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Exploring Strategic Communicative Barriers and Adaptive Strategies of Senior High School Physics Teachers

Dalere, Johanna Justine^{1*}, Calzada, Marc Paul², Ancheta, Winicel May³, Abad, Gerry⁴, Antonio, Vida⁵, Cabrera, Rhea⁶

^{1, 2, 3, 4, 5, & 6} Student, Mariano Marcos State University, Graduate School

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*Corresponding author: Dalere, Johanna Justine

Student, Mariano Marcos State University, Graduate School

Abstract

This study examines the strategic communicative barriers experienced by Senior High School Physics teachers in delivering General Physics instruction and explores the adaptive strategies they employ to enhance student understanding. Conducted in the Schools Divisions of Batac City, Laoag City, and Ilocos Norte, the research involved 34 Physics teachers teaching General Physics I and II during the 2024–2025 academic year. Using a descriptive research design, data were collected through semi-structured interviews aimed at uncovering specific communication challenges and pedagogical adaptations related to the teaching of complex Physics concepts.

Findings reveal three major strategic communicative barriers: communicating complex concepts, engaging diverse learners, and facilitating student expression. Teachers face difficulties in simplifying abstract, symbolic, and mathematical Physics content, addressing student misconceptions, and supporting the application of formulas. Diverse learner profiles, including varied prior knowledge, motivation, and anxiety toward Physics, further complicate effective communication. Additionally, language-related barriers such as students' fear of using English and limited communication confidence hinder active participation and expression in the classroom.

In response to these barriers, teachers employ various adaptive strategies to improve comprehension and engagement. Real-life contextualization through analogies and relatable examples helps make abstract concepts more tangible. Inquiry and dialogic teaching methods, including guided questioning and problem-based prompts, foster critical thinking and active participation. Technology and visual integration using digital tools, simulations, and visual aids support diverse learning styles and clarify

difficult topics. Collaborative and adaptive communication strategies, such as peer learning and real-time feedback, promote inclusive and responsive instruction. Finally, translanguaging practices—including code-switching and the use of vernacular languages—enhance clarity and accessibility, especially for linguistically diverse students.

The study is anchored in Dell Hymes' Communicative Competence Theory, emphasizing strategic competence as crucial for overcoming communication breakdowns in teaching. The findings underscore the importance of strategic communicative competence in Physics education, highlighting how communication barriers shape teachers' adaptive behaviors. The results suggest that effective Physics instruction requires not only mastery of subject matter but also dynamic management of communication strategies to meet diverse learner needs.

This research contributes valuable insights into the multifaceted communicative challenges faced by Physics teachers and the pedagogical adaptations that support student learning. It recommends targeted professional development programs to enhance teachers' strategic communicative competence, promote differentiated and culturally responsive instruction, and encourage the use of translanguaging and technology integration. By addressing these communicative barriers and supporting adaptive teaching strategies, educators can improve Physics instruction and foster deeper understanding among students. Future research may investigate the long-term effects of enhanced communicative competence and adaptive strategies on student achievement across diverse educational settings.

Keywords: strategic communicative competence, Physics education, communicative barriers, adaptive strategies, senior high school, inquiry teaching, translanguaging

Introduction

Physics, as a core branch of science, is essential for understanding the natural world and developing scientific literacy among students. The Philippine K to 12 curriculum adopts innovative approaches such as spiral progression and practical applications to deepen students' comprehension and engagement in Physics (Pacala, 2022). Despite these reforms, student performance in Physics remains below international benchmarks, highlighting persistent instructional barriers (Moro & Billote, 2023). A critical factor underlying these barriers is the strategic communicative competence (SCC) of Physics teachers, which encompasses the ability to effectively use communication strategies, adapt to diverse learners, negotiate meaning, utilize feedback, and integrate visual and technological aids to facilitate learning (Mahdi, 2023). This study focuses on the barriers Physics teachers face in developing and applying SCC to enhance student understanding of complex scientific concepts, as well as on how these communicative barriers shape and influence their adaptive strategies in teaching.

Physics teachers encounter significant barriers in conveying the abstract, symbolic, and mathematical nature of Physics concepts. The subject matter often involves theories and representations—such as energy, forces, and electric fields—that are intangible and challenging for students to grasp without effective scaffolding. Teachers report that students commonly hold misconceptions, such as the belief that heavier objects fall faster, which hinder new learning and requires careful communicative interventions to correct (Mayer, 2022). Additionally, students struggle to apply Physics formulas in problem-solving, pointing to a communication gap between conceptual understanding and mathematical application. To address these issues, teachers employ various adaptive strategies, including the use of analogies, real-life examples, and visual aids to make abstract content more concrete and relatable. These strategies are dynamic responses to the communicative barriers they face, demonstrating how barriers in communication directly inform pedagogical adjustments. However, the inherent complexity of Physics content continues to act as a barrier even for skilled educators, necessitating ongoing refinement

of communication techniques and adaptive strategies (Mayer, 2023; Tiwari, 2024).

The theoretical framework guiding this study is grounded in Dell Hymes' Communicative Competence Theory, which broadens the understanding of language proficiency beyond grammatical knowledge to include the ability to use language effectively and appropriately in social contexts. Hymes (1972) identified four components of communicative competence: linguistic competence, sociolinguistic competence, discourse competence, and strategic competence. This study specifically focuses on strategic competence, which involves the skills teachers use to overcome communication breakdowns and enhance clarity in teaching. Strategic communicative competence enables Physics teachers to adapt their language, negotiate meaning with students, provide timely feedback, and employ various communicative strategies to facilitate understanding of complex scientific concepts. Importantly, these competencies are embedded within the teachers' adaptive strategies, shaping how lessons are planned, delivered, and adjusted according to student needs. By applying Hymes' framework, the study emphasizes that effective Physics instruction requires not only mastery of subject matter but also the capacity to manage communication barriers dynamically, ensuring that students across diverse backgrounds can meaningfully access and engage with scientific knowledge.

