regularly.	3.61	Moderate
Composite Mean	**3.16**	**Moderate**

Scale: 3.25-4.00 High; 2.50-3.24 Moderate; 1.75-2.49 Low; 1.00-1.74 Very Low
*Reverse Coded

With overall interpretations ranging from moderate to high, Table 4 presents the mean attitude levels of STEM students toward physics in terms of interest, perceived difficulty, relevance to real-life situations, and self-efficacy. The composite mean of 3.19 for interest, considered moderate, indicates that students' interest in physics is generally positive but not consistently high. When lectures are engaging, students are motivated and eager to understand how things work, but their interest in tackling difficult tasks and solving physics problems remains moderate. The high motivation rating when lectures are engaging aligns with Brakhage et al.'s (2023) study, which demonstrated that interest increases when physics is related to students' personal experiences. However, Mbonyiryivuze et al. (2021) demonstrated that many students perceive physics as difficult and demanding, consistent with a moderate interest in problem-solving.

The composite mean of 2.64 for perceived difficulty, classified as moderate, suggests that students have some difficulty studying physics, particularly in applying concepts independently. The study by Nuutila et al. (2021), which identified that perceived difficulty can affect students' confidence and academic participation, is consistent with the difficulties students encountered in solving problems and associating concepts. Similar results were observed by Wulandari et al. (2021), who found that students' motivation and academic performance may decline if they perceive physics as challenging. The findings of Okafor (2022) and Irsalina et al. (2025), who stated that self-regulated learning and metacognitive abilities enhance comprehension, are evident in the very low rating of reliance on teacher explanations, which implies a strong sense of self-directed learning. A composite mean of 2.97, considered moderate, for Real-Life Situations, indicates that students understand the relationship between physics and real-life situations, although not always strongly. In line with the findings of Sudirman et al. (2023), who pointed out that contextualized lessons enhance positive attitude, students stated that physics integrates with practical comprehension and real-life reasoning. However, some students still believe that physics has little influence on real-world situations. According to Mbonyiryivuze et al. (2021), students may find it challenging to understand real-world relationships when they are not highlighted in the classroom. The composite mean of 3.16 for Self-Efficacy, which is considered moderate, suggests that most students believe they can do well in Physics, though their confidence may not be strong. Students exhibited persistence and confidence in problem-solving, supporting Appiah-Twumasi (2024), who identified that higher self-efficacy enhances perseverance in difficult tasks. The low result for giving up quickly suggests that students tend to persist, consistent with Greco et al.'s (2022) finding that high self-efficacy leads to greater perseverance, motivation, and engagement in schoolwork.

Overall, the results indicate that students have a moderately positive attitude toward Physics, as evidenced by their reasonable interest, perceived difficulty, relevance to real-life situations, and self-efficacy. Students are eager and confident about learning, yet there is still room for improvement in participation, in making things seem less challenging, and in making Physics more relevant to real life. Supporting such factors can facilitate profound learning, higher confidence, and enhanced academic performance in Physics.

A new model emerges after identifying seven links that do not have a significant correlation to the endogenous variable. It illustrates a streamlined relationship between teaching strategies, student attitude, and academic performance. Three teaching strategies maintain their influence on the students' attitude toward Physics. These significant predictors collectively explain 51% (R2 = 0.51) of the variance. The model confirms that teachers have significant control over how much students enjoy Physics through activities, context, and problem-solving.

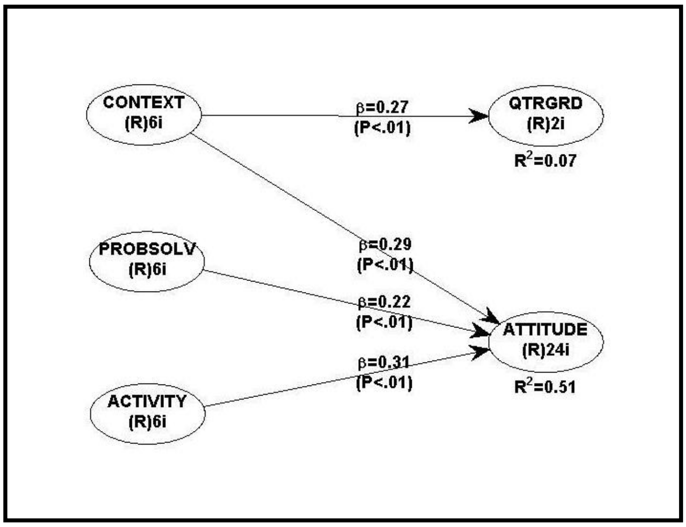

Figure 3. The Emerging Model for the Relationship Among Teaching Strategies, Students' Attitude, and Academic Performance in Physics

On the other hand, only one strategy was correlated with academic performance, as measured by quarterly grades. The emerging model also shows no direct link between attitude and academic performance, as indicated by the structural model. This supports the conclusion that students' attitudes do not influence their performance in Physics.

