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Undergraduate Thesis, Philippine Normal University-Manila

PHILIPPINE NORMAL UNIVERSITY
The National Center for Teacher Education

A COMPARATIVE ANALYSIS OF SENIOR HIGH STEM STUDENTS' PERCEPTIONS OF COLLABORATIVE AND SELF-EXPLANATION STRATEGIES IN SOLVING PHYSICS

An Undergraduate Thesis
Presented to
Faculty of Science, Technology, and Mathematics
College of Teacher Education
Philippine Normal University Manila,

In Partial Fulfillment of the Requirements
for the course 2S-SCI03
(Science Research 2)

LIZA S. NICOR
SHIELO A. PARMIS

NOVEMBER 2025

PHILIPPINE NORMAL UNIVERSITY
The National Center for Teacher Education

APPROVAL SHEET

This thesis entitled **"A COMPARATIVE ANALYSIS OF SENIOR HIGH STEM STUDENTS' PERCEPTIONS OF COLLABORATIVE AND SELF-EXPLANATION STRATEGIES IN SOLVING PHYSICS"** prepared and submitted by **LIZA S. NICOR & SHIELO A. PARMIS** in partial fulfillment of the requirements for the subject 2S-SCI03 (Science Research 2), is hereby recommended for approval and acceptance.

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ABSTRACT

Name: Liza S. Nicor & Shielo A. Parmis

Title of the Study: A Comparative Analysis of Senior High Stem Students' Perceptions of Collaborative and Self-Explanation Strategies in Solving Physics

Key Concepts: Learning Strategies, Collaborative Learning Strategy, Self-explanation Strategy

Degree: Bachelor of Science in Education with Specialization in Physics

Adviser: Marie Paz Morales, PhD

The collaborative strategy and self-explanation strategy are two learning strategies that can be used to solve physics problems. In this study, researchers will determine the perceived effectiveness of these two learning strategies in solving physics problems. Previous research has found that most students view physics as challenging and complex. These perceptions lead to a lack of interest in physics and can impact their ability to solve physics problems effectively. This study will employ a qualitative research design to explore and compare the perceptions of Senior High STEM students regarding collaborative and self-explanation strategies for enhancing problem-solving skills. To achieve the research objectives, data collection will follow three main steps: a systematic literature review, interviews with STEM students and teachers, and document analysis of student work solutions.

To ensure ethical compliance, permission will be obtained from school administrators, and informed consent will be secured from students, parents, and teachers before conducting interviews and collecting student work samples. The results of this study can contribute to academic knowledge, inform educational policy-making, and support national educational development.

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In writing this study, the researchers want to acknowledge the following people:

First, the researcher acknowledged the presence of **DR. MARIE PAZ MORALES**, the research adviser, for her guidance, insightful feedback, and consistent support throughout the process of the study. Her expertise and encouragement to the researchers greatly enriched and influence the quality of this research and made this study successful.

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ACRONYM

- STEM – Science, Technology, Engineering, and Mathematics
- SHS – Senior High School
- DepEd – Department of Education
- SDG – Sustainable Development Goal
- PISA – Programme for International Student Assessment
- TIMSS – Trends in International Mathematics and Science Study
- CL – Collaborative Learning
- SE – Self-Explanation
- PSP – Problem-Solving Performance
- CPU – Conceptual and Procedural Understanding
- IV – Independent Variable
- DV – Dependent Variable
- AHS – Araullo High School
- SA – Student A (pseudonym)
- SB – Student B (pseudonym)
- SC – Student C (pseudonym)
- SD – Student D (pseudonym)
- SE – Student E (pseudonym)
- SF – Student F (pseudonym)
- SG – Student G (pseudonym)
- SH – Student H (pseudonym
- TA – Teacher A (pseudonym)
- TB – Teacher B (pseudonym)

A COMPARATIVE ANALYSIS OF SENIOR HIGH STEM STUDENTS' PERCEPTIONS OF COLLABORATIVE AND SELF-EXPLANATION STRATEGIES IN SOLVING PHYSICS

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CHAPTER 1

THE PROBLEM AND LITERATURE REVIEW

This chapter includes the background of the problem, the literature review, the research problem and hypotheses, conceptual framework, and the definition of terms used in the study.

Background of the Study

Physics problem-solving is an important skill in science, technology, engineering, and mathematics (STEM) education. However, many students face challenges in effectively applying problem-solving strategies, leading to difficulties in conceptual understanding and academic performance. To address these issues, this study explores self-explanation and collaborative learning strategies as methods to enhance students' problem-solving abilities in physics. By analyzing these strategies, this research aligns with national, local, and global education priorities aimed at improving STEM education outcomes.

This study is grounded in the Sustainable Development Goals (SDGS) 4 and 9, which emphasize quality education and industry, innovation, and infrastructure. According to the 2024 SDG progress report, while global secondary school completion rates have improved from 53% in 2015 to 59% in 2023, this increase has not necessarily translated to better learning outcomes, as students' proficiency in reading and mathematics continues to decline (United Nations, 2024).

Furthermore, findings from the 2019 Trends in International Mathematics and Science Study (TIMSS) indicate that while some countries improved in Grade 8 science from 2015 to 2019, others experienced a decline, highlighting the need for better instructional strategies in physics education (Mullis et al., 2020). In the Philippines, the government is continually working to strengthen the K-12 science curriculum, aiming to enhance students' competitiveness in science and technology. However, challenges persist, as reflected in the 2022-2023 survey by the Department of Education (DepEd), which found that only 23.24% of approximately 2.8 million senior high school students enrolled in the STEM strand (Gatchalian, 2023).

This study aims to enhance STEM students' problem-solving skills, thereby better preparing them for a future career in science and technology, which aligns with the Department of Education's (DepEd) goals. In terms of local level, a national report states that students in Metro Manila (NCR) scored 390 in science and 402 in mathematics, which is higher than national average but still lower in the global benchmark of 489, this data is from Programme for International Student Assessment (PISA) 2018. In NCR, despite having the highest STEM enrollment rate in the Philippines, dropout rates remain high. It is estimated that 20% of students fail to complete the STEM track, with one of the most common reasons being difficulty with subjects. (Philippine Department of Education, 2019).

The study focuses on comparing the perceived effectiveness of self-explanation and collaborative learning strategies on solving physics problems.

By examining their impact on students' problem-solving performance, motivation, conceptual understanding, and procedural knowledge, this work contributes to enhancing current approaches and reinforcing STEM preparedness for future careers. Findings from this study will provide valuable insights for educators, curriculum developers, and policymakers, helping them to improve physics instruction to support senior high school STEM students (Maries & Singh, 2023; Rafanan et al., 2020).

The backbone of this study is grounded in credible theories in education and cognitive science. Self-explanation and Collaborative learning are based on metacognitive and social constructivist theory. Metacognitive Theory suggests that students who engage in self-explanation develop a deep understanding by actively monitoring and regulating their learning process. This approach encourages them to outline their reasoning, identify knowledge gaps, and refine their problem-solving strategies, ultimately leading to a deeper conceptual and procedural understanding (Maries & Singh, 2023). On the other hand, Social Constructivism claims that learning is enhanced whenever students interact and build knowledge collaboratively with their peers, classmates, or friends. In this context, collaborative learning enables every student to engage in discussions, challenge each other's ideas, and develop problem-solving strategies together. The increase in motivation and engagement by creating an interactive learning environment enables students to learn not only from their school instructor but also from their peers (Rafanan et al., 2020). In addition to

these learning strategies, this study also considers Polya's Method Theory, which focuses on problem-solving performance. Polya's is outlined into four steps of how to solve problems: 1) understanding the problem, (2) devising a plan, (3) carrying out the plan, and (4) reviewing the solution. By looking into how these strategies' self-explanation and collaborative learning strategy influences students' ability and capability in following these steps, this research aims to determine which strategy is more effective in improving problem-solving performance (Mullis et al., 2020). Lastly, this study is anchored to Cognitive Load Theory, which emphasizes the balance between conceptual understanding- grasping the underlying principles of physics- and procedural understanding -applying problem-solving steps effectively- STEM students can develop efficient ways of physics problem solving, whether they are working independently through self-explanation or collaboratively with peers (The Education Hub, 2019).

Nevertheless, despite efforts to improve STEM education, certain issues in physics problem-solving persist. Several studies have examined general learning strategies; however, few have conducted direct comparative analyses between self-explanation and collaborative learning in the context of solving physics problems. This is relevant in the Philippine education system, where challenges such as limited STEM enrollment, resource constraints, and high dropout rates hinder students' performance (Gatchalian, 2023).

Moreover, global studies such as TIMSS 2019 and PISA 2018 highlight a decline in science and mathematics proficiency among students, reinforcing the need for innovative instructional methods (Mullis et al., 2020; Philippine Department of Education, 2019). Understanding how different strategies impact problem-solving performance, motivation, conceptual, and procedural understanding will provide valuable insights for educators and policymakers aiming to strengthen physics education.

Literature review

Collaborative Learning in Solving Physics Problems

Physics is considered a complex subject because it explores the fundamental principles governing the universe (Argaw et al., 2016). In physics, problem-solving is a critical component that helps students apply theoretical knowledge to practical and complex situations. However, some students struggle in solving physics problems despite having prior knowledge in physics (Ince, 2018). Different learning strategies can be used to enhance problem-solving skills, one of which is the collaborative learning strategy. Collaborative learning is an educational strategy that emphasizes teamwork and interaction among students, enhancing their learning outcomes (Amalia, 2018). The Vygotsky sociocultural theory views learning as a social process (Amalia, 2018). This theory can be observed in collaborative learning, which occurs when students engage with peers to exchange knowledge, ideas, and

problem-solving techniques. Interaction within a group is crucial for student learning, especially in science education, particularly in physics. In which it involves complex concepts that require a deep learning approach to understand (Scager et al., 2017).

Additionally, there is an old adage that states, "two heads are better than one," which is still used today to emphasize that learning can achieve better results in academia if students interact and collaborate (Anthony et al., 2018). It is widely recognized that some students, particularly in STEM fields, face difficulties in understanding physics concepts (Laguindab et al., 2025). These might affect the performance of STEM students in solving physics problems, which contain complex concepts that require a solid foundation to perform. For this reason, it is essential that teachers encourage students to practice learning strategies to avoid such cases in learning physics, particularly when solving physics problems. According to Setiawan et al. (2020), collaborating in small groups to solve physics problems has a significant impact on students. Through sharing ideas, knowledge, and abilities, students can develop a deeper understanding and achieve better learning outcomes in physics education. With this, students can also ask clarifying questions about the concept they find challenging, which strengthens their understanding of the physics problem they are solving (Hayashi, 2020). Moreover, collaborative learning strategies can develop skills such as critical thinking and deeper learning on the topics in physics, which leads to students' success in science education (Balta & Awedh, 2017).

Self-Explanation as a Learning Strategy

There is also a learning strategy that can help students to solve physics problems. Self-explanation is a learning strategy in which students explain the steps they take to solve physics problems to themselves (Gjerde et al., 2022). As previously stated, physics is considered a complex subject by most students. Even students in STEM education viewed physics as the most challenging subject among all others in their strand. Hence, explaining the physics problem to oneself enables students to develop skills in solving physics problems (Badeau et al., 2017).

In addition, the self-explanation strategy facilitates a deeper understanding and knowledge construction, particularly for students with limited prior knowledge (McNamara, 2017). This strategy will also make learners aware of their comprehension levels, which is crucial for understanding the concepts in physics. According to Kwon and Therriault (2014), such a strategy has the potential to impact student memory retention. They emphasise the importance of using a self-explanation strategy to more deeply encode the information, which is associated with better long-term retention. They further elaborated in their study that students who practice explaining the concept to themselves in physics problems have greater comprehension performance in science education.

Furthermore, self-explanation strategy corresponds to the theory of metacognition—the awareness and regulation of one's learning processes. Since students who practice self-explanation are capable of monitoring their understanding through assessing their comprehension of the problem, identifying gaps within or

inconsistency in their knowledge (Conati, 2016). Moreover, learners who practice self-explanation strategies enhance their problem-solving skills and conceptual understanding, thereby promoting a deeper understanding of the complexity of physics (Durkin et al., 2017). The effectiveness of this strategy could also be seen in other fields, such as geometry in mathematics (Maarif et al., 2020). They demonstrated the effectiveness of the self-explanation strategy in understanding mathematical proofs, which is relevant to physics problems—applying mathematics to describe the natural world.