Engaging a diverse student population presents further barriers for Physics teachers. Learners enter the classroom with varied levels of prior knowledge, learning styles, motivation, and attitudes toward the subject. Many perceive Physics as difficult or irrelevant, leading to low motivation and engagement. Some students experience anxiety or intimidation due to the technical nature of the subject, which may cause hesitancy in participation (Caingcoy, 2024). To foster engagement, teachers implement differentiated instruction, peer learning, and real-world applications that connect Physics concepts to everyday experiences. These adaptive strategies are deliberate responses to communicative barriers, designed to accommodate the diversity of learners and enhance accessibility. Creating a supportive and positive classroom

environment is also critical to build students’ confidence and reduce apprehension (Gulzar et al., 2024). Despite these efforts, the barrier of catering to diverse needs remains a significant obstacle to effective communication and student involvement. Hence, this study aimed to explore teachers’ strategic communicative barriers in teaching Physics alongside the adaptive strategies they employ to mitigate such barriers.

Methodology

This study employed a descriptive research design aimed at thoroughly exploring and describing the barriers experienced by Physics teachers in their strategic communicative competence and how these barriers influence their adaptive strategies in instruction. The design focused on capturing detailed accounts of the specific communication barriers teachers face and the corresponding adaptive strategies they adopt to overcome these barriers, without manipulating any variables. By emphasizing description, the study sought to understand the nature and extent of these communicative barriers and their practical implications as directly reported by the teachers.

The research was conducted in the Schools Divisions of Batac City, Laoag City, and Ilocos Norte in the Philippines, areas selected for their representation of public secondary schools offering the Senior High School Science, Technology, Engineering, and Mathematics (STEM) strand, where General Physics I and II are taught. These locations provided a relevant context for examining the communicative barriers faced by educators within the Philippine K to 12 curriculum framework and the instructional adaptive strategies they employ in response.

The population comprised 34 Senior High School Physics teachers actively teaching General Physics during the 2024–2025 academic year. For the qualitative portion, purposive sampling was used to select teachers for interviews, ensuring that participants with rich experiences and insights regarding communicative barriers and related adaptive strategies were included. This approach facilitated an in-depth exploration of the barriers teachers encounter in their instructional communication and the pedagogical adaptations they implement.

Data collection relied solely on a semi-structured interview guide, adapted from Calzada and Antonio (2024), which was specifically designed to elicit detailed information about the communicative barriers faced by Physics teachers and the adaptive strategies they use to address these barriers. The interview questions focused on uncovering obstacles related to communication strategies, adaptation to diverse learners, negotiation of meaning, use of feedback, problem-solving communication, utilization of visual aids, technology integration, and how these barriers inform their instructional adaptations. Expert validation of the interview guide ensured the questions were clear, relevant, and capable of capturing the nuanced barriers and associated adaptive strategies experienced by teachers.

Interviews were conducted online through platforms such as Zoom and Google Meet, providing a flexible and accessible environment for teachers to candidly discuss their barriers and instructional

adaptations. This method allowed participants to elaborate on their experiences, share specific examples, and express the complexities involved in communicating Physics content effectively while adapting their teaching methods.

Analysis of the interview data followed Braun and Clarke’s (2006) thematic analysis model, enabling a systematic identification and interpretation of recurrent themes related to the communicative barriers reported by teachers and the adaptive strategies they employ. The analysis revealed several key barriers: overcoming the abstract and symbolic nature of Physics concepts, addressing student misconceptions, bridging gaps caused by students’ varying language proficiencies and confidence, and managing limited access to professional development focused on communication skills and technology use. Importantly, these communicative barriers were closely linked to specific adaptive strategies adopted by teachers to enhance student understanding and engagement. This descriptive approach provided a comprehensive and detailed understanding of the multifaceted communicative barriers that Physics teachers face, alongside the practical adaptive strategies they employ, offering valuable insights for designing interventions to support their instructional effectiveness.

Results and Discussions

Strategic Communicative Barriers Experienced by Physics teachers.

This section discusses the strategic communicative-based barriers encountered by Senior High School Physics teachers in delivering General Physics instruction.

Based on the participants' responses, three key themes emerged: communicating complex concepts, engaging diverse learners, and facilitating student expression. These themes highlight the communication-related barriers that impact teaching effectiveness and student comprehension. Each theme reflects specific challenges and the corresponding strategies employed by teachers to address them in the classroom setting.

Communicating Complex Concepts. Understanding and communicating the abstract nature of Physics is one of the primary challenges teachers face in General Physics. Physics involves intricate theories, symbolic representations, and mathematical formulations that may be overwhelming for many students. These concepts are often not directly observable—such as energy, force, or electric fields—and are represented using symbols, equations, and abstract models. This makes it difficult for learners to grasp the content intuitively.

Teachers must strategically simplify and scaffold these concepts to support comprehension. The responses revealed three major difficulties: abstract and symbolic content, learners’ misconceptions, and difficulty applying formulas.

Physics teachers must strategically simplify and scaffold complex ideas to support student comprehension. The responses from the teachers highlight the necessity of using analogies, real-life examples, and visual representations to make abstract content more tangible and relatable.

Table 1. Strategic communicative-based barriers encountered by physics teachers

Theme	Codes	Particulars
Communicating complex concepts	- Abstract and symbolic content - Learners’ misconceptions - Difficulty applying formulas	...use analogies and real-world examples... ...hard for learners to grasp concepts... Students struggle with applying formulas...