Table 5
Beta Coefficients of the Paths and p-values for Ho

Paths	Beta (β) Coefficient	p-value*	Standard Error	Effect Size**	Interpretation
Ho1: Teaching Strategies–>Attitude Toward Physics					
CONTEXT–>ATTITUDE	0.287	<0.001	.073	.178	Medium
PROBSOLV–>ATTITUDE	0.220	0.002	.074	.132	Small
ACTIVITY–>ATTITUDE	0.310	<0.001	.073	.202	Medium
Ho2: Teaching Strategies–>Academic Performance					
CONTEXT–> QTRGRD	0.266	<0.001	.073	.071	Small

*Significant at p<0.05
** Effect size coefficient: 0.02 – small, 0.15 – medium, 0.30 – large

Table 5 shows the Beta (β) coefficients, p-values, standard errors, and effect sizes for the important paths in the emerging model. With a medium effect size (d = 0.202), the findings indicate that activity-based learning (β = 0.310, p < .001) is the most significant predictor of students' attitudes toward physics. It suggests that practical exercises have a significant impact on attitudes toward physics. This is in line with research by Masood et al. (2023) and Bugingo et al. (2024), which highlighted that activity-based methods strengthen students' attention, engagement, and conceptual knowledge of physics. Likewise, context-based instruction (β = 0.287, p < .001) demonstrates a significant effect on attitude with a medium effect size (.178), which supports the findings of Barrun and Cajurao (2025), Villa (2018), and Bahtaji (2015) that Physics lessons' contextualization enhances motivation and appreciation of the subject. Despite a lower effect size (0.132), the problem-solving method (β = 0.220, p = .002) has a significant influence on students' attitudes. This is similar to research by Kanyesigye et al. (2022) and Nicholus et al. (2023), which demonstrated how structured problem-solving stimulates positive learning attitudes and improves student participation.

With respect to academic performance, context-based instruction is the only teaching strategy that shows a significant association with students' quarterly grades (β = 0.266, p < .001), but the effect size is small (d = 0.071). This exhibits a transition from the negative correlation identified in the initial structural model (β = -0.273, p < .001), suggesting that the impact of context-based instruction is influenced by model refinement and interaction of instructional variables. This result aligns with the findings of Bahtaji (2015), Barrun and Cajurao (2025), and Maya et al. (2021), who observed that when lessons are contextualized and properly aligned with assessment and cognitive criteria, academic performance increases. The stability and accuracy of the model's estimates are further supported by the finding that the standard error values (.073 to .074) are the same across all paths.

In summary, the results exhibit a significant relation between teaching strategies and students' attitude toward physics, particularly activity-based learning, context-based instruction, and problem-solving methods (Villa, 2018; Barrun & Cajurao, 2025; Bugingo et al., 2024; Masood et al., 2023; Kanyesigye et al., 2022; Nicholus et al., 2023). This supports the partial rejection of the first null hypothesis. Comparably, only context-based instruction exhibits a substantial direct link with academic performance, whilst the other teaching strategies do not (Abebe et al., 2022; Hanifah et al., 2023; Pranata et al., 2025). This means that the second null hypothesis is also partially rejected. Furthermore, students' attitudes did not significantly influence the relationship between teaching strategies and academic performance, which aligns with the studies by Ibrahim et al. (2019) and Mutya et al. (2023), who reported that a positive attitude does not necessarily lead to improved performance. These findings indicate that although teaching strategies significantly influence students' perceptions of Physics, additional instructional alignment is necessary to ensure that a positive attitude correlates with enhanced academic performance.

Table 6

Context-Based Instruction Action Plan for Enhancing Physics Performance Among STEM Students

Goal	Objectives	Tasks	Resources Needed	Time-line	Responsible Parties	Performance Indicators	Evaluation
Institutionalize a Structured Context-Based Instruction Framework.	Ensure uniform implementation of high-quality CBI. Strengthen transition from real-life context to abstract reasoning.	Develop a standardized CBI instructional model (Engage–Contextualize–Conceptualize–Compute–Evaluate). Create exemplar lesson demonstrations. Conduct peer observation focusing on contextual depth and clarity.	Standardized CBI template Sample model lessons Observation checklist tools	2-3 mos.	Physics Teachers Department Head	Increase consistency in CBI delivery. Improved student conceptual and computational scores.	Observation reports Quarterly grade comparison
Strengthen Cognitive and Analytical Integration within CBI.	Address variability caused by students' prior knowledge and reasoning ability. Ensure contextual learning leads to measurable mastery.	Integrate structured scaffolding within contextual tasks. Implement weekly higher-order contextual problem sets. Conduct error-analysis discussions after assessments.	Analytical worksheets Problem-solving templates Diagnostic tests	1-2 mos.	Physics Teachers	Higher scores in application and analysis-level questions Reduced repeated conceptual errors	Pre/ post diagnostic results Item analysis reports