Comparative Effectiveness of Problem-Solving Strategies

Collaborative and self-explanation strategies both lead to better learning outcomes when solving physics problems. Performing physics problems within a small group can reduce cognitive load when completing complex tasks (Sankaranarayanan et al., 2021). Students who worked in groups produce higher-quality solutions. In contrast, students who work alone during problem-solving in physics are more likely to struggle with the complexity of the problem concepts (Brand et al., 2023). However, some studies found no significant difference between collaborative and self-explanation strategies in solving physics problems (Ozkara & Cakir, 2020). However, they found collaborative learning significantly increases students' motivation compared to individual learning. In addition, cooperative learning enhances the critical thinking skills of students by facilitating peer support, cooperation, and the sharing of ideas, which can lead to the creation of creative

solutions (Firdaus & Satriawan, 2025). On the other hand, self-explanation strategies improve their procedural fluency by encouraging students to verbalize the steps on their own, allowing them to find mistakes or errors while solving physics problems (Phuong, 2020).

Collaboration and self-explanation learning strategies have distinct yet complementary roles in solving physics problems. Sharma (2024) highlights how collaboration supports shared regulation and constructive interaction which allow students to refine their understanding through peer discussions. On the other hand, Ozkara and Cakir (2020), along with Mapile and Lapinid (2023) emphasize that self-explanation promotes deeper conceptual understanding by encouraging students to articulate their reasoning independently. In addition, Van Dusen (2015) and Marshman et al. (2021) suggest that motivation plays a crucial role, with collaborative learning reducing anxiety and self-explanation fostering persistence. By comparing these approaches, this study aims to explore how senior high STEM students utilize collaboration and self-explanation when solving physics problems, providing insights for optimizing instructional strategies.

Although collaborative and self-explanation strategies have been widely studied, there is still limited research on how these strategies enhance students' understanding when solving physics problems. Both strategies remain underexplored and require further investigation (Maarif et al., 2020). Persistent misconceptions have been observed, suggesting the need for explored methods that effectively address these gaps (Balta & Awedh, 2017). In addition, the lack of time devoted in

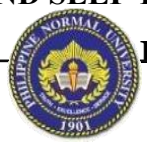
studying these two strategies, focusing only on limited information, prevents researchers from drawing solid conclusions (Prani et al., 2018). Addressing these gaps is crucial for improving educational interventions and instructional designs.

Solving physics problems is challenging for STEM students because of the subject's systematic and technical nature, but strategies like collaborative learning and self-explanation can enhance students' understanding and performance. Collaborative learning supports peer interaction and motivation, while self-explanation fosters metacognitive skills and deeper conceptual understanding. Despite their differences, both strategies contribute to students' performance, motivation, and engagement, as well as their conceptual and procedural understanding, leading to better retention. However, limited research and persistent misconceptions underscore the need for further analysis to optimize these strategies in STEM education at the local, national, and global levels.

Research problems and hypotheses

This study examines the perceived effectiveness of collaborative learning and self-explanation strategies in solving physics problems among STEM students. Specifically, it seeks to answer the following questions:

- How do previous studies compare the effectiveness of collaborative learning and self-explanation strategies in physics education?
- What is the perception of STEM students and teachers in the effectiveness of collaborative learning and self-explanation strategies in solving physics problems?



- How do students problem-solving skills relate to their use of collaborative or self-explanation strategies?

Conceptual framework

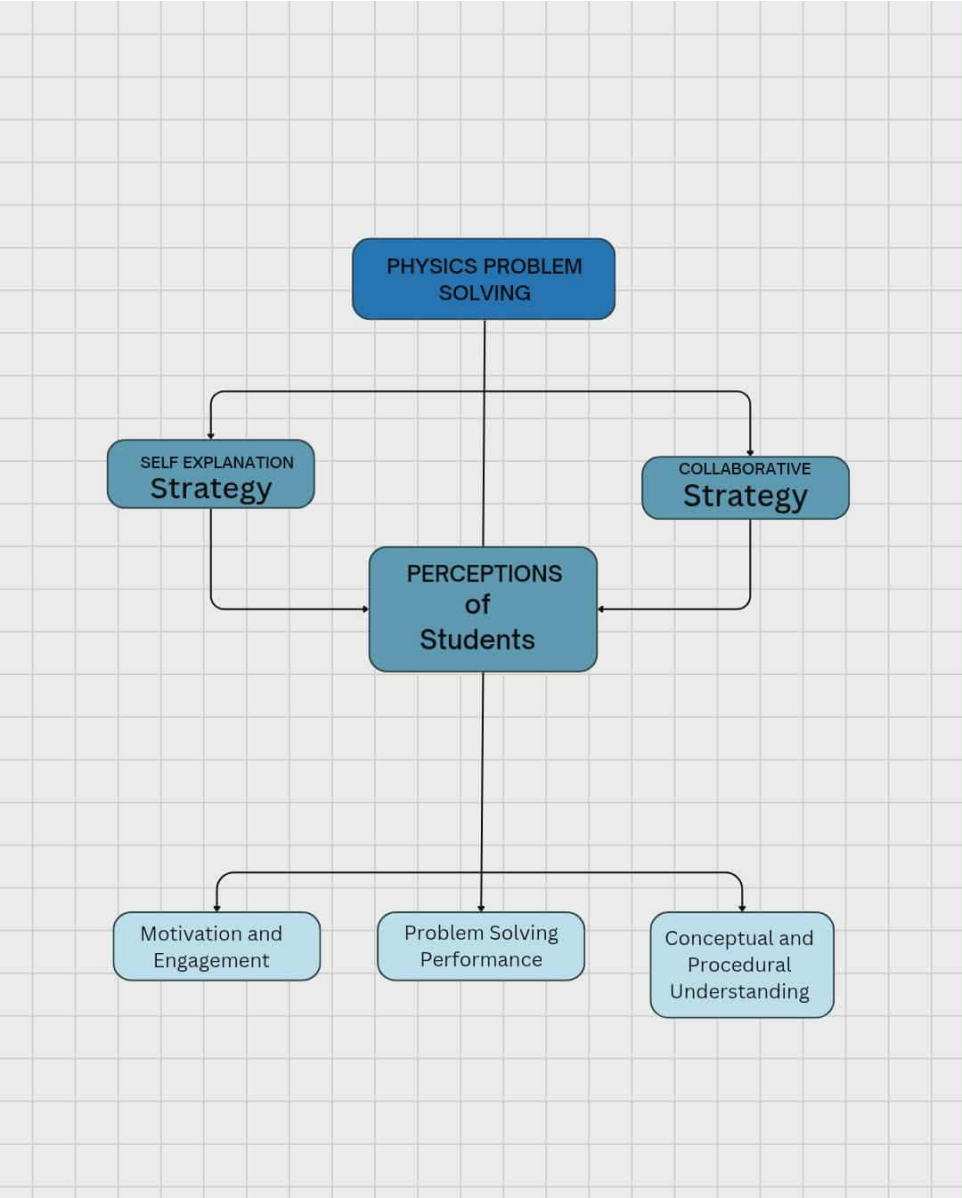


Figure 1: Conceptual Framework

As pointed out previously, the need to enhance STEM education focusing on

physics problem-solving has been highlighted by global and national reports (Creswell & Poth, 2018; Yin, 2016). In response to this challenge, this study analyzes two strategies to physics problem-solving: self-explanation and collaborative strategy. These strategies are backed by credible theories that provide a backbone for their effectiveness. Self-explanation is supported by metacognition, which refers to an individual's ability to monitor, evaluate, and regulate their own thinking and learning processes (The Education Hub, 2019). By engaging in self-explanation, students solidify their understanding of a problem, identify gaps in their knowledge, and enhance their reasoning. This reflective process enhances their ability to solve physics problems independently, improving both problem-solving performance and conceptual and procedural understanding (Maries & Singh, 2023). On the other hand, the collaborative strategy is supported by social constructivism theory, which highlights the role of interaction and shared experiences in learning (Richardson, 2015). Students engage in discussions, exchange ideas, and collectively construct knowledge, where this strategy allows learners to develop a deeper understanding of physics concepts by benefiting from diverse perspectives and feedback from their peers (Rafranan et al., 2020).

This study is structured by a conceptual framework that shows the relationship between two independent variables: self-explanation strategy and collaborative strategy, with three dependent variables: problem-solving performance, motivation and engagement, and conceptual and procedural understanding. Additionally, the framework includes perception variables to account for the viewpoints of both

students. Students' perception refers to how learners view the effectiveness and usefulness of the strategies in enhancing their learning, (Gencoglu, Helms-Lorenz & Maulana, 2021).

Self-explanation strategy that consists of students verbalizing their own understanding and reasoning processes as they individually solve a physics problem, where this strategy encourages metacognition and individual reflection, which can potentially enhance students' understanding and performance in physics problems (The Education Hub, 2019). On the other hand, the collaborative learning strategy promotes peer interaction and cooperative learning, where students share ideas, solve problems, and provide feedback together (Richardson, 2015; Rafanan et al., 2020). . These two strategies are implemented as an intervention to assess their impact on the three dependent variables.

To begin with, the Problem-Solving Performance describes a student's ability and capability to analyses and solve problems correctly. Following that, Motivation and Engagement pertain to students' interest, persistence, and active participation in physics problem-solving. Lastly, for Conceptual and Procedural Understanding, it assesses the level of student understanding of physics concepts and their ability to apply procedures systematically and accurately.

Overall, this conceptual framework assumes a direct relationship between independent and dependent variables, with no intervening such as mediating and moderating variables included. It provides a structured approach to understanding how self-explanation and collaborative strategies contribute to students' problem-

solving performance, motivation and engagement, and conceptual and procedural understanding in physics. It guides the design, data collection, and analysis of the study by focusing on how instructional strategies affect student learning outcomes in physics. By analyzing these relationships, this study aims to enhance physics education and address the challenges faced by STEM students in both local and global contexts (Palinkas et al., 2015).

Definition of terms

- Instructional approaches refer to the methods and strategies used by educators, which vary based on subject matter, learner needs, and educational goals.
- Collaborative learning is a learning approach where students work together in groups to solve problems, complete tasks, and understand concepts.
- Individual learning - Self-directed approach to learning where learners engage with material, task, and problems independently.
- Learning strategies - Techniques or methods that students use to acquire, process, and retain information more effectively.
- Self-explanation strategy - a learning strategy where students explain to themselves the concept
- Metacognition - It involves "thinking about thinking" and learning about learning".
- Physics Problem - A question about problems in physics that need concept application of its principles, equation, and logical thought process to solve

problems.

- Problem Solving - It is the process of identifying problems, analyzing the factors problems, analyzing the factors problems, and finding solutions to issues.
- Physics Education - This refers to the teaching of physics, focusing refers to the teaching of physics, focusing readers on how to study and practice it effectively.
- Effectiveness of learning -. Measurement of how students acquire, retain, and apply knowledge efficiently

CHAPTER 2

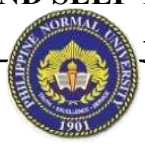
METHODOLOGY

This chapter presents the research design, research site, selection criteria and participants, role of the researcher, research instrumentations and methods of validation, interventions, data collection, data analysis, potential ethical issues, and risk analysis as used in the study.

Research design

This study employs a qualitative research design to explore and compare the perceived effectiveness of collaborative and self-explanation strategies in enhancing problem-solving skills among Senior High STEM students (Creswell & Poth, 2018). A comparative case study will then be employed to explore patterns, themes, and variations between the two strategies, ensuring a comprehensive and detailed evaluation (Yin, 2014). To provide a thorough understanding of the effectiveness of the two strategies, this study uses a three-phase qualitative approach: a systematic literature review, interviews, and document analysis (Palinkas et al., 2015).