Engaging diverse learners	<ul style="list-style-type: none"> - Varied learning styles and prior knowledge - Low motivation and engagement - Student intimidation toward Physics 	<p>...variety of academic backgrounds and ways of processing information.</p> <p>...students view Physics as this daunting, irrelevant subject.</p> <p>...technical nature of Physics can be intimidating...</p>
Facilitating student expression	<ul style="list-style-type: none"> - Fear of using English - Hesitant to participate - Limited communication confidence 	<p>...feel anxious about using English in class.</p> <p>...students hesitating to participate...</p> <p>...feel their contributions are valued.</p>

Many students enter Physics classes with pre-existing misconceptions about how the physical world works, such as believing heavier objects fall faster than lighter ones. These misconceptions can interfere with new learning and require intentional instructional strategies to uncover and correct them. Teachers often employ guided questioning, conceptual discussions, and experiments to challenge these false notions and facilitate conceptual change.

Moreover, translating theoretical understanding into mathematical applications poses a significant challenge. Even when students appear to understand concepts, they often struggle to identify the appropriate formulas or apply them correctly in problem-solving contexts. Teachers mitigate this by teaching structured problem-solving frameworks, offering step-by-step instruction, and using varied practice to reinforce understanding. These techniques help students not only memorize formulas but also apply them meaningfully.

Effectively communicating complex Physics concepts requires teachers to adopt diverse pedagogical strategies such as analogies, visual aids, and real-life examples. Addressing student misconceptions demands diagnostic teaching methods like formative assessments and conceptual discussions. To support formula application, teachers must strengthen students' problem-solving and mathematical skills through guided instruction and scaffolded practice. Instructional materials should be simplified and made more accessible, and teachers need ongoing professional development to improve their strategic communication in delivering abstract content.

This is supported by the statements of the respondents as follows:

I often use analogies and real-world examples to make abstract ideas more concrete.

- Teacher 4

I found it hard for learners to grasp concepts that are too high for them... I often use vocabulary to build up to introduce them to the basic concepts first.

- Teacher 23

Students struggle with applying formulas and reasoning through Physics problems systematically... I teach problem-solving frameworks, like using step-by-step breakdowns.

- Teacher 5

The findings coincide with the study of Mayer (2023) and Pospiech (2023), which emphasized that the complexity of Physics tasks spanning physical, mathematical, and computational domains poses significant communicative challenges for teachers. Effectively conveying these concepts requires not only subject mastery but also strategic communication skills to maintain clarity without oversimplifying. Similarly, Tiwari (2024) and Jarvis et al. (2017) found that diverse student learning needs demand differentiated instruction and inclusive communication strategies,

presenting further difficulties for Physics teachers in effectively engaging all learners.

Additionally, Sultanalieva et al. (2021) revealed that integrating technology into Physics instruction introduces new communicative demands, as many educators lack sufficient training to effectively use digital tools to clarify abstract content. These studies collectively underscore the multifaceted nature of the communicative challenges faced by Physics educators and highlight the urgent need for continuous professional development in both content delivery and strategic communication.

Acknowledging these significant communicative hurdles, it becomes evident that effective pedagogical strategies are crucial for making complex Physics concepts accessible to all students. This necessitates approaches that go beyond traditional lecture methods and incorporate flexible, inclusive communication techniques.

Engaging Diverse Learners. Engaging students in General Physics can be challenging due to the wide range of learning styles, prior knowledge, motivation levels, and attitudes toward the subject. This diversity demands a flexible and responsive instructional approach that acknowledges and accommodates the varied needs of learners. Teachers must navigate these differences to foster meaningful participation and sustained interest. The responses revealed three major issues that affect engagement: varied learning styles and prior knowledge, low motivation and engagement, and student intimidation toward Physics.

Students enter the Physics classroom with varying degrees of readiness—some possess strong foundations in mathematics and science, while others face difficulties in basic concepts. This variability necessitates differentiated instruction, such as peer teaching, tiered tasks, and flexible grouping, to ensure equitable access to content. Teachers must tailor their strategies to meet individual learning needs, thus creating inclusive environments where all students, regardless of their starting point, can engage meaningfully with the subject.

Moreover, many students perceive Physics as a difficult or irrelevant subject, resulting in a lack of interest or enthusiasm. To counter this, teachers use real-world applications and inquiry-based activities that connect Physics concepts to everyday life. These strategies help students see the value and relevance of the subject, thereby increasing their motivation to learn.

The technical nature of Physics often leads to anxiety or self-doubt among students. This intimidation can cause learners to disengage or hesitate to participate. Teachers mitigate this by creating a supportive environment, using encouraging feedback, and breaking down complex topics into manageable parts to build students' confidence gradually.

This implies that engaging diverse learners in General Physics highlights the need for instructional differentiation, where teachers are equipped to recognize and address variations in student

readiness, learning styles, and prior knowledge. Curriculum content must also be made relevant by integrating real-life applications and inquiry-based tasks that enhance student interest and motivation. Additionally, cultivating a positive and supportive classroom environment is essential to alleviate student anxiety and build confidence, especially among those intimidated by the subject. Lastly, continuous professional development is vital to help teachers effectively manage diverse classrooms and foster inclusive and motivating learning experiences.

This is supported by the statements of the respondents as follows:

I have seen firsthand how my students come in with a variety of academic backgrounds and ways of processing information. To make sure everyone can thrive, I try to use differentiated instruction, like peer teaching and flexible grouping. It really helps me reach those who might struggle with the material and ensures that all my students feel included.

- *Teacher 1*

I often find that many of my students view Physics as this daunting, irrelevant subject. To change that perception, I make it a point to connect our lessons to real-world applications. When they see how Physics concepts apply to things they experience daily, their interest and motivation start to grow.

- *Teacher 7*

I know that the technical nature of Physics can be intimidating for a lot of my students, which sometimes leads to anxiety or self-doubt. To help with this, I focus on creating a warm, supportive classroom atmosphere. I offer lots of positive feedback and break down complex topics into smaller, manageable parts, which helps my students build their confidence over time.

- *Teacher 4*

The findings coincide with the study of Caingcoy (2024), who emphasized that culturally responsive teaching strategies, such as recognizing students' backgrounds and tailoring content accordingly, enhance engagement and achievement among diverse learners, especially in subjects like Physics that are often perceived as difficult. Similarly, Gulzar et al. (2024) found that inclusive pedagogical practices, which include differentiated instruction, collaborative learning, and multimodal teaching, significantly improve participation and academic performance among students from varied linguistic and cultural backgrounds.