Enhance Assessment Alignment with Contextual Learning.	Minimize mismatch between instruction and grading criteria. Increase the reliability of academic performance indicators.	Revise the assessment blueprint to include a balance of contextual reasoning and computation. Develop performance-based contextual tasks. Pilot test contextual exam items before full implementation.	Revised test blueprint Rubrics Contextual performance task bank	1 mo.	Physics Teachers Academic Coordinat or	Improved performance in contextual exam components. Balanced distribution of item difficulty levels	Assess-ment validation results Mean score monitoring
Implement Continuous Data-Driven Monitoring of CBI Effective-ne ss.	Identify moderating variables affecting CBI outcomes. Stabilize its academic impact across student groups.	Conduct quarterly performance trend analysis. Compare contextual vs. non-contextual item results. Provide targeted remediation based on data findings.	Performanc e tracking sheets Data analysis templates	Quar-t erly	Physics Teachers School Research Coordinat or	Reduced performance fluctuations Improved overall Physics mean scores	Statistical comparison reports Progress monitoring records
Expand Professional Developme nt on Advanced Context-Bas ed Pedagogy.	Deepen teachers' expertise in designing academicall y rigorous, contextually grounded tasks. Enhance capacity to manage variables influencing CBI effective-ne ss	Conduct in-depth wworkshopson desig-ning high level contextual problems (HOTS integ Ration.) Training on balancing contextualization with abstract formalism. Seminar on interpreting assessment data to refine CBI. Encourage teachers to conduct action research on the effectiveness. of CBI	Training modules Research templates Data analysis guides Professional learning materials	Semi-annual	School Administr ation Departme nt Head Physics Teachers	Increased teacher competency ratings Improved student academic performance trends Completion of at least one CBI-related action research per year	Post-trainin g evaluation surveys Research outputs Student achievement comparison
Establish a Collaborativ e Learning Community for CBI Innovation.	Promote the sustainabilit y of improvemen ts in contextual teaching. Encourage continuous refinement of contextual strategies.	Conduct monthly Learning Action Cell (LAC) focused on contextual lesson sharing. Develop a shared digital repository of contextual Physics materials. Peer coaching and feedback cycles.	Shared drive repository LAC documentati on forms	Month ly	Physics Teachers LAC Leader	Increased repository contribution s Documente d improvemen ts in lesson quality	LAC minutes Peer feedback reports

The approach addresses research findings that CBI directly improves academic performance but is sensitive to other variables, including the problem-solving methods employed, the integration of activity-based learning strategies, prior mathematical understanding, and assessment alignment, by providing specific examples for each goal. Studies on contextualized instruction have revealed that well-designed contextualized modules outperform traditional lecture methods in student achievement (Marzan, 2019). Further, it has been determined that structured learning materials aligned with objectives, along with assessment activities, resulted in higher normalized gains in physics performance. For example, data monitoring, contextual problem-solving, and structured worksheets ensure that CBI remains effective even when students' preparation varies. Likewise, professional development endeavors empower teachers to modify the CBI while incorporating moderating variables, ensuring that the learning outcomes are sustainable and consistent. This development action plan aligns with the findings of De Putter-Smits et al. (2020), who found that professional development programs addressing teachers' concerns about context-based science education effectively shift teaching methods toward student-centered learning. These initiatives suggest that teachers are better equipped to implement CBI while accounting for moderating variables, thereby improving the consistency and sustainability of learning outcomes. Overall, the developmental action plan translates study findings into actionable initiatives, providing a roadmap to maximize the positive effects of CBI while minimizing limitations that may reduce its impact on academic performance. It is also research-based and practically useful since it integrates theory, statistical evidence, and classroom practice.

4. Conclusions

Based on the significant findings, the conclusion is that Physics classes for STEM students can be improved by combining traditional and student-centered teaching strategies. The teaching strategies used by Physics teachers are implemented to a great extent, indicating that they are regularly employed in STEM Physics classes. The lecture method is employed to a great extent, indicating that teacher-directed instruction remains a common approach to imparting Physics concepts and content. Context-based instruction is employed to a great extent, which reveals that Physics teachers commonly relate Physics lessons to real-life situations and practical applications to make learning more engaging for students. The problem-solving method is employed to a great extent, demonstrating that Physics teachers commonly involve students in solving Physics-related problems to help them enhance their analytical and computational skills. Inquiry-based learning is applied to a great degree, indicating that Physics teachers provide students with opportunities to explore, inquire, and develop conceptual understanding through guided inquiry. Activity-based learning is widely used, indicating that hands-on, interactive classroom activities are frequently incorporated into Physics instruction to improve student participation and understanding.