A systematic review of relevant literature will establish a conceptual framework, analyzing previous qualitative studies on these strategies. To gather in-depth understanding, interviews will be conducted with 8 students and 2 teachers, providing them the opportunity to share their experiences and perspectives (Etikan, Musa, & Alkassim, 2016). Furthermore, a document analysis of student work samples,



approximately 1 to 2 problem-solving outputs of each student, will contribute qualitative information regarding the effectiveness of each strategy. The qualitative

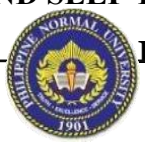
approach enables a deeper analysis of senior high STEM students' learning experiences, real-world challenges, and the effectiveness of strategy in improving problem-solving skills for physics problems.

Research site

The research will be conducted at Araullo High School, located at the United Nations Avenue corner of Taft Avenue in Manila, National Capital Region, Philippines. This site was chosen because it is more accessible to the researcher and is located near the researcher's university, making it a more practical and cost-efficient site. Additionally, Araullo High School offers a Senior High School STEM strand ensuring the availability and qualified participants who are actively engaged in science education, to be specific in solving physics and have experienced with the both targeted learning strategies which are collaborative and self-explanation.

Selection criteria and participants

The participants in this study will consist of approximately 8 Senior High STEM students and 2 science teachers from Araullo High School located at United Nations Avenue corner Taft Avenue in Manila, National Capital Region, Philippines. This is a convenient sampling because the location is accessible and near for the



researcher; it is within walking distance from the university they are in, which will lessen their expenses in terms of transportation, food, and other urgent expenses (Etikan et al., 2016).

Inside the school, the researcher will use purposive sampling, as this study employs a comparative analysis of two strategies: collaborative and self-explanation. Teachers will be given a survey form to collect information, such as the subject assigned, grade level, and years of teaching experience. Eight students will be interviewed and chosen, including four students from Grade 11 and four students from Grade 12 with Science grades ranging from 88–89. The researcher will interview these participants to gather their perceptions of the more effective learning strategy, whether collaborative or self-explanation.

Participants will be selected through purposive sampling, ensuring that those actively involved in STEM education and holding perceptions about the strategy being studied are included as participants (Creswell & Poth, 2018).

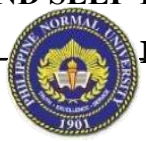


Table 1

Demographic Profile of the Student Profile (n=8)

Profile Category	Sub-Category	Frequency & Percentage
Grade Level	Grade 11	4 (50%)
	Grade 12	4 (50%)
Gender	Male	3 (37.5%)
	Female	6 (75%)
Age	16	4 (50%)
	17	4 (50%)
Learning Preference	Alone	2 (25%)
	With a group	1 (12.2%)
	Both	5 (62.5%)
Access to Study Device	Yes	8 (100%)
	No	0
Daily Study Hour	<1hour	2 (25%)
	1-2hours	4 (50%)
	3-4hours	2 (25%)
	>4 hours	0

Self-Rated Physics Confidence	Very Confident	0
	Confident	4 (50%)
	Neutral	4 (50)
	Not Confident	0

Table 1 presents the demographic profile of the eight Senior High STEM students from Araulo High School who participated in the study. The participants were equally distributed across Grade 11 and Grade 12, with four students in each grade level. Regarding gender, three participants were male and five were female. The age distribution was also balanced, with four students aged 16 and four aged 17. In terms of learning preferences, the majority of participants (five) indicated a preference for a combination of individual and group study, while two preferred studying alone and one preferred studying in a group. All participants reported having access to study devices. Daily study hours varied, with four students dedicating 1–2 hours per day, and the remaining students studying either less than one hour or 3–4 hours daily. Finally, participants' self-rated confidence in physics was either "Confident" or "Neutral," with no participant reporting "Very Confident" or "Not Confident."

Table 2

Demographic Profile of the Teacher Profile (n=2)

Profile Category	**Sub-Category**	**Frequency & Percentage**
Gender	Male	1 (50%)
	Female	1 (50%)
Age	Below 30	1 (50%)
	31-40	0
	41-50	1 (50%)
	Above 50	0
Teaching Experience in Physics	1-3 years	0
	4-6 years	0
	7-10 years	1 (50%)
	>10 years	1 (50%)
Use of Collaboration & Self-Explanation Strategies	Yes	2 (100%)
	No	0
Classroom Practices:		
Collaborative	Always	0
	Often	0
	Sometimes	2 (100%)
	Rarely	0
Self-Explanation	Always	2 (100%)
	Often	0
	Sometimes	0
	Rarely	0

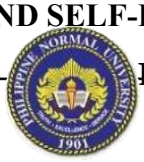


Table 2 presents the demographic profile of the two physics teachers from Araulo High School who participated in the study. Both teachers were equally distributed in terms of gender, with one male and one female. Their ages varied, with one teacher below 30 years old and the other between 41 and 50 years old. Teaching experience in physics ranged from 7–10 years for one teacher and more than 10 years for the other. Both teachers reported using collaborative and self-explanation strategies in their classrooms. Regarding classroom practices, both teachers indicated that they sometimes employ collaborative strategies, while self-explanation strategies were consistently used.

The study employs theoretical sampling, wherein participants are selected based on their relevance to the research objectives. Eight STEM students are chosen to ensure the quality of the data, as this is a case study (Yin, 2014). Two science teachers, specifically those teaching Physics, are selected because the study focuses on physics problem-solving strategies at the senior high school level.

Additionally, one to three problem-solving outputs from each student will be collected for analysis, as output-based evidence helps support the comparison of the two strategies in academic settings of physics.

The collected outputs will be analyzed using dimensions and constructs derived from previous studies. For collaborative outputs, the constructs may include shared reasoning, peer scaffolding, negotiation of meaning, and collective problem-solving (Vygotsky, 1978). For self-explanation outputs, constructs such as metacognitive

reflection, clarity of reasoning, and personal articulation of concepts will be considered. The analysis will be guided by a rubric measuring conceptual understanding, reasoning quality, and problem-solving accuracy.

Ethical guidelines, including informed consent, voluntary participation, confidentiality, and the secure handling of data, will be observed throughout the study to protect participants' rights and privacy. Informed consent forms will be secured before participation, ensuring all participants are fully aware of the study's purpose and procedures. No students will be involved in the data collection process without proper approval protocols being followed, ensuring compliance with institutional and ethical standards (BERA, 2018).

Role of researcher

In this study, the researcher's role includes designing interview questions and surveys, distributing forms to teachers, coordinating schedules for interviews over the 6 weeks of period, and collecting student's physics problems - solving outputs for group work and individual work. To maintain objectivity and avoid bias, researchers will ensure that the process is conducted ethically and consistently.

Moreover, for data analysis the researcher will analyze qualitative data, identify three emerging themes and ensure that the interpretation of the findings and results is all based on the participants' perspective, information, and experiences. The researcher will also communicate with the Araullo High School administration and obtain the necessary permission for data collection before the study is with the Araullo

High School administration and obtain the necessary permission for data collection before the study is conducted.

Research instrumentation and methods of validation

These instruments will be utilized to ensure comprehensive data collection and analysis for comparing the collaborative strategy and self-explanation strategy employed by senior high STEM students in solving physics problems. The study seeks to provide a comprehensive evaluation of the perceived impact on students' performance and cognitive development. The findings will serve as contributions to the refinement of teaching.

The instrument used in this study consists of three parts: document analysis, interview, and document analysis. The researcher will conduct first a short survey form for teachers in Araullo High School that teach under STEM strand, the brief survey form consist of 3 open questions just to know if the teachers has a background of implementing collaborative and self-explanation in teaching physics, their subject and grade level, and what are they perspective in these strategies, where in these survey is validated by experts.

The systematic review comprises 10 peer-reviewed studies on collaborative and self-explanation strategies in problem-solving among STEM students. This instrument/tool is designed to be completed within one week, allowing for the systematic analysis of the effects of the two learning strategies—collaborative strategy and self-explanation strategy. The process in this instrument involves reviewing

scholarly articles, research reports, and academic papers to provide relevant information on the implementation and impact of both strategies. This instrument served as the foundation for contextualizing the research and strengthening its theoretical underpinnings.

Interview protocols will be used in this study as an instrument for gathering qualitative data. A structured set of approximately 16 questions has been designed to delve deeply into the perspectives of senior high school STEM students and teachers regarding their use of collaborative and self-explanation strategies when solving physics problems. The content of the questions aims to uncover the following:

- The perceived effectiveness of collaborative and self-explanation in solving physics problems
- Challenges students encounter while using these approaches
- The effectiveness of these two learning strategies in terms of performance, engagement, and conceptual and procedural understanding of the STEM students in physics
- Teachers' integration of the collaborative strategy and self-explanation strategy to the learning and understanding of physics among STEM students

To ensure the reliability and validity of this instrument, it will undergo several evaluations by three subject matter experts specializing in physics and pedagogy. These experts will assess the relevance, clarity, and alignment of the questions with the research objectives.

The documents gathered from the students will undergo document analysis. The researcher will collect approximately 2 to 3 worked samples (problem solving output) from the STEM students. The objective of this analysis is to identify the pattern, strategies, and variations in problem-solving approaches.

Data collection

This study aimed to compare the perceived effectiveness of collaborative learning and self-explanation strategies in solving physics problems among students in the STEM field. The data collected in this study are used to compare the effectiveness of the two learning strategies, which will enhance students' ability to solve physics problems. To gather data, three primary methods were employed: systematic review, interview, and document analysis.

A systematic review will be employed in this study to examine and synthesise the existing literature on collaborative and self-explanation strategies for solving physics problems. The researcher will thoroughly review at least 10 peer-reviewed studies to identify the effectiveness of employing these two learning strategies in developing performance in solving physics problems, increasing engagement, and enhancing the conceptual and procedural knowledge of students. Moreover, the collection of articles is conducted through academic databases such as Google Scholar, JSTOR, and ScienceDirect, among others. The literature must be also published from 2014 to 2025 to ensure the inclusion of recent and relevant literature. The selected study is reviewed for

its methodology, findings, and relevance to the research objectives. Additionally, the document analysis will provide a theoretical foundation for the study, highlighting previous studies and identifying the gaps that are crucial for conducting this study.

An Interview will be conducted with 8 STEM students and 2 teachers to gather qualitative data on their perspective in using the collaborative learning and self-explanation strategies in solving physics problems. The 8 STEM Students and 2 teachers will answer the structured interview questions focusing on the perceived benefits, challenges, and effects of the two learning strategies. The researchers will ensure a conducive environment for the participants by encouraging open and honest responses during the interview. Moreover, for accurate data transcription, the interview will be recorded using a voice recorder with the participant's consent.

The researcher will collect approximately one to two student work examples (problem-solving output and corresponding assessment) from the STEM students. The collected documents must be reviewed and recorded by the teachers. Moreover, these will be systematically analyzed based on the development criteria validated by experts to ensure objectivity and alignment with the research objectives. Additionally, the data collected will help identify trends, patterns, and variations in the students' problem-solving approaches. The data collected through systematic review, interviews and document analysis will be compared, highlighting the effect in students' performance, engagement, and conceptual and procedural understanding of STEM students in solving physics problems.

Data analysis

This study will employ a multi-layered approach to analyses data collected on the perceived effectiveness of collaborative and self-explanation strategies used by senior high STEM students in solving physics problems. There are various methods for analyzing data collected through systematic reviews, interviews, and document analysis.

A thematic analysis will be utilized in this study to synthesize a systematic review of at least 10 literatures on collaborative and self-explanation strategies, with a focus on identifying patterns, gaps and insights specific to their application in physics problem-solving. Moreover, this will be used to evaluate recurring themes, frameworks, and outcomes reported in these studies.

The transcription, coding, and thematization will be used to analyses interviews conducted with STEM students and teachers. Each transcript will then undergo a rigorous coding process to identify key concepts and recurring ideas. Additionally, these codes will be grouped into themes that provide insights into student's cognitive processes and performance influencing their use of collaborative learning and self-explanation strategies in solving physics problems.

Additionally, the collected work samples from STEM students will be analyzed through the process of qualitative content analysis. This method will be used to evaluate the effectiveness of collaborative learning and self-explanation strategies by examining students' problem-solving methods in solving physics problems.