Farooqi et al. (2024) emphasized effective teaching strategies for diverse learners, including the integration of technology, individualized learning, and peer learning, which can support engagement through visual aids, real-life examples, and discussions tailored to various cognitive styles and preparedness levels.

In addition, Pejaner and Mistades (2020) observed that when Physics teachers intentionally connect content to students' lived experiences and cultural contexts, it fosters a sense of relevance and belonging, resulting in more active learning and persistence in STEM pathways.

Facilitating Student Expression. Facilitating student expression is crucial in Physics education, especially in diverse classrooms where language barriers can hinder participation. Many students may feel hesitant to express their thoughts and ideas due to a fear

of using English or a lack of communication confidence. To foster a more inclusive environment, teachers can adopt strategies that encourage open communication and create a safe space for students to share their understanding without fear of judgment. By allowing code-switching, encouraging participation, and nurturing a supportive classroom culture, educators can help students overcome these barriers and express themselves more freely. Fear of using English. Many students, particularly non-native speakers, may fear using English in a Physics classroom due to worries about making mistakes or not being understood. This fear can lead to reluctance to participate in discussions or ask questions. To address this, teachers can create an environment where mistakes are seen as a natural part of the learning process. Emphasizing that everyone is learning together can help alleviate this fear and encourage students to practice their language skills in a supportive setting. Hesitant to participate. Students often hesitate to participate in class discussions, particularly when they feel uncertain about their knowledge or language proficiency. This hesitancy can result in missed opportunities for learning and engagement. Teachers can combat this by implementing structured group activities or think-pair-share exercises, which provide students with lower-pressure opportunities to share their thoughts with peers before speaking in front of the whole class. This approach can help build confidence and encourage more students to contribute. Limited communication confidence. A lack of confidence in communication can significantly impact a student's willingness to express their ideas in Physics. Students may feel that their contributions are not valuable or worry about how their peers will perceive them. To boost communication confidence, teachers can foster a supportive classroom environment by providing positive reinforcement and recognizing students' efforts to participate. Encouraging peer feedback and collaborative projects can also create a sense of community, making it easier for students to share their thoughts without fear of judgment.

In summary, facilitating student expression in Physics education involves recognizing and addressing the barriers that prevent students from participating fully. This implies that facilitating student expression in Physics education emphasizes the importance of creating an inclusive, supportive, and interactive learning environment.

This is supported by the statements of the respondents as follows:

I have noticed that many of my students, especially non-native speakers, feel anxious about using English in class. To help them, I create an environment where making mistakes is part of learning. I emphasize that we're all in this together, which encourages them to practice their language skills without fear.

- *Teacher 9*

I often see students hesitating to participate because they're unsure of their knowledge or language proficiency. To combat this, I implement structured activities like think-pair-share, which give them a chance to share their ideas in a lower-pressure setting before speaking to the whole class. This helps build their confidence.

- *Teacher 11*

I focus on creating a supportive classroom atmosphere where students feel their contributions are valued. This

makes it easier for students to express their thoughts and ideas without the fear of being judged.

- Teacher 12

The findings coincide with the study of Surrain et al. (2022) emphasized that teacher code-switching and small-group instruction significantly enhance the classroom participation of dual language learners, reducing language anxiety and promoting inclusivity. Pajrina et al. (2022) found that structured activities like think-pair-share and the use of positive reinforcement can significantly boost students' communication confidence and willingness to participate in class.

Keown-Murray et al. (2023) highlighted the value of fostering a classroom culture of acceptance and mutual respect, which encourages students to share ideas without fear of judgment. Likewise, Chrismaretta and Abrar (2024) emphasized that collaborative strategies improve students' speaking comprehension and build their confidence in articulating scientific ideas, particularly in Physics and other STEM subjects.

Collectively, these findings reinforce that facilitating student expression requires more than language support; it necessitates a shift toward culturally responsive and emotionally supportive pedagogy. Teachers must intentionally design interactions and environments where students feel safe, valued, and confident enough to express their understanding. This holistic, communicative approach not only strengthens individual learner outcomes but also builds a classroom culture conducive to equity, engagement, and scientific inquiry.

Adaptive Strategies Employed by Physics Teachers. This section presents communicative-based adaptive strategies employed in teaching Physics, focusing on five key themes that enhance student engagement and understanding. The selection of these themes is grounded in the Braun and Clarke model of thematic analysis, which emphasizes the systematic identification, analysis, and reporting of patterns within qualitative data. This approach allows educators to distill complex instructional adaptations into coherent themes that reflect effective pedagogical strategies.

The identified themes include real-life contextualization, inquiry and dialogic teaching, technology and visual integration, collaborative and adaptive communication, and translanguaging for clarity, as shown in Table 6.

Real-life Contextualization. In teaching General Physics, one of the most prominent strategies employed by educators is real-life contextualization. This approach involves bridging the gap between abstract scientific concepts and students' everyday experiences. This is done by incorporating analogies, relatable scenarios, and practical applications. Teachers make complex ideas more accessible and meaningful. Such contextualized instruction not only deepens students' conceptual understanding but also fosters engagement and curiosity, as learners can see the relevance of Physics in the world around them.

Table 2. Communicative-based adaptive strategies employed in teaching Physics.