STEM students’ attitudes toward Physics are moderate, indicating a generally positive view of the subject, but they still need to be developed. STEM students' interest in Physics is moderate, suggesting that even when they exhibit interest and participation, there is still room to nurture it further and increase their engagement with the subject. STEM students' perception of difficulty in Physics is moderate, indicating they encounter some difficulty comprehending the subject, though not extremely high. STEM students’ perception of the relevance of Physics to real-life situations is moderate; however, this perception may still be enhanced. STEM students’ self-efficacy in Physics is moderate, indicating that they are moderately confident in their ability to acquire and apply knowledge in the subject. However, this confidence can still be enhanced. STEM students' academic performance in Physics ranges from satisfactory to outstanding, indicating relatively high cognitive performance, although their attitude is only moderate.

Not all teaching strategies significantly influence STEM students' attitudes toward Physics. Only activity-based learning, context-based instruction, and the problem-solving method were significantly associated with STEM students' attitudes, revealing that these strategies are more effective at developing positive attitudes toward Physics. The significant relationship between teaching strategies and students’ interest in Physics suggests that engaging, meaningful teaching methods may strengthen students' participation and motivation to learn more about the subject. The significant relationship between teaching strategies and students’ perceptions of difficulty suggests that effective teaching strategies may help students reduce their perceived difficulty in understanding Physics. The significant relationship between teaching strategies and students’ perceptions of relevance to real-life situations demonstrates that highly effective teaching methods may help students appreciate the practical value and applications of Physics. The significant relationship between teaching strategies and students’ self-efficacy indicates that meaningful, interactive learning experiences can help students build confidence in solving problems in Physics lessons and tasks. Context-based instruction was the only teaching strategy that showed a strong correlation with students' academic performance; however, its effect was sensitive to the integration of other variables in the analysis. Only context-based instruction had a significant effect on students' academic performance. At the same time, the lecture method, problem-solving method, inquiry-based learning, and activity-based learning exhibit no statistically significant direct effect on their grades. Students' attitudes toward Physics did not significantly affect their academic performance, indicating that a moderately positive attitude does not necessarily correlate with higher performance in Physics. A development action plan has been proposed to support teachers and school administrators in successfully implementing context-based instruction to enhance STEM students' academic performance in Physics.

Recommendations - To improve the implementation of teaching strategies in Physics, teachers should continue using a variety of strategies, including lecture, context-based instruction, problem-solving, inquiry-based learning, and activity-based learning, to maintain effective classroom discussion for STEM students. Since physics teaching strategies are already widely used, teachers and school administrators may continue to employ them while continually refining their delivery to ensure the strategies remain appropriate and tailored to their students' learning needs. Teachers and school administrators may strengthen STEM students' attitudes toward Physics by implementing strategies that promote interaction, significantly reduce perceived difficulty, enhance real-world relevance, and build higher self-efficacy in learning Physics. Even though students' academic performance in Physics ranges from very satisfactory to outstanding, teachers may continue to observe their progress while providing supplemental learning assistance, enriching activities, and differentiated instruction to maintain and enhance their performance. Teachers may place greater emphasis on activity-based learning, context-based instruction, and problem-solving methods, as these strategies are related to students' attitudes toward Physics. Teachers may improve the implementation of context-based instruction in the classroom, given that it is the only teaching strategy that has demonstrated a significant effect on STEM students' academic performance. Teachers may place greater emphasis on real-life applications, contextual illustrations, and practical situations when explaining Physics concepts to enhance students' academic performance. Despite this, there is still room for development in execution, alignment with learning objectives, and the assessment of lecture-, problem-solving-, inquiry-based, and activity-based learning methods to further improve student performance. Teachers and school administrators may not rely solely on students' attitudes toward Physics to improve their academic performance. Rather, teachers may assess other academic factors, such as learning strategies, assessment methods, classroom resources, prior knowledge, and learning preparedness, to strengthen students' performance in Physics. Given that context-based instruction was the only strategy that showed a significant correlation with students' academic performance, teachers and school administrators may place greater emphasis on its effective use. Professional development initiatives, training seminars, and collaborative planning meetings may also be provided to support teachers in developing effective, contextually grounded learning experiences. The proposed developmental action plan may be examined, discussed, and enacted by school administrators and Physics teachers to enhance the application of context-based instruction and improve STEM students' academic performance in Physics. For future researchers to conduct additional studies to examine why students’ attitudes toward Physics do not significantly influence their academic performance. Future studies may also investigate other teaching strategies that could have a more direct and significant effect on students’ academic performance in Physics. Moreover, researchers may investigate the learning strategies students use and determine whether these strategies are significantly correlated with their academic performance in Physics.

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