Moreover, the qualitative content analysis will help identify patterns and recurring themes across the worked samples.

Potential ethical issues

This study priorities the well-being and rights of the participants, this will ensure the ethical considerations of the participants. Permissions will be obtained from the school administrator before initiating the study. The informed consent will be secured from students, parents and teachers to maintain the formality in conducting the study. Confidentiality is maintained by anonymizing all collected data from the participants, It will ensure the privacy of the participants. Participation in the study will be voluntary; participants can withdraw at any time without negative consequences.

Risk Analysis

The potential risk associated with the study is discomfort during interviews. Students might feel uncomfortable discussing their experiences, particularly if they struggle with physics. The work samples may raise concerns about the privacy of the students' participants. Moreover, students may feel obligated to participate and the interpretation of the student work might be misinterpreted. To address these concerns while conducting the data collection, researchers should prioritize the safety of the participants and accuracy of the collected date.

CHAPTER 3

FINDINGS AND DISCUSSIONS

This chapter presents the data obtained from the interview conducted among the eight students and two teachers.

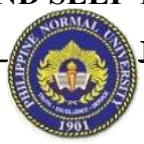
A.Effectiveness of Collaborative Learning and Self-Explanation in Solving Physics Problem based on Literature

Table 3

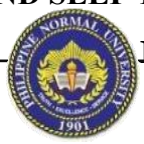
Effectiveness of Collaborative Learning and Self-Explanation in Solving Physics Problem based on Literature

Theme	List of Literature	Description of Themes
Theme 1: Collaborative Learning in Solving Physics Problems	Setiawan, A., Degeng, İ., Sa'dıjah, C., Praherdhiono, H. (2020). The Effect Of Collaborative Problem Solving Strategies And Cognitive Style On Students' Problem Solving Abilities. Journal for the Education of Gifted Young Scientists, 8(4), 1618-1630. https://doi.org/10.17478/jegys.812781	According to Setiawan et al. (2020), collaborative problem-solving strategies, when aligned with students' cognitive styles, significantly improve their ability to solve physics problems. Students working in groups are able to share perspectives, clarify misunderstandings, and co-construct solutions, which strengthens both conceptual understanding and procedural skills.
	Good, M., Maries, A., & Singh, C. (2019). Impact of traditional or evidence-based active-engagement instruction on introductory female and male students' attitudes and approaches to physics problem solving. Physical Review Physics Education Research, 15(2), 020129. https://doi.org/10.1103/PhysRevPhysEducRes.15.020129	Good, Maries, and Singh (2019) highlighted that active-engagement instruction, which includes collaborative elements, positively influences students' attitudes and approaches to physics problem solving. Students participating in collaborative learning develop not only procedural competence but also confidence in tackling complex problems.
	Costley, J. How role-taking in a group-work setting affects the relationship between the amount of collaboration and germane cognitive load. Int J Educ Technol High Educ 18, 24 (2021). https://doi.org/10.1186/s41239-021-00259-w	Costley (2021) emphasized the role of group dynamics in collaborative settings, showing that role-taking and structured collaboration can optimize cognitive load and improve learning outcomes.

Theme 2: Self-Explanation as a Learning Strategy	Gjerde, V., Paulsen, V., Holst, B., & Kolsto, S, D. (2022). Problem solving in basic physics: Effective self-explanations based on four elements with support from retrieval practice. Physical Review Physics Education Research. https://doi.org/10.1103/PhysRevPhysEducRes.18.010136	Self-explanation is a metacognitive learning strategy where students generate learning from their own explanation to make sense or understand information about a certain topic (Gjerde et al., 2022).
	Conati, C. (2015). Commentary on: "Toward Computer-Based Support of MetaCognitive Skills: a Computational Framework to Coach Self Explanation."International Journal of Artificial Intelligence in Education, 26(1),183–192.https://doi.org/10.1007/s40593-015-0074-8	Self-explanation learning strategy is connected to the Metacognition theory because in this learning strategy, learners possess the ability to monitor, evaluate, and regulate one's cognitive processes while solving (Conati, 2016)



	McNamara, D. S. (2017). Self-Explanation and Reading Strategy Training (SERT) improves Low-Knowledge students' science course performance. Discourse Processes, 54(7), 479–492. https://doi.org/10.1080/0163853x.2015.1101328	Self-explanation learning strategy is the process of reading text aloud and explaining its meaning to oneself. It helps deepen comprehension by encouraging learners to actively use their prior knowledge to understand and integrate information from the text. (McNamara, 2017)
Theme 3: Comparative Effectiveness of Problem-Solving Strategies	Sankaranarayanan, Rajagopal & Kwon, Kyungbin & Cho, Yonjoo. (2021). Exploring the differences between individuals and groups during the problem-solving process: The collective working-memory effect and the role of collaborative interactions. Journal of Interactive Learning Research. 32. 43-66. https://www.researchgate.net/publication/352280257_Exploring_the_differences_between_individuals_and_groups_during_the_problem-solving_process_The_collective_working-memory_effect_and_the_role_of_collaborative_interactions	Self-explanation learning strategy is a process where the learners generate explanations to themselves as they learn and solve physics problems. On the other hand, collaborative learning strategies reinforce active engagement among group members to work together to achieve a common goal, (Sankaranarayanan, 2021),



Kanevsky, L., Lo, C. O., & Marghelis, V. (2021). Individual or collaborative projects? Considerations influencing the preferences of students with high reasoning ability and others their age. High Ability Studies, 33(1), 87–119. https://doi.org/10.1080/13598139.2021.1903842	Self-explanation learning strategy is where students clarify their own reasoning by connecting to their prior knowledge. While collaborative learning strategy, strengthen dialogue and teamwork. (Kanevsky, 2021)
Brand, C., Hartman, C., Loibl, K., & Rummel, N. (2023). Do Students Learn More from Failing Alone or In Groups? Insights Into the Effects of Collaborative Versus Individual Problem Solving in Productive Failure. Instructional Science. https://doi.org/10.1007/s11251-023-09619-7	Brand et al. (2023) found that students working collaboratively through productive failure achieved deeper conceptual understanding and stronger problem-solving skills compared to students working alone, as group interactions allow for idea sharing, feedback, and misconception correction.

Laguindab, M. S., Abdulrachman, N. M., & Basher, S. M. (2025). Exploring the Root Causes of Physics Aversion among Grade 12 STEM Students: A Qualitative Case Study at RPMD National Science High School. International Journal of Research and Innovation in Social Science, VIII(IIIS), 6218–6232. https://doi.org/10.47772/ijriss.2024.803465s	Laguindab et al. (2025) noted that students' engagement and confidence in physics are influenced by their problem-solving approach, with collaborative methods supporting conceptual mastery and overcoming difficulties more effectively than individual work.

Table 3 presents that both collaborative learning and self-explanation strategies play significant roles in improving students' physics problem-solving skills. Collaborative learning facilitates peer interaction, discussion, and collective reasoning, which strengthens students' conceptual understanding and confidence in tackling complex problems. Meanwhile, self-explanation encourages students to actively reflect on their reasoning, integrate prior knowledge, and monitor their cognitive processes, promoting deeper comprehension and independent problem-solving skills. Comparative studies suggest that combining these strategies can maximize learning outcomes. Collaborative methods support engagement, motivation, and shared problem-solving, while self-explanation develops metacognitive skills and individual reasoning. Furthermore, the literature indicates that group dynamics, structured roles, and the

alignment of strategies with students' cognitive styles can influence the effectiveness of collaborative learning. Overall, integrating both strategies provides a balanced approach that addresses cognitive, procedural, and affective aspects of learning physics.

B. Perceived effectiveness of collaborative learning and self-explanation strategies in problem solving

Table 4

Perceived Effectiveness of Collaborative Learning and Self-Explanation Strategies in Problem Solving

Constructs	Frequency for Students [Percentage]	Frequency for Teachers [Percentage]	Total Frequency [Percentage]
Collaborative Engagement and Peer Support	22 (22.92%)	8 (26.67%)	30 (23.81%)
Perceptions of Self-Explanation Learning	32 (33.33%)	2 (6.67%)	34 (26.98%)
Comparative and Influencing Factors	20 (20.83%)	8 (26.64%)	28 (22.22%)
Strategies in Solving Physics Problem	22 (22.92%)	12 (40.00%)	34 (26.98)
Total	**96 (100.00%)**	**30 (100.00%)**	**126 (100.00%)**

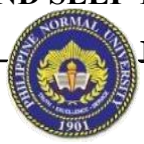
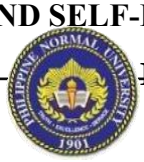


Table 4 shows the frequency of mentioned themes in the responses from the students' participants and teachers participants interviewed. It visually summarizes how often each theme appeared in all participants, which allows for easy comparisons between the four themes. Based on the data table, Theme 2, which pertains to the Perceptions of Self-Explanation Learning has the highest number of frequencies with a percentage of 33.33%. The students mostly mentioned their perception about self-explanation strategy, indicating how prominent this strategy is during the interview with the students participants. While, theme 3 has the lowest frequency with a percentage of 20.83%, indicating how students discussed superficially the comparison of the two strategies and the factors influencing them. Whereas, Collaborative Engagement and Peer Support (Theme 1) and Strategies in Solving Physics Problem (Theme 4) have the same number of frequencies with a percentage of 22.92%.

In addition, theme 4 has the highest frequency for teacher participants with a percentage of 40.00%, mentioned 12 times in the interview. Which indicates how teachers frequently mentioned how they implement the strategies on students. On the other hand, the Perceptions of Self-Explanation Learning was addressed briefly by the teacher participants with a percentage of 6.67%. Indication of how much they perceive Self-explanation strategy to the learners of the students. Additionally, both Collaborative Engagement and Peer Support (Theme 1) and Comparative and Influencing Factors (Theme 3) have the same number of frequencies with a percentage of 26.67%. Overall, the data table show how each theme makes a relevance during an interview with the 8 students and 2 teacher participants.



Theme 1

Perceptions of Collaborative Learning

Collaborative learning strategy is where learners actively work together to achieve learning goals. Perception of collaborative learning strategy depends on the experiences of learners. Some of them find it beneficial since the learners will have an opportunity to engage with diverse perspectives, clarify their own thinking and improve their conceptual and procedural understanding of physics. However, can also be mixed or negative when group dynamics are imbalanced or when some members of the group contribute less than others. Students may feel frustrated if the responsibilities are unfair and unclear.

Additionally, this theme captures how students rely on peer interaction, mutual assistance and shared learning, which helps them to understand the concepts, manage tasks, and stay motivated even in the complex topic. Moreover, under this theme different categories used to describe the perception of the students and teachers about peer teaching, informal help-seeking, mutual checking, and shared problem solving as vital strategies that enhance the comprehension and confidence of the learners.

Participants shared their perception about the collaborative learning strategy. Each student and teacher have different opinions and preferences about collaborative learning in solving physics problems. Several students mentioned that collaborative learning is essential because peer assistance helps them clarify misconceptions and also encourages them to work and do their best in their assigned tasks. Students A shared "Kapag nagsosolve po kami ng Physics problem ng mga classmate ko, nagiging mas

madali ang pag-answer namin sa problem. (When I solve Physics problems with my classmates, it becomes easier for us to answer the problem.) ".

Student A also added "Pag may nagkakamali po, tinatanong po sa kagrupo para mas malaman po (If someone makes a mistake, they ask their groupmates to learn more.)". Which show how important peers in assessing and giving feedback. While Student D shared how important collaboration is "Natutunan ko po na dapat may kausap ako. Kailangan po ng support. 'Yun po ang realization ko. (I learned that I should talk to someone. I need support. That's my realization.)"

Aside from these, participants understand that collaborative learning strategy is more effective if students are actively engaged. Teacher A shared.