Themes	Code	Particulars
Real-life contextualization	<ul style="list-style-type: none"> - Use of analogies - Application of real-world examples - Concept simplification 	I use analogies and real-world examples... ...employed real-world examples... ...explain theories in small, digestible parts...
Inquiry and dialogic teaching	<ul style="list-style-type: none"> - Guided questioning - Open discussions - Problem-based prompts 	I use guided questioning in my lessons... It encourages them to explore concepts, ask questions, and participate in discussions ... I love incorporating problem-based prompts because...
Technology and visual integration	<ul style="list-style-type: none"> - Use of visual aids - Interactive simulations - Integration of digital tools 	...visual integration is a powerful strategy... Interactive simulations allow my students to experiment ... Integrating digital tools into my lessons has...
Collaborative and adaptive communication	<ul style="list-style-type: none"> - Peer learning/group work - Real-time feedback - Instructional adjustments based on student needs 	I have noticed that encouraging peer learning and group work... Providing real-time feedback during... Adjusting my instruction based on student needs...
Translanguaging for clarity	<ul style="list-style-type: none"> - Code-switching - Use of vernacular/local language - Translation of key terms 	... Using code-switching in my lessons really helps clarify complex concepts. Incorporating local vernacular into my Physics instruction... Translating key terms into my students' native languages is...

Respondents emphasized the value of this approach in their teaching practices. Teacher 4 mentioned using analogies and real-life examples to concretize abstract ideas and engaging students in group discussions to enhance peer understanding. This helps students understand complex Physics concepts by comparing them to things they already know. For example, explaining electricity by

comparing it to water flowing through pipes makes it easier for students to grasp the idea of current and resistance. Furthermore, analogies make abstract ideas more relatable and easier to remember, helping students connect what they are learning to everyday experiences.

Teacher 10 elaborated on incorporating visuals, simulations, and real-life contexts alongside guided questioning to encourage

critical thinking and reflection. The integration of real-world examples brings Physics concepts to life by showing how they apply in everyday situations. For example, to explain motion, teachers might refer to a car speeding up or slowing down. This helps students see the relevance of Physics in their own lives and makes learning more interesting and practical. Real-world examples help students understand how Physics is used to solve real problems.

This implies that real-life contextualization in teaching Physics enhances student engagement and motivation by making concepts relevant to their everyday lives. It aids comprehension and retention using analogies and real-world examples, allowing students to better internalize complex ideas. Additionally, this approach promotes critical thinking and problem-solving skills by encouraging students to apply theoretical knowledge to practical situations. Furthermore, it fosters inclusivity by incorporating diverse examples that reflect students' backgrounds, creating a welcoming classroom environment.

Teacher 26 emphasizes the use of simple, relatable analogies to make complex Physics concepts more understandable. These analogies help break down abstract ideas into manageable parts. Curiosity-driven questions further promote analytical thinking by encouraging students to explore, question, and apply what they learn. Ultimately, these strategies help cultivate a deeper appreciation for Physics and its real-world applications.

This is supported by the statements of the respondents as follows:

I often ask questions to check if students are following along and encourage them to ask questions too. I use analogies and real-world examples to make abstract ideas more concrete. Sometimes, I have students work in groups to explain concepts to each other in their own words.

- Teacher 4

The strategic communicative-based practices I employed in teaching General Physics include the use of analogies and real-life examples, incorporation of visuals and simulations to enhance comprehension, asking guided questions to simulate critical thinking, providing consistent feedback and encouraging student reflection, and adjusting lesson pacing and delivery based on student reactions and performance.

- Teacher 10

I would explain theories in small, digestible parts and use real-world analogies to make them relatable. I would foster curiosity by asking thought-provoking questions that challenge students to analyze and explore theories.

- Teacher 26

The findings coincide with the study of Mahdi (2023), who emphasized that teachers' use of clear and concise communication strategies, along with appropriate media, enhances students' understanding and motivation. Similarly, Rachman et al. (2024), Wiley et al. (2023), and Mahadi (2021) found that structured and transparent communication, especially when enhanced by technology, strengthens teacher-student relationships and leads to higher academic achievement in science classrooms.

Finally, Coletti et al. (2023) confirmed that communication training programs tailored to STEM educators lead to measurable gains in instructional clarity and student outcomes, reinforcing the

importance of strategic communicative practices in technical disciplines like Physics.

Thus, real-life contextualization is shown to be instrumental in enriching Physics instruction. It supports comprehension, promotes critical thinking and problem-solving, and fosters inclusivity by incorporating diverse and familiar examples. This strategic practice ultimately enhances student engagement, deepens understanding, and cultivates appreciation for the real-world relevance of Physics.

Inquiry and Dialogic Teaching. This is a dynamic instructional approach that fosters critical thinking and active engagement among students in Physics education. This method encourages students to explore concepts, ask questions, and participate in discussions, creating a collaborative learning environment. Employing guided questioning, open discussions, and problem-based prompts, educators can stimulate deeper understanding and promote a culture of inquiry in the classroom.

Through guided questioning, teachers pose thought-provoking questions that lead students to think critically about Physics concepts. It encourages learners to articulate their reasoning and explore their thought processes. For example, a teacher might ask, "What factors affect the speed of an object in motion?" This prompts students to consider various variables, fostering a deeper understanding of the principles of motion.

Open discussions provide a platform for students to express their ideas, challenge assumptions, and engage with their peers. This collaborative dialogue not only enhances understanding but also builds communication skills. For instance, during a discussion on energy conservation, students can share their perspectives on how energy changes form in different scenarios, facilitating a richer exploration of the topic.

Meanwhile, problem-based prompts present students with real-world challenges that require them to apply their knowledge of Physics to find solutions. This approach encourages critical thinking as students must analyze the problem, gather relevant information, and collaborate to develop a viable solution. For example, a prompt might involve designing a simple machine to lift a weight, prompting students to integrate their understanding of forces and mechanics.

Inquiry and dialogic teaching empower students to take an active role in their learning, enhancing their critical thinking skills and fostering a deeper understanding of Physics concepts.