"May gumagawa ng experiment, may tumitingin sa activity sheet, sa laboratory activity sheet, which is maganda kasi nagkakaroon ng interaction between the groupmates. May tumitingin sa procedure kung tama, meron ding humahawak ng lab o nag-e-experiment talaga para makita kung tama at accurate o precise — accuracy and precision." - (TA)

("Someone is doing an experiment, someone is looking at the activity sheet, the laboratory activity sheet, which is great because there is interaction between the groupmates. Someone is looking at the procedure to see if it is correct, someone is also running the lab or actually experimenting to see if it is correct and accurate or precise — accuracy and precision." - TA)

In addition, identifying the benefits of collaborative learning strategy is essential to justify the use of group based strategies. Student A shared "Mas nagiging

maganda po 'yung koneksyon namin. Pag may groupings po, mas dumadami po ang kaalaman ko dahil marami po akong nakukuhang knowledge sa kanila tungkol sa Physics. (Our connection is getting better. When there are groupings, my knowledge increases because I get a lot of knowledge from them about Physics.)". Other student shared also, "And nakakatulong po ang collaboration. Kumbaga kasi, may mga classmates rin po akong nagbibigay sa'kin ng idea on how to solve that Physics problem po. (And collaboration helps. I mean, I also have classmates who give me ideas on how to solve that Physics problem.)" - SH

Some students prefer collaborative learning strategies because it fosters their conceptual understanding of Physics. Student D shared "Sa paggawa po namin, nagtutulungan po kami. May mga nagsasabi kung ano ang gagawin, ganito ganyan. Most of the time po, may mga nag-e-express ng ideas. Minsan po, may mga nag-i-implement ng plano. (In our work, we work together. Some say what to do, this way, that way. Most of the time, some express ideas. Sometimes, some implement plans.)"

Moreover, the benefits of collaboration not only affect the conceptual understanding of the students but also how they interact with other people. Students C shared "Nakakatulong kapag cooperative 'yung member, nagbibigay ng inputs. (It helps when members are cooperative... providing inputs)" While, student A, emphasizing groupmates without cooperation can affect the performance of the group. Student A shared "Yung mga pabigat na kagrupo po, mahirap po 'yun. Pero kapag lahat po kami nagko-collaborate, marami po kaming natutulungan sa isa't isa. Marami po kaming nabibigay na idea. (The burdens of being in a group are difficult. But when we all

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collaborate, we help each other a lot. We give each other a lot of ideas.)"

Overall, the responses of each participant highlight how crucial is collaborative learning strategy in enhancing the conceptual understanding, emotional support and engagement of the learners.

Theme 2

Perceptions of Self-Explanation Learning

In this study, self-explanation learning is employed as a strategy where students articulate concepts, processes, and solutions in their own words while solving physics problems. This approach enables learners to deepen their conceptual understanding by clarifying reasoning, identifying errors, and reinforcing mental connections. It encourages independent learning, reflective analysis, and metacognitive awareness, helping students build stronger internal frameworks that support long-term retention. Through self-explanation, learners become more active in constructing meaning, allowing them to regulate their learning pace and refine cognitive processing during problem-solving.

This theme describes how students value personal reasoning, self-questioning, and independent clarification in understanding physics concepts, especially when dealing with complex problem-solving steps. Under this theme, categories highlight students' emphasis on self-monitoring, error detection, reflective thinking, and deeper conceptual reasoning as core elements of effective learning. It also presents how students recognize self-explanation as a meaningful tool for strengthening

comprehension, correcting misconceptions, and increasing confidence in physics problem solving.

The participants generally perceived self-explanation as a helpful learning strategy for independent understanding, error detection, and concept mastery in solving physics problems. Several students expressed that self-explanation strengthened clarity because it enabled them to assess whether they truly grasped concepts. One participant emphasized, "I think mas effective po sa akin kapag ine-explain ko 'yung process. Doon ko po na-check kung naiintindihan ko talaga 'yung topic" (It is more effective when I explain the process because I can check if I truly understand it) - SC.

The effectiveness of explaining concepts aloud was also mentioned by another student who stated, "Kapag ganun po ako magpaliwanag, mas naiintindihan ko siya, kaya nakakapag self-study po ako" (When I explain it, I understand it more, allowing me to self-study) - SB.

Similarly, the internal learning benefit was highlighted by, "Self-explanation po… pag self po mas nahahasa po natin ang sarili natin kasi nakakapag-focus po tayo kapag mag-isa lang" (Self-explanation improves us because we can focus better when alone)-SC. Some students also adopted structured steps such as writing and recalling concepts independently, as described by "Sinolve ko po sa paper… then nirecite ko siya after" (I solved using paper then recited it after) -SE.

Many participants preferred self-explanation because it aligned with independent learning, concentration, and discipline-building. Some students found individual learning more effective for comprehension, expressing, "Mas gusto ko po

individual" (I prefer individual work) - SG and "More on individual sa Physics" (I learn more individually in Physics) - SG. Another described focused learning at home, stating, "Mas gusto ko po sa bahay kasi naa-assess ko po ang sarili ko" (I prefer studying at home because I can assess myself) - SE.

For others, independence fostered confidence and critical thinking, as highlighted: "Mas mabilis po akong makagets kapag mag-isa lang po ako at nagfofocus" (I understand faster when studying alone and focused) - SA. This belief was echoed repeatedly, with one asserting, "Self-learning or self-discipline ang pinaka-importante" (Self-learning and self-discipline are most important) -SG.

From a teacher's perspective, self-explanation was viewed as empowering students, saying, "Mas natututo sila sa sarili nilang paraan… mas nagko-concentrate sila" (They learn through their own ways and concentrate more) - TA.

Despite its benefits, participants also acknowledged limitations such as absence of immediate feedback, delayed realization of errors, and knowledge uncertainty. One student shared, "Minsan hindi ko napapansin kapag nagkakamali… pag tapos na po, saka ko nakikita" (Sometimes I don't notice mistakes until I finish) - SA, while another admitted, "Confident ako pero walang kasiguruhan kung tama… wala akong mapagtanungan" (I am confident but unsure if it is correct because I have no one to ask) - SD.

For this reason, some selectively seek help only when necessary, as expressed: "Depende sa topic kung magre-rely ako sa sinasabi nila" (It depends on the topic if I will rely on them)-SF. Nonetheless, students still valued teacher guidance as a reliable

resource, acknowledging, "Pwede po mag-ask sa teacher" (I can ask the teacher) - SF.

Perceive self-explanation as an effective metacognitive and independent learning strategy, particularly in physics problem-solving, as it enhances focus, self-assessment, awareness of misconceptions, and long-term learning discipline, but is most effective when paired with occasional expert or peer validation.

Theme 3

Comparative and Influencing Factors

Comparing different learning styles reveals how various factors shape students' experience and outcomes. Collaborative learning and self-explanation strategies are both powerful tools for deepening understanding of physics. However, they operate through different mechanism and different outcomes depending on their effectiveness in the students' learning. Self-explanation strategy involves individual clarifying concepts to themselves. They explain their solution to themselves, how ideas connect and steps that they did during problem solving. On the other hand, collaborative learning strategies relies on interaction among peers to construct knowledge. Through the discussions among peers, learners are exposed to multiple viewpoints that can challenge their assumptions and understanding about physics.

Furthermore, this theme explains how the students' learning behaviors, choices and experience are shaped by a combination of internal and external influences. In addition, the theme helps the researcher to reveal that the students' preferences for self-explanation and collaborative learning is not fixed but rather context dependent. This

shows what are the benefits and challenges students might encounter in the implementation of the strategies, with the emphasis of fairness, integrity and responsibility influencing their choices.

The collaborative learning and self-explanation strategy has a different style of learning. Participants have different opinions and perspectives about the two learning strategies. Some students show how responsible they are as they desire to genuinely learn and not depend on others. Teacher A shared "Actually, sa collaborative meron talaga akong napapansin na problema. May mga students kasi na hindi talaga nagpaparticipate sa klase, lalo sa groupings. (Actually, I've noticed a problem with collaborative learning. There are students who don't really participate in class, especially in groupings.)".

This is the reason why some students don't prefer collaborative learning strategy because some are only relying on other members to have a grade, Student G shared SG "Meron po siyang malaking contribution, kase po… ahh… kapag po kase ako ang leader, kunwari po nag… ako lang po ang may malaking contribution doon sa grade na nakukuha ko. Pero kapag po groupings halimbawa po, mababa po kaming lahat, hatak po iyon sa grade po, ganun po." - (SG)

("He has a big contribution, because… ahh… when I'm the leader, it's like… I'm the only one who has a big contribution to the grade I get. But when it comes to groupings, for example, we're all low, that drags on the grade, that's how it is." - SG)

Several students have different preferences of which methods are more effective to them. Student D shared "Kapag sobrang hirap, kailangan ko po ng kasama. Kapag

kaya naman, individual na lang. (When it's really hard, I need someone to help me. When I can, I just do it individually.)".

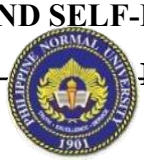
This is the indication that some students' preferences of learning strategy is due to the complexity of the topic. But Teacher B shared also, "Mas may problema sa individual. Minsan nawawala 'yung motivation. Sa group, may leader, may nagdi-direct. Isinasama nila 'yung iba sa pag-aaral. Pag individual, hindi lahat nakakasabay." - (TB)

("There is more of a problem with individuals. Sometimes motivation disappears. In a group, there is a leader, someone directs. They include others in their studies. When it comes to individuals, not everyone can keep up." - TB)

The implementation of learning strategy depends on what is more effective in a specific situation because of the internal and external factors that influence it. Teacher B shared "Kapag nahirapan sila sa topic, mag-a-adjust ka. Magre-revisit ka sa susunod na araw. Hindi naman lahat agad master sa computation. (If they have difficulty with the topic, you will adjust. You will revisit the next day. Not everyone is a master in computation right away.)".

While some prefer the self-explanation strategy because of the complexity of the topic. Teacher B shared

"Kahit alam mong effective ang collaborative, minsan kailangan mong mag-shift sa individual. May times na kahit na-plano mo na collaborative, may estudyanteng magsasabi, "Ma'am, mahirap po ito, partner na lang." So mag-a-adjust ka. Sabi ko, "Sige, partner na lang." Naka-base talaga sa topic at sa student feedback." - (TB)



("Even if you know collaboration is effective, sometimes you have to shift to an individual. There are times when even if you plan to be collaborative, a student will say, "Ma'am, this is difficult, can this activity be by partner." So you adjust. I said, "Okay, lets make it by partners." It's really based on the topic and the student feedback." - TB)

Moreover, some participants build confidence through the collaborative learning strategy, which affects their performance. Students B shared

"Mas collaborative po ako kasi minsan may hesitation ako sa sagot ko. Mas nakakagaan po ng anxiety kapag may naco-confirm akong tama." -(SB)

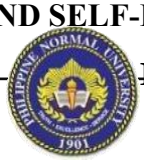
("I am more collaborative because sometimes I hesitate in my answers. It relieves my anxiety when I am confirmed to be correct." - SB)

Overall, the participants' choice depends on the internal and external factors, which influence the students' learning.

Theme 4

Strategies in Solving Physics Problem

Problem-solving strategies in physics are considered as structured steps and techniques that learners use to analyze, interpret, and solve physics-related problems. These strategies involve conceptual understanding, selection of appropriate methods, analytical reasoning, and decision-making skills to arrive at accurate solutions. Approaches such as self-explanation, collaborative problem solving, worked-example analysis, and task-focused planning are applied to improve learners' conceptual mastery



and cognitive engagement. Effective problem-solving strategies also help reduce physics-related anxiety, promote persistence, and enhance performance by providing structured opportunities for students to organize information, verify solutions, and reflect on their problem-solving processes.

This theme captures how students strategically use both individual and collaborative approaches to understand concepts, perform calculations, detect errors, and verify solutions. The categories under this theme describe how students apply step-by-step reasoning, consult peers when needed, analyze mistakes, and use tools such as writing, diagrams, and verbalization to enhance clarity and accuracy. These approaches collectively illustrate how students navigate physics problem solving through flexible, adaptive, and reflective methods suitable to the learning environment and task demands.

The participants shared diverse strategies they apply when solving physics problems, and their responses revealed that both collaborative learning and self-explanation are valuable depending on the task, confidence level, and learning environment.

Several students emphasized that collaborating with peers deepened their conceptual understanding because it exposed them to different thought processes and corrective feedback. One participant stated, "Nadadagdagan talaga 'yung insights at ideas kapag may kagrupo" (Insights and ideas really increase when working with a group) - SC.