This implies that inquiry and dialogic teaching in Physics education are significant. This approach actively engages students, fostering ownership and responsibility for their learning, which leads to increased motivation and participation. Guided questioning promotes critical thinking skills, preparing students for real-world problem-solving. Open discussions enhance communication skills by encouraging students to express ideas and value diverse perspectives, creating a supportive classroom culture. Additionally, problem-based prompts allow students to apply theoretical knowledge to practical situations, making Physics more relevant and engaging while fostering collaboration. Overall, this teaching method inspires students to become active learners and develop a lifelong interest in science.

This is supported by the statements of the respondents as follows:

I have seen firsthand how this dynamic instructional approach fosters critical thinking and active engagement

among my students in Physics. It encourages them to explore concepts, ask questions, and participate in discussions that create a vibrant learning environment.

- *Teacher 8*

When I use guided questioning in my lessons, I notice my students become more involved. For instance, when I ask, 'What factors affect the speed of an object in motion?' it prompts them to think critically and articulate their reasoning, which deepens their understanding of key principles.

- *Teacher 10*

I love incorporating problem-based prompts because they challenge my students to tackle real-world issues. When they work together to design a simple machine to lift a weight, I see them applying their Physics knowledge in practical ways, which enhances their collaboration and critical thinking skills.

- *Teacher 14*

The findings coincide with the study of Gillies (2023) and Vaschenko (2023), which emphasized the importance of dialogic interactions in science education that involve students' dialogue and questioning, as encouraging such interactions helps students think more critically and understand concepts more deeply (Gillies, 2022). This aligns with the present findings, which highlight the value of classroom discussions and peer interactions in clarifying complex Physics concepts.

Similarly, Sam (2024) and Gillies (2020) found that effective teachers promote inquiry-based learning by creating supportive environments where students are encouraged to express confusion, pose questions, and collaboratively solve problems, key elements of dialogic teaching that lead to improved engagement and learning outcomes. This approach enhances engagement and learning outcomes by facilitating meaningful interactions and supporting students' scientific literacy and reasoning skills.

In support of this, Antonio and Prudente (2023) argued that inquiry-oriented instruction combined with dialogic feedback helps build scientific reasoning skills and enhances students' participation in meaning-making during lessons. Additionally, Imaniar et al. (2020), Hendratmoko et al. (2023), and Pols et al. (2023) demonstrated that integrating inquiry-based and dialogic methods in Physics teaching improves students' attitudes toward science and their ability to construct evidence-based arguments.

In summary, inquiry and dialogic teaching, integrating guided questioning, open discussion, and problem-based prompts, not only enhance students' conceptual grasp of Physics but also promote critical thinking, collaborative learning, and the ability to apply scientific knowledge in real-world contexts.

Technology and Visual Integration in Physics Education. Technology and visual integration are a powerful strategy in physics education that enhances understanding and engagement by utilizing visual aids, interactive simulations, and digital tools. This approach addresses the diverse learning styles of students and clarifies abstract concepts, making them more accessible and relatable. By incorporating various technological resources into the classroom, educators can create a more dynamic and effective learning environment.

Visual representations such as diagrams, videos, and charts help students grasp relationships and processes that may be difficult to

comprehend through text alone. When students can visualize wave properties like amplitude and frequency or the structure of electric circuits, they form clearer mental models, which aids retention. Similarly, interactive simulations allow students to manipulate variables and observe real-time effects, transforming passive learning into active exploration. Simulations of projectile motion or force interactions, for instance, empower students to engage with complex phenomena in a safe and controlled environment. Digital tools and platforms further expand the learning experience by enabling virtual experiments, collaborative tasks, and data analysis, often beyond the limitations of the physical classroom. These tools not only enhance scientific inquiry but also foster collaboration and digital literacy.

The responses of the teachers affirm the effectiveness of this integrated approach. Teacher 8 noted that visual aids like diagrams and videos help simplify complex concepts and boost accessibility. Teacher 10 highlighted how simulations support active learning by allowing students to explore and experiment virtually. Teacher 12 emphasized the transformative role of digital tools in creating collaborative, inquiry-based experiences that reinforce scientific understanding.

Technology and visual integration in Physics education serve to clarify abstract ideas and cater to diverse learning styles. By employing visual aids, interactive simulations, and digital tools, educators can create a more engaging and effective learning environment that promotes deeper understanding and retention of Physics concepts.

This is supported by the statements of the respondents as follows:

I have found that technology and visual integration are a powerful strategy that significantly enhances my students' understanding and engagement in Physics. Using visual aids like diagrams and videos helps clarify complex concepts and makes them more accessible.

- *Teacher 8*

Interactive simulations allow my students to experiment with Physics concepts in a virtual environment. For instance, when they manipulate variables in a projectile motion simulation, they can visually grasp how different angles influence the trajectory, deepening their understanding of motion.

- *Teacher 10*

Integrating digital tools into my lessons has transformed the learning experience. Platforms that facilitate remote experiments not only reinforce scientific methods but also foster collaboration among students, allowing them to communicate and share their findings effectively.

- *Teacher 12*

The findings coincide with the study of Nasution et al. (2025) and Karim and Karim (2024), who found that integrating simulations, animations, and interactive media in Physics instruction enhances students' conceptual clarity and retention of abstract ideas. This supports the current findings that technology and visual tools help bridge the gap between theoretical concepts and real-world applications. Similarly, Sebastian and Kuswanto (2024) and Socrates and Mufit (2022) emphasized the effectiveness of visual learning platforms and augmented reality in improving students' spatial reasoning and problem-solving skills in Physics, particularly in topics like kinematics and electromagnetism.

Moreover, Fadillah et al. (2024) and Rizaldi et al. (2024) also demonstrated that students who engaged with visual-based e-learning modules showed significantly better performance in Physics assessments compared to those taught through traditional methods. Furthermore, Kim and Jin (2022) highlighted that technology-enhanced visualizations allow students to explore complex scientific phenomena at their own pace, fostering autonomy and deeper inquiry-based learning.

In summary, technology and visual integration in Physics education do more than just support comprehension—they create immersive and responsive learning environments that accommodate various learning styles, promote critical thinking, and bridge the gap between theoretical knowledge and real-world application.