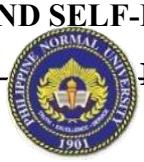
Another explained that learning from a more knowledgeable peer enhanced mastery, saying, "May kagrupo kami na mas marami pong alam… valuable 'yung input

niya… Imbes na surface level lang 'yung alam ko, mas napapalalim pa po 'yung understanding ko sa topic" (We have a groupmate who knows more and their input is valuable; instead of shallow knowledge, my understanding becomes deeper) - SC.

Through group work, students also verified their interpretations of a concept, as one expressed, "May kanya-kanya kaming understanding at nakikita namin kung pareho ba o iba-iba ang pag-intindi namin… mas maganda talaga ang collaborative" (We each have our own understanding and we compare them; collaboration is better) - SB. However, collaboration was not always comfortable for all participants, especially for those who felt pressured when others answered faster, as described:

"Gusto ko namang gets ko 'yung lesson pero kino-confirm ko pa kung naintindihan ko talaga… minsan napre-pressure ako lalo na sa physics" (I want to understand the lesson, but I still need to confirm if I understood; sometimes I feel pressured in physics) - SD.

For some, explaining concepts aloud helped them reinforce comprehension; as one student shared, "Pag nag-e-explain po ako, mas naiintindihan ko kasi para na rin po akong nagtuturo sa iba" (When I explain, I understand better as if I am teaching someone) -SA. Another reported using structured steps, especially in vector problems, saying, "Sa resultant vector po… naiintindihan ko dahil may step-by-step solution" (I understand resultant vector problems through step-by-step solutions) -SA. Self-explanation was also used creatively at home as one participant narrated, "Pag self-explanation po, parang tinuturuan ko po ang sarili ko… tumitingin ako sa mirror" (With self-explanation, it feels like I am teaching myself… I even look at myself in the mirror)

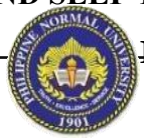


- SH.

Another participant used it to identify areas of weakness, saying, "Nalalaman ko po kung saan ako mahina at ano ang dapat i-improve" (I discover my weaknesses and what I must improve) - SE. Despite favoring collaboration for idea-building, many expressed that computation-heavy tasks are more effectively done individually: "Mas prefer nila ang collaborative… pero kapag computation na, kailangan talaga nila gawin nang mag-isa" (They prefer collaborative, but when it comes to computation, they really need to work individually) - TB. Reinforcing this, another student stated, "Sa physics… mas pipiliin ko pong mag-individual kapag nagsa-solve" (In physics, I prefer working individually when solving)- SD.

These further reveals that while both collaborative learning and self-explanation demonstrate complementary instructional value, student perceptions indicate that self-explanation is particularly essential for developing foundational problem-solving skills. In this sense, collaboration appears to function more effectively as a secondary, verification-driven phase, wherein students compare, refine, or validate their individually-formed understanding with others.

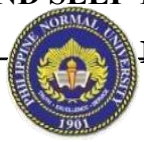
The perception of the students and teachers participants on the two learning strategies depends on their experiences and outcomes. How the specific learning strategy helps learners improve their understanding of physics concepts and their skills in problem solving. Several participants described collaboration learning as a way to share ideas, clarify confusing parts, and receive feedback from peers. While, self-explanation strategy is perceived as a strategy that deepens understanding and



strengthens independence in solving problems. Having a different perspective of the two learning strategies shows that both collaborative learning and self-explanation strategies have different effects on each learner.

These perceptions imply that both strategies offer distinct advantages that can benefit different learners depending on the complexity of the task and their preferred learning style. Since students and teachers recognize varied strengths in each approach, instructional planning may need to incorporate both collaborative and self-explanation strategies to support learners effectively. Integrating the two strategies may help address diverse needs, enhance engagement, and strengthen understanding in physics problem-solving.

While several students appreciated the collaborative learning, a large number of student participants stated that they preferred working individually, especially when solving physics problems. On the other hand, teachers viewed collaborative learning as highly effective for increasing student engagement during class. In summary, self-explanation is more effective for achieving the goal of enhancing conceptual and procedural understanding in problem-solving. Meanwhile, collaborative learning is valuable for improving engagement and motivation, and both strategies are beneficial in problem-solving, each serving different purposes depending on the learning context and specific learning goals.

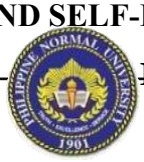


C. Problem-solving Skills

Table 6

Problem Solving Skills

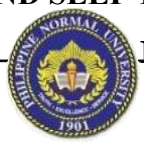
Student	Understanding the Problem	Identifying Knowns and Unknowns	Choosing a Strategy	Applying Concepts	Performing Calculations	Checking and Interpreting the Solution	Reflecting on the Process	Overall Remarks
Student A	/	/	/	/	/	/	/	Student A shows a good understanding of the topic. The calculations are also accurate, applying the physics concepts and with minor issues in angle interpretation



Student B	/	/	/	/	/	/	/	Student B shows strong skills in answering the physics problem. The participant clearly understands the topic, showing a complete and correct solution with minor room for improvement.
Student C	/	/	/	/	/			Student C shows a strong understanding of the topic, uses the correct strategy for solving and correctly apply the concept. Some of the error is due to not double checking the final answers.

Student D	/	/	/	/	/	/	/	Student D shows a clear understanding about the topic, which demonstrates a strong foundational problem solving skills. Through the correct computations and good conceptual reasoning, with minor improvement of the accuracy of the answer.

Student E	/	/	/	/	/			Student E shows a good conceptual understanding of the topic. The participants demonstrate a good calculation for problem solving, with minor improvement of the answer inaccuracy and clarity.
Student F	/	/	/	/	/	/		Student F shows a solid conceptual understanding of the topic, with the correct strategy in solving the problem. The participants mostly identify all the values with minimal improvement.



Student G	/	/	/	/	/	/	/	Student G shows a strong understanding about the topic. The participants correctly identified values, correctly applied the strategy and the physics concept. In addition, the calculations follow the correct formula with minor improvement in checking and organizing.

Student H	/	/	/	/	/	/	/	Student H shows a clear understanding of the topic, demonstrating strong foundational problem-solving skills. Almost perfect completion of the problem set and answers presented in an organized format.

Table 6 presents the problem-solving skills of Senior High STEM students in solving physics problems. The assessment focused on seven dimensions: understanding the problem, identifying knowns and unknowns, choosing a strategy, applying concepts, performing calculations, checking and interpreting the solution, and reflecting on the problem-solving process.

D. Senior High STEM students Perception

Table 7

Comparison of Grade 11 and Grade 12 Perceptions on Collaborative Learning and Self-Explanation Strategies

Themes	Grade 11 Perceptions	Grade 12 Perceptions
Theme 1: Collaborative Learning in Solving Physics Problems	Collaborative learning is mainly associated with peer interaction and support. Student C emphasized helping classmates understand and checking solutions; Student E highlighted task distribution; Student F mentioned selective reliance on peers; and Student H repeatedly referred to idea sharing and peer guidance.	Students A and Students G repeatedly highlighted peer interaction and support, emphasizing how exchanging ideas and receiving immediate assistance deepens understanding. While Students B mostly mentioned collaborative participation and Students D frequently mentioned collaborative preferences.
Theme 2: Self-Explanation as a Learning Strategy	Self-explanation is viewed as a strategy that clarifies understanding and exposes errors. Student C associated it with verifying details; Student E emphasized self-assessment methods like blurting; Student F noted that it reveals gaps when they struggle to continue explaining; and Student H linked effective learning to being able to explain concepts clearly.	For grade 12 students, self-explanation helps their understanding in solving physics problems. Students A highlighted conceptual understanding. While, Students B emphasized its role in critical and Analytical thinking. On the other hand, Students D consistently connected self-explanation with Self-Regulated learning and Student G often mentioned the effectiveness of self-explanation.

Theme 3: Comparative Effectiveness of Problem-Solving Strategies	The effectiveness of each strategy is context-dependent. Student C preferred collaboration for idea comparison and self-explanation for focus; Student E leaned toward collaboration for group tasks and self-explanation at home; Student F judged effectiveness based on the topic and peer ability; while Student H valued collaboration for idea building but relied on self-explanation to confirm personal understanding.	When comparing collaborative learning and self-explanation strategies, grade 12 students have different perceptions of which strategies are most effective. Students A often mentioned strategic reflective learning and Students B emphasize comparison between learning strategies. Additionally, Students D discussed instructional effectiveness and Students G frequently mentioned individual preference and motivation.

Table 7 shows the different perceptions of Grade 11 and Grade 12 STEM students in collaborative learning and self-explanation strategies. Grade 11 tends to anchor their insights on personal comfort, emotional readiness and comprehension checking. While Grade 12 often mentioned the effectiveness of the learning strategies in analytical, strategic and cognitively advanced reasoning.

Discussion

Effectiveness of Collaborative Learning and Self-Explanation in Solving Physics Problems based on Literature

Theme 1: Collaborative Learning in Solving Physics Problems

This theme reviews three studies that explored how collaborative learning supports the development of physics understanding and problem-solving skills. The reviewed works collectively investigated how students interact during group tasks, how collaboration influences cognitive processing, and how peer engagement contributes to deeper comprehension. The studies also examined learners' attitudes toward collaborative environments and how structured group strategies shape their performance in physics. Overall, the literature highlights the central role of collaboration in promoting active engagement, clarifying misconceptions, and strengthening both conceptual and procedural learning.

The reviewed studies consistently show that collaborative learning facilitates active cognitive engagement and enhances students' problem-solving abilities. Interaction among peers encourages explanation, clarification, and negotiation of ideas, enabling learners to process information more deeply and correct misunderstandings. These collective findings indicate that structured collaboration creates opportunities for meaningful dialogue that strengthens physics comprehension and promotes higher-order thinking (Setiawan et al., 2020).

Collaborative learning not only improves conceptual understanding but also develops essential skills such as communication and teamwork. Evidence suggests that learners benefit from explaining their thought processes to peers, which strengthens understanding of physics concepts. However, some learners prefer working individually, indicating that a balanced approach integrating both collaborative and independent problem-solving may maximize learning outcomes.

The findings suggest that teachers should incorporate structured collaborative problem-solving tasks in physics lessons. Assigning roles such as recorder, explainer, and checker, or using problem-based group discussions, can enhance engagement and learning outcomes (Johnson & Johnson, 2019; Laal & Ghodsi, 2012). Scaffolds such as guiding questions or prompts can ensure active participation and promote deeper understanding of concepts.

Theme 2: Self-Explanation as a Learning Strategy

Based on the three literature reviews, self-explanation learning strategy is a central mechanism for deep learning, whether in problem-solving, reading comprehension or Metacognitive development. According to Gjerde et al. (2022), through self-explanation students can enhance their problem-solving skills, allowing them for retrieval practice. Their findings focus on four essential elements of productive self-explanation, these are the identifying principles, linking concepts, articulating reasoning and evaluating solutions. The researchers emphasized the importance of Self-Explanation, that through this learning strategy students performed better in solving

physics problems.

Additionally, Conati (2015) highlights the development of intelligent tutoring systems through self-explanation strategy. The researcher explains that self-explanation learning enhances the ability of the learners to monitor their comprehension and understanding of physics. Meanwhile, McNamara (2017) provides empirical evidence that shows how self-explanation learning strategy and reading strategy training improves science course outcomes of low knowledge students. The findings reveal the importance of self-explanation in conceptual understanding of the students, especially for those learners struggling in understanding the concept and at same time applying the physics concept in solving physics problems.

These three literatures emphasize that self-explanation is a powerful strategy to help learners to understand the conceptual and procedural concepts of physics. The literature from Gjerde shows that structured self-explanation grounded in identifying principles and articulating reasoning significantly enhance the physics problem solving. Hence, McNama (2017) reinforced this idea through demonstration of self-explanation to help low knowledge learners understand the concept of physics and apply it in solving problems. Conati (2015) expands this understanding by highlighting the role of intelligent tutoring systems in scaffolding self-explanation. Their articles reveal a coherent picture of self-explanation, which provides the learners with structure that will guide and support them in solving physics problems.