Collaborative and Adaptive Communication. This is a vital instructional strategy in Physics education that emphasizes the importance of peer interaction and responsive teaching. This approach fosters a learning environment where students can work together, share ideas, and support each other's understanding of complex concepts. Employing peer learning and group work, providing real-time feedback, and making instructional adjustments based on individual student needs, educators can create a more personalized and effective learning experience. This strategy not only enhances student engagement but also promotes critical thinking and collaboration, equipping students with essential skills for success in both academic and real-world contexts. Peer learning/group work. Peer learning and group work are essential components of collaborative communication in Physics education. Working in groups, students can share diverse perspectives, challenge each other's ideas, and deepen their understanding of complex concepts. This collaborative approach encourages students to articulate their thoughts and reasoning, fostering critical thinking and problem-solving skills. For instance, when tasked with a group project on energy transfer, students can discuss their findings, collaborate on solutions, and learn from one another's insights, ultimately enhancing their grasp of the topic. Real-time feedback. Providing real-time feedback is crucial for helping students understand their progress and areas for improvement. As teachers facilitate group activities or discussions, they can offer immediate feedback, guiding students in their thought processes and encouraging them to refine their ideas. For example, during a lab activity, if a student struggles with applying a Physics principle, the teacher can step in to provide constructive feedback, helping the student adjust their approach and gain clarity. This timely feedback not only boosts student confidence but also reinforces learning in the moment. Instructional adjustments based on student needs. Adaptive communication involves making instructional adjustments based on the diverse needs of students. Observing group dynamics and individual participation, teachers can identify areas where students may need additional support or challenge. For instance, if a group is struggling to grasp a concept during a collaborative experiment, the teacher can modify the lesson plan, introduce additional resources, or provide targeted instruction to address those gaps. This responsive approach ensures that all students are engaged and supported, enhancing their overall learning experience.

Collaborative and adaptive communication in Physics education enriches the learning environment by promoting peer interaction, providing timely feedback, and adjusting instruction to meet individual student needs. Promoting a culture of collaboration and

responsiveness, educators can enhance student engagement, understanding, and success in Physics.

This implies that collaborative and adaptive communication in Physics education is significant for enhancing both student learning and teaching effectiveness. By fostering peer interaction through group work, students become more engaged and motivated, creating a sense of community and ownership over their learning. Providing real-time feedback allows for immediate corrections and guidance, improving student performance and confidence. Additionally, making instructional adjustments based on individual student needs ensures that all learners receive the necessary support, fostering an inclusive classroom environment. Overall, this approach enriches the learning experience, promotes deeper understanding, and equips students with essential skills for success in both academic and real-world contexts.

This is supported by the statements of the respondents as follows:

I have noticed that encouraging peer learning and group work enhances student engagement. When they collaborate, they feel more connected to each other and to the material, which makes learning more enjoyable.

- Teacher 10

Providing real-time feedback during group activities has been a game-changer. It allows me to guide students right when they need it, helping them refine their ideas and boosting their confidence in their understanding.

- Teacher 15

Adjusting my instruction based on student needs is crucial. By observing how my students interact and what challenges they face, I can modify my lessons to ensure that everyone is engaged and supported in their learning journey.

- Teacher 14

The findings coincide with the study of Calalb and Dabija (2024), and Odell et al. (2023) stressed that collaborative communication strategies such as student-led discussions, peer instruction, and group problem-solving can enhance learning outcomes by promoting shared understanding and active participation in science classrooms. This aligns with the current study's findings that adaptive and collaborative communication helps Physics teachers meet diverse student needs and foster inclusive learning environments.

Furthermore, Koimah et al. (2024), Aysha (2023), and Parsons et al. (2017) highlighted that differentiated instruction enhances student engagement and learning outcomes. Effective adaptation in communication, including modifying instructional language and responding to student cues, is essential for successfully implementing this approach, particularly in complex subjects like Physics.

In addition, Al-Mansouri (2024) stressed that real-time feedback enhances teachers' ability to adapt explanations and foster collaborative dialogue, leading to improved student engagement and comprehension. This approach promotes a student-centered learning environment, ultimately resulting in more effective classroom interactions and better learning outcomes.

Moreover, Ginting et al. (2024) and Tang (2023) highlighted the importance of integrating adaptive strategies with student-centered learning, showing that when teachers simplify content and draw on

students' prior knowledge through discussion, learning becomes more accessible and meaningful (Levitt and Grubaugh, 2023 & Srinivasa et al., 2022).

Building on these insights, it is evident that implementing adaptive and collaborative communication strategies is crucial for optimizing Physics education. The convergence of findings from recent studies underscores the importance of fostering an inclusive, student-centered learning environment where diverse instructional approaches such as peer instruction, differentiated teaching, and real-time feedback are effectively integrated. Such strategies not only enhance student engagement and understanding but also accommodate varying learning needs, ultimately leading to improved academic outcomes in complex subjects like Physics. Future research could further explore how these approaches can be tailored to different educational contexts to maximize their impact on student learning.

Translanguaging for clarity. Translanguaging for clarity is an effective instructional strategy in Physics education that enhances student comprehension by incorporating multiple languages within the learning environment. This approach allows educators to strategically use code-switching, local vernacular, and translation of key terms to make complex concepts more accessible to all students. Embracing students' linguistic backgrounds and utilizing their native languages alongside English, teachers can promote a deeper understanding of Physics concepts. This practice not only supports language learners but also enriches the overall classroom discourse, creating an inclusive environment that values diverse linguistic perspectives and promotes equitable learning opportunities for every student.

Code-switching is where teachers alternate between English and the students' local language within a single lesson or explanation. This method helps clarify complex scientific concepts and reinforces student comprehension. For example, when discussing the laws of motion, a teacher might first present the term in English and then explain it in the students' native language, ensuring the concept is more fully understood. This approach not only supports cognitive processing but also affirms students' linguistic and cultural identities, fostering a more inclusive and supportive learning environment.