Looking at the three literatures, it becomes clearer that self-explanation learning strategy is a critical process to enhance cognitive development, shape student

engagement, and articulate one's own understanding. Some students struggle with generating their own reasoning on their own. Through the findings of McNamara (2017), it reinforced the importance of teaching students how to explain to themselves, and not assuming that they naturally know how to implement self-explanation strategies in solving problems.

Additionally, as a teacher, this will be a reminder that cognitive development must be intentionally activated during lessons and teachers should know how to implement self-explanation strategy (Gjerde, 2022). If students find themselves struggling with self-explanation, teachers can guide them through giving support. With that, the literature encourages students to incorporate self-explanation strategies in solving problems that could strengthen not only their conceptual understanding but also their metacognitive skills.

The findings imply that teachers should incorporate structured self-explanation into lessons, especially in solving physics problems. Instead of just asking students to solve problems, teachers should embed questions such as "Why does this principle apply?" (Gjerde, 2022). Through incorporating this question, it gives a conceptual clarity in improving the accuracy of the problem-solving of the students. This suggests that curriculum materials and assessments should intentionally guide learners toward explanation based-reasoning.

Additionally, McNamara (2017) emphasizes that schools can incorporate self-explanation as a routine to academic skills such as problem-solving skills. This can help

low knowledge students to understand the complexity of physics. Conati (2015), implies that self-explanation can play a crucial role in supporting students' metacognitive growth, with that teachers should consider integrating the problem-solving with prompt reflection that could reinforce cognitive understanding of the students.

Theme 3: Comparative Effectiveness of Problem-Solving Strategies

This theme focused on four studies that compared individual and collaborative problem-solving approaches. The reviewed works examined how the two strategies differ in learning processes, outcomes, and student preferences. The studies explored how learners think and work when solving problems alone versus in groups, how peer interaction influences performance, and how collaboration affects interest and participation. The literature also showed that some students prefer group work because it provides support and shared effort, while others prefer working individually for independence, pace control, or confidence in their own reasoning. Overall, the findings present a balanced understanding of the strengths and limitations of both approaches.

The researchers infer that differences between collaborative and individual problem-solving stem from how cognitive resources are utilized. Group work allows learners to pool working-memory capacity, reducing individual cognitive load and enabling more efficient processing of complex tasks. Collaborative interactions also stimulate explanation, questioning, and error detection, which strengthen conceptual understanding. Sankaranarayanan et al. (2021) emphasize that the collective working-memory advantage in group settings contributes to improved reasoning and more

effective problem-solving compared to individual work.

Lessons incorporating both self-explanation and collaborative problem-solving allow learners to internalize concepts individually and subsequently test, discuss, and refine reasoning with peers. This dual approach strengthens independent thinking and social learning skills, promoting higher-order cognitive development and metacognitive awareness.

Teachers are encouraged to integrate self-explanation followed by collaborative problem-solving in physics instruction. For instance, lessons may begin with self-explanation prompts, such as "Explain why this principle applies," followed by small-group problem-solving discussions (Gjerde et al., 2022; Johnson & Johnson, 2019). Curriculum materials should provide tasks that require both individual reflection and collaborative verification to enhance conceptual understanding, problem-solving performance, and metacognitive growth.

B. Perceived Effectiveness of Collaborative Learning and Self-Explanation Strategies in Problem Solving

Theme 1: Collaborative Learning in Solving Physics Problems

Based on the findings, student participants show that collaborative learning strategy supports meaningful space for the learning of the peers in understanding the concept and performing calculations for physics problems. Many students described collaboration as enabling the change of ideas, clarification of misconceptions, and

expansion of their knowledge through the peer support and collaboration engagement between learners.

The responses of the participants show how important the collaborative learning strategy is in the academic growth of the students. They find it helpful in answering problem solving in physics. They consider collaborative learning strategies that promote peer support and encourage active participation. Though some students find it challenging to work a task in a group due to some members relying only on them, it is still crucial for a learner to collaborate with peers because aside from it will deepen their understanding about the topic, it will also help develop their communication, empathy, and teamwork skills. Students' responses show that collaboration requires effort, patience and responsibility from everyone to work effectively. Additionally, students' responses show how collaborative learning strategies allow students to share ideas and learn from each other, combining different perspectives making complex subjects like physics easier to understand.

According to Pettersson et al. (2024), cooperative learning positively impacts the students' performance in physics. This learning strategy encourages students to actively participate in their learning; a task becomes easier if there is cooperation from other people. Through the help and support from the peers, it achieves a common goal, that is to deepen and increase knowledge. Additionally, the researchers emphasized that without the efforts of all groupmates, nothing can be achieved. And that is what the participants wanted to show, that it is necessary to make an effort and not just rely on the group. Collaborative learning can help students to develop critical skills that are

crucial for learning such as teamwork, communication and problem solving. Based on participants' responses, discussing in a group helps make a task easier and helps students understand the concept being studied more thoroughly. Furthermore, it fosters positive interdependence because students support each other, which enhances their motivation and engagement in learning. This is what Tullis and Goldstone (2020) emphasize in their study, that through peer interactions, students improve accuracy and confidence in answering physics problems. Because according to their study peer instruction encourages students to verbalize their reasoning, which is crucial for the improvement of learning outcomes. This social and cognitive interaction between peers results in process gain, in which students perform better in groups than individuals.

Looking at the responses of the students and teachers, it becomes apparent that collaborative learning has an impact not on just the conceptual and procedural understanding of the students but also on how they interact with other people.. Students recognize the importance of collaboration in helping them clarify ideas, compare methods and also building their confidence through peer interaction. Their perception on collaborative learning highlights the importance of having peers in understanding the complexity of physics. They find collaborative learning as more engaging while solving problems, which is crucial for learners because they feel motivated in answering physics problems, which show the positive results of this strategy. At the same time students expressed their frustrations when they encounter group members who don't participate in doing the activity.

The findings implies that collaborative learning has a strong potential to enhance

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students' engagement, confidence, and conceptual understanding of the students in solving physics problems. Students become more motivated when they work with peers and share ideas from each other (Deysolong, 2023). Peer tutoring helps them to understand better the concept in physics that helps them answer the problems. For teachers, these findings imply that collaboration should be intentionally integrated into lessons to support low performing students and deepen the conceptual understanding of learners.

Additionally, through collaborating with peers, teachers find it helpful in bridging the understanding gap between the terms or concepts that may not always be addressed during the whole class instruction. The findings also reveal the challenges that students might encounter when they deal with collaborative activity. Such as uneven participation, passive group members and reliance on stronger students indicate that collaborative learning requires careful design and monitoring by the teacher (Le, 2018). It must be addressed in order to have a positive outcome on students' learning. Teachers should establish clear group roles and expectations for participation in order to prevent students relying on their group members (Franklin, 2019). Moreover, the findings imply that collaborative learning is most effective when teachers provide structure, oversight and purposely groupings.

Theme 2: Self-Explanation as a Learning Strategy

The findings indicate that students perceive self-explanation as an effective strategy for independent learning and mastery of physics concepts. By articulating

solutions and reasoning in their own words, learners develop deeper conceptual understanding, improve error detection, and reinforce cognitive connections. Participants highlighted that self-explanation enhances focus, concentration, and discipline, allowing learners to regulate their own learning pace and assess comprehension. While students appreciated the autonomy and confidence gained from this strategy, they also acknowledged limitations such as delayed feedback and uncertainty, which sometimes required consulting a teacher or peer. Overall, self-explanation was valued for promoting reflective thinking, metacognitive awareness, and procedural fluency in solving physics problems.

Researchers infer that self-explanation fosters active cognitive engagement and strengthens problem-solving skills by encouraging learners to verbalize and analyze their reasoning (Chi et al., 2020). The participants' experiences support this, indicating that explaining processes aloud or in writing enhances conceptual understanding, reinforces mental connections, and develops metacognitive skills. The study highlights that self-explanation improves independent comprehension, self-discipline, and critical thinking, which are essential for complex problem solving in physics. However, the absence of immediate feedback suggests that occasional guidance or peer validation is necessary to ensure accuracy and prevent reinforcement of misconceptions (Roy & Chi, 2021).

Researchers observe that self-explanation empowers students to take ownership of learning while strengthening cognitive and metacognitive abilities. Independent articulation of concepts allows learners to clarify understanding, detect errors, and

consolidate knowledge in ways that collaborative approaches may not fully achieve. The effectiveness of the strategy depends on learners' self-discipline, motivation, and access to occasional guidance for confirmation. Researchers note that self-explanation serves as a complementary approach to collaborative learning, balancing independent reasoning with peer-supported conceptual development.

The findings imply that teachers should intentionally incorporate self-explanation activities into physics instruction to enhance independent problem-solving, procedural fluency, and metacognitive awareness (Roy & Chi, 2021). Structured prompts, reflective questioning, and guided exercises can strengthen learners' ability to articulate reasoning while fostering focus and self-discipline. Periodic feedback or peer validation is recommended to prevent the reinforcement of misconceptions and ensure accurate understanding. Integrating self-explanation with collaborative learning activities may provide a balanced approach that promotes both independent mastery and social engagement, supporting holistic learning outcomes in physics.

Theme 3: Comparative Effectiveness of Problem-Solving Strategies

Students' responses show that their preferences for collaborative learning and self-explanation strategy are shaped by how these strategies support their confidence, comprehension and understanding about the concept of physics. Several student participants describe collaborative learning as more enjoyable and socially motivating, while the self-explanation strategy promotes deeper concentration, which allows students to fully engage with the problem-solving process. Their differences in

preference show that students much more prefer collaborative learning as more beneficial in solving physics problems.

Additionally, the teacher responded by noting that student engagement in an activity and their understanding vary depending on how complex it is. Several teachers believe that self-explanation strategy helps students to concentrate, internalize steps and strengthen procedural problem-solving skills. Teachers' responses emphasize that collaborative learning was seen as more effective for conceptual understanding, than self-explanation strategy. Furthermore, teachers' responses also highlight several influencing factors that could affect the success of collaborative learning and self-explanation strategies in solving physics problems. This includes task difficulty, student readiness, classroom dynamics and issues related to cheating or fairness. The preferences of teachers and participants between the two learning strategies are influenced by the external and internal factors.

According to Kanevsky (2022), the preferences of students depend on the factors such as the nature of the task, expected difficulty, trust among peers and the perceived fairness of the assessment. The study also added that the students mostly look at the risk or the negative effects of the learning strategies such as the conflict, unfair workload and grade concerns, rather than the benefits students get such as support and shared ideas. From this study, the preferences of the participants in choosing a learning strategy also depend on different factors. Both the students and teachers participants look at the risk and benefits that they can get from the learning strategy. While the two teachers' participants have different preferences in choosing learning strategies, both of them look

at the risk and benefits that students will get in implementing either of the two learning strategies.

The responses of the participants are essential to deeply understand the importance of collaborative learning and self-explanation strategies in solving physics problems. Strengthen the understanding of how effective the two learning strategies are in guiding students to develop their conceptual and procedural understanding in physics. Each participant has a different preference on the collaborative strategy and self-explanation strategy, and it depends on how effective that learning strategy is in enhancing the students' understanding of physics.

Additionally, in choosing which strategy students most preferred, they are not just looking at the positive impact of the learning strategies. They are also based on the negative effects of the learning strategy in their emotional and mental. Some students find collaborative strategy challenging because of the unequal participation, they feel frustrated and distracted because of the impact of the group members in their learning. The difference in the effectiveness between collaborative strategy and self-explanation strategy depends on the task, the learner and the learning environment.

The findings implies that collaborative learning and self-explanation strategy contributes to different dimensions of students' learning. The responses of the students and teachers recognize that collaborative learning boosts the engagement, confidence and peer supported understanding of the students. At the same time, the self-explanation strategy in solving physics problems underscores the importance of independent problem-solving practice. Both the learning strategies are important to the cognitive

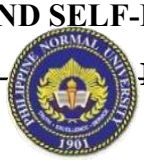
development and enhancing problem solving skills of the students.

Additionally, most of the students and teachers' participants preferred self-explanation strategies when solving physics problems. They find self-explanation strategy more effective because it strengthens procedural accuracy and independent thinking. This implies that teachers should implement a self-explanation strategy to deeper procedural fluency, concentration and mastery when working alone. However, the teachers should still therefore master the art of shifting between collaborative and individual strategies based on the task difficulty. Students with a low-level understanding of the physics concept, tend to struggle in solving physics problems. With that, teachers should integrate the two learning strategies to support holistic learning, promoting social interaction and cognitive independence among students.

Problem-Solving Skills

6.1 Understanding the Problem

Most students demonstrated a good understanding of the physics problems. Students A, B, C, D, E, F, G, and H were able to comprehend the problem statements and grasp the underlying concepts. Student A showed minor issues in angle interpretation, while Student E occasionally struggled with fully understanding the problem. These results suggest that students generally have a strong conceptual foundation, although some require additional guidance to interpret problems accurately (Ince, 2018; Good et al., 2019).



6.2 Identifying Knowns and Unknowns

The majority of students correctly identified the given information and the quantities to solve for. Students B, C, D, F, G, and H demonstrated full identification of all relevant values, whereas Students A and E missed minor details. Proper identification of knowns and unknowns is essential for selecting appropriate strategies and ensuring accurate calculations (Setiawan et al., 2020).

6.3 Choosing a Strategy

All students employed suitable strategies for solving the physics problems. Students A, B, C, D, E, F, G, and H applied stepwise reasoning or relevant formulas correctly. This aligns with prior research, which indicates that selecting an appropriate strategy is a key step in effective problem solving, whether individually or collaboratively (Badeau et al., 2017; Brand et al., 2023).

6.4 Applying Concepts

Students generally applied physics concepts correctly. Students A, B, C, D, E, F, G, and H demonstrated accurate use of theoretical principles, formulas, and laws. Correct application of concepts reflects strong conceptual understanding and is critical to solving physics problems effectively (Argaw et al., 2016; Laguindab et al., 2025).

6.5 Performing Calculations

Calculations were generally accurate. Minor errors occurred in Students A, C, D, and E, often due to small misinterpretations or skipped steps. Performing accurate calculations ensures that the final solution is reliable and demonstrates procedural competence (Good et al., 2019).

6.6 Checking and Interpreting the Solution

Some students consistently checked and interpreted their results correctly. Students B, D, F, G, and H verified their solutions and interpreted the results appropriately, while Students C and E occasionally overlooked this step. Reflection and verification are crucial for minimizing errors and aligning answers with conceptual understanding (Setiawan et al., 2020; Costley, 2021).

6.7 Reflecting on the Process

Students demonstrated varying levels of reflection on their problem-solving approach. Students B, D, G, and H reflected thoughtfully on the steps taken and considered improvements for future problems. Students A, C, E, and F showed some reflection, mostly focusing on calculation and strategy. Reflection enhances metacognitive awareness, which is necessary for developing independent problem-solving skills (Badeau et al., 2017; Ozkara & Cakir, 2020).

The results indicate that Senior High STEM students generally possess strong problem-solving skills in physics, particularly in understanding concepts, applying strategies, and performing calculations. Minor improvements are recommended in checking solutions, interpreting results, and reflecting on the problem-solving process to further enhance accuracy and metacognitive skills. These findings are consistent with previous studies emphasizing the importance of strategy selection, reflection, and collaboration in improving physics problem-solving proficiency (Ince, 2018; Badeau et al., 2017; Brand et al., 2023).

Theme 1: Collaborative Learning in Solving Physics Problems

The findings indicate that Senior High STEM students generally demonstrate strong problem-solving skills in physics, particularly in understanding problems, identifying knowns and unknowns, selecting strategies, applying concepts, and performing calculations. Most students accurately interpreted problem statements, applied stepwise reasoning, and correctly used theoretical principles and formulas. Minor difficulties were observed in angle interpretation, checking solutions, and reflecting on processes, suggesting areas for additional guidance. Overall, students exhibited both conceptual and procedural competence, with collaborative learning likely supporting understanding, strategy selection, and peer engagement in problem-solving tasks.

Researchers infer that collaborative learning enhances students' problem-solving abilities by allowing them to share perspectives, verify understanding, and reinforce conceptual and procedural knowledge (Badeau et al., 2017; Brand et al., 2023). The observed minor errors and occasional lapses in reflection suggest that guidance and structured peer interaction are crucial for developing metacognitive awareness. Prior studies emphasize that effective problem-solving involves understanding the problem, identifying relevant information, selecting appropriate strategies, and verifying solutions, all of which can be strengthened through collaborative engagement (Ince, 2018; Setiawan et al., 2020).

Researchers note that students' problem-solving skills are generally strong, reflecting both individual competence and the benefits of collaborative learning.

Collaboration allows learners to clarify misunderstandings, compare approaches, and refine strategies, fostering confidence and deeper understanding. Observations indicate that while students excel in calculations and concept application, reflection and verification of solutions vary, highlighting the importance of integrating opportunities for metacognitive development alongside collaborative activities. Such reflection enhances independent reasoning and promotes sustained problem-solving proficiency.

The findings suggest that teachers should continue promoting collaborative learning to strengthen conceptual understanding, procedural fluency, and problem-solving confidence (Argaw et al., 2016; Laguindab et al., 2025). Structured group activities, clear guidance on strategy selection, and prompts for solution verification can improve accuracy and metacognitive awareness. Educators are encouraged to provide feedback and facilitate reflection to address minor lapses in checking results and interpreting solutions, thereby enhancing students' overall problem-solving competence and preparing them for complex physics tasks (Costley, 2021; Ozkara & Cakir, 2020).

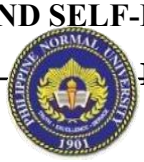
Theme 2: Self-Explanation as a Learning Strategy

Based on the evaluation of the problem-solving skills of the students' participants, most of them demonstrate strong skills in understanding the problem, identifying value, choosing strategy, and applying concepts in solving the problem. These traits students possess indicate that students not only understand the physics concept but they can simply apply the concept in solving physics problems.

Through the data results, students show that through articulating their reasoning, connecting prior knowledge, and clarifying the meaning of the steps through self-explanation strategy, students can perform better in solving problems. However, some students struggled in areas like checking and interpreting solutions. These weaknesses reveal where self-explanation could further support their learning. Allowing students to justify their answers and evaluating if the result is reasonable.

According to Zhang and Fiorella (2024), self-explanation helps students in identifying and correcting their conceptual errors. This is important for learners to know if their solutions in physics are correct and the physics concept they apply is accurate. Students demonstrate higher quality reasoning and error correction by practicing self-explanation strategy. This aligns closely with the results of the problem-solving skills of the students' participants, that they have a strong performance in identifying knowns and unknowns, selecting strategies, and applying concepts. These strengths indicate that many students were already engaging in internal forms of self-explanation.

Self-explanation learning strategy is most effective when it is supported by teachers, parents and institutions, because students often face struggle in generating deep explanations of the physics concept (Zhang & Fiorella, 2024). This idea reflects a gap in metacognitive monitoring, which is where students defect surface errors but they don't know if their final solution is reasonable. Self-explanation learning strategies help students to improve error correction; they would benefit from structured guidance that directs them to justify each step, evaluate conceptual consistency, and verify whether results make sense.



The results of the evaluation of the problem-solving skills of the students demonstrate a solid conceptual understanding. With this, the students can correctly identify values in the problem and appropriately apply strategies to solve the problem. Many of the students can correctly apply the physics concept but they still struggle with minor steps in solving the problem. Additionally, important reflections from the results of the table are difficult in checking and interpreting their solutions. This indicates a gap in their metacognitive awareness, implying that students know how to solve the problem but not all of them think about why their solution makes sense.

With this, it is important to teach our students to practice self-explanation strategy while solving physical problems. In order to help them to understand that it is not only about computation but also reasoning, justification and self-evaluation, which will help learners to fully understand the physics concept behind what they solved.

The findings imply that students benefit significantly from self-explanation strategy because it strengthens their metacognitive skills, which promote reflection, self-monitoring, and explanation of reasoning. Based on the results, most of the students have strong skills in solving problems but the only thing they struggle with is interpreting solutions and finding errors from their solution. With that, teachers should therefore encourage students to articulate why they chose a strategy in solving the problem in order for them to internalize concepts and avoid common errors.

Additionally, teachers should include activities that require students to verify solutions, justify steps and connect each calculation to the underlying concept. Self-explanation strategies will not only enhance student performance in solving problems

in Physics but also it can foster their independent, analytical thinking and strategic thinkers in physics.

Theme 3: Comparative Effectiveness of Problem-Solving Strategies

The findings indicate that students' preferences for collaborative learning and self-explanation strategies are influenced by how each approach supports understanding, confidence, and problem-solving performance in physics. Several students described collaborative learning as more socially motivating and engaging, facilitating idea sharing and peer-supported comprehension. In contrast, self-explanation was valued for promoting independent focus, procedural accuracy, and internalization of problem-solving steps. Teachers noted that task complexity, student readiness, and classroom dynamics affect the effectiveness of each strategy. Overall, collaborative learning enhanced conceptual understanding and peer engagement, while self-explanation strengthened concentration and procedural fluency, highlighting the complementary roles of both strategies.

Researchers infer that students' strategy preferences depend on task demands, perceived benefits, and potential challenges such as unequal participation or cognitive load (Kanevsky, 2022). Collaborative learning supports conceptual understanding and confidence through peer interaction, while self-explanation develops metacognitive skills and procedural accuracy. Both strategies contribute to learning outcomes, but their effectiveness is context-dependent. Prior studies emphasize that integrating both collaborative and individual approaches can optimize cognitive and social learning,

balancing engagement, independent reasoning, and mastery of complex concepts (Tullis & Goldstone, 2020; Roy & Chi, 2021).

Problem solving skills are an essential component in studying physics. Applying learning strategy in solving problems could help students to not just understand the concept of physics but also apply appropriate formulas. Students who leaned more on self-explanation tend to show a stronger performance in conceptual understanding and in choosing strategies. Based on their results in which strategy they most preferred in solving physics problems, most of them choose self-explanation strategy or individual working. Looking at their performance in solving physics problems, this aligns with how self-explanation deepens internal reasoning by requiring students to articulate why a step is valid or how the concept applies.

Their preferences and the problem-solving skills are coherent to each other, showing how effective self-explanation strategy is in solving physics problems. The collaborative learning strategy strengthens their motivations, compares reasoning, discusses mistakes and validates answers with peers. When comparing the two learning strategies, collaborative learning and self-explanation strategy support students' understanding and problem-solving skills in different but complementary ways.

Findings implies that teachers should intentionally integrate both learning strategies rather than rely on only one learning strategy. Self-Explanation strengthens logical reasoning and helps students justify their solution or answers in solving physics problems. However, the results also show that students implementing self-explanation strategies may need support in checking and interpreting solutions, especially if the

students are at a low level of understanding in physics. Therefore, the implications of this is that teachers should give opportunities for students to first attempt a self-explanation strategy and then verify their solution with peers.

Additionally, the findings imply that the assessment method should not only capture the final answer but also the reasoning behind the solution. Since the two learning strategies foster different ways to help students strengthen their problem solving skills, teachers can design an activity that will require students to articulate their explanation individually and then engage in peer discussion to develop both internal reasoning and social verification skills, in which help them in solving problem (Ashikullah, 2024).

Comparison of Grade 11 and Grade 12 STEM Students Perception

Theme 1: Collaborative Learning in Solving Physics Problems

Both Grade 11 and Grade 12 students view collaborative learning as helpful in improving their understanding of physics, but they emphasize different aspects of its value. Grade 11 students mainly describe collaboration as a source of peer support, idea sharing, and clarification, helping them check their solutions, distribute tasks, and compensate for gaps in understanding. Their perception of collaboration centers on the immediate assistance they receive and the comfort of learning with peers.

Meanwhile, Grade 12 students recognize collaboration as beneficial but focus more on conceptual refinement, engagement, and performance improvement. They highlight how group discussions generate stronger ideas, increase confidence, and

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promote active involvement in solving physics problems. Their use of collaboration is more intentional, emphasizing knowledge contribution, interaction