Closely linked to code-switching is the use of vernacular or local language, which can significantly enhance relatability and engagement. By incorporating culturally familiar terms, analogies, or examples, teachers help students connect new scientific knowledge to their everyday experiences. This makes abstract Physics concepts, like energy transfer or momentum, more meaningful and easier to grasp. Additionally, translating key terms into students' first languages ensures that essential vocabulary is not a barrier to learning. Providing equivalent terms for words like "force" or "energy" strengthens comprehension and builds confidence in using scientific language. Together, these interconnected practices, code-switching, use of vernacular, and key term translation work in harmony to create an accessible and linguistically responsive Physics classroom that supports all learners.

Translanguaging for clarity, through code-switching, the use of vernacular/local language, and translation of key terms, creates an inclusive learning environment that enhances accessibility and understanding of complex Physics concepts.

This is supported by the statements of the respondents as follows:

I find that using code-switching in my lessons really helps clarify complex concepts. When I explain a Physics term in English and then switch to the students' local language, it reinforces their understanding and makes them feel more comfortable in the classroom.

- *Teacher 11*

Incorporating local vernacular into my Physics instruction has been a game-changer. By using terms and examples that my students are familiar with, I create a relatable context that helps them connect their cultural experiences to the scientific concepts we're discussing.

- *Teacher 15*

Translating key terms into my students' native languages is essential for promoting clarity. When I introduce concepts like 'force' or 'energy' and provide the equivalent term in their local language, it not only boosts their comprehension but also builds their confidence in discussing scientific ideas.

- *Teacher 12*

The findings coincide with the study of Pérez et al. (2024) and Charamba (2023), who affirmed that translanguaging allows multilingual students to access complex scientific concepts more effectively by leveraging their full linguistic repertoires. This approach fosters deeper understanding and engagement, as students can think about concepts in their first language before expressing them in English (Ollerhead et al., 2020). This aligns with the present findings that Physics teachers' strategic use of both English and students' first languages enhances clarity and fosters deeper understanding.

Kim and Kim (2024) highlighted that translanguaging in science education enhances inclusivity and cognitive engagement, especially in linguistically diverse classrooms. Their research indicates that students are more likely to participate and grasp complex concepts when teachers incorporate students' home languages. Similarly, Charamba (2023) found that translanguaging enables multilingual students to utilize their linguistic resources to develop scientific explanations, leading to improved academic performance in a South African classroom.

Feser and Höttecke (2021) further supported this by showing that Physics teachers who employed purposeful code-switching and translanguaging techniques effectively clarified complex terminologies, which significantly enhanced student comprehension and confidence in understanding Physics concepts, thereby promoting better language proficiency in the subject.

Additionally, Luchenko and Doronina (2024) argued that translanguaging is not merely a linguistic strategy but a pedagogical tool that enables meaning-making, especially in STEM fields where language barriers often hinder full engagement. Their insights reinforce the importance of integrating translanguaging into science and Physics instruction to foster understanding and inclusive learning environments.

The five key communicative-based strategies enhance Physics education by fostering engagement and understanding. Real-life contextualization connects abstract concepts like forces and energy to students' everyday experiences through analogies and examples. Inquiry and dialogic teaching promote critical thinking through guided questioning and open discussions, allowing students to explore complex topics collaboratively. Technology and visual

integration use visual aids and interactive simulations to clarify challenging concepts, making learning dynamic. Collaborative and adaptive communication emphasizes peer learning and provides real-time feedback, ensuring that all students receive necessary support for grasping complex ideas like electricity and magnetism. Finally, translanguaging for clarity employs code-switching and local vernacular to make Physics more accessible, especially in diverse classrooms. Together, these strategies create a more effective and inclusive learning environment for all students.

Conclusions

Based on the findings of this study, several conclusions can be drawn regarding the strategic communicative barriers experienced by Senior High School Physics teachers in delivering General Physics instruction. First, the abstract and symbolic nature of Physics content constitutes a significant communicative barrier. Teachers face challenges in simplifying and scaffolding intricate theories, symbolic representations, and mathematical formulations in ways that students can readily understand. Student misconceptions further complicate communication, necessitating deliberate and well-planned interventions. Second, engaging a diverse learner population remains a persistent barrier. Teachers must address wide variations in students' prior knowledge, learning styles, motivation, and attitudes toward Physics. Low motivation and intimidation due to the technical nature of the subject impede effective communication and active participation. Third, facilitating student expression is hindered by language-related barriers, particularly students' fear of using English and limited communication confidence. These barriers affect students' willingness to participate in classroom discussions, thereby impacting learning outcomes. Finally, these communicative barriers are intensified by restricted access to professional development opportunities focused on communication skills and technology integration, limiting teachers' ability to employ varied and effective adaptive strategies.

Recommendations

In response to these conclusions, the following recommendations are proposed to address the strategic communicative barriers faced by Physics teachers. First, professional development programs should be designed and implemented to specifically enhance teachers' strategic communicative competence. These programs must provide practical training on simplifying complex concepts, correcting misconceptions, and adapting communication to meet diverse learner needs. Second, schools should promote differentiated instruction and culturally responsive teaching strategies that acknowledge and accommodate the varied academic backgrounds, learning preferences, and motivational levels of students. Third, to overcome language-related barriers, teachers should be encouraged to use translanguaging, code-switching, and structured activities such as think-pair-share that build students' communication confidence and foster active participation. Fourth, ongoing support and training in the effective use of visual aids and digital technologies should be provided to equip teachers with the tools necessary to enhance engagement and comprehension. Finally, future research should investigate the long-term effects of improved strategic communicative competence on student achievement and evaluate the effectiveness of targeted interventions in diverse educational contexts. Implementing these recommendations will strengthen Physics teachers' communicative abilities, ultimately improving teaching effectiveness and student learning outcomes in Physics education.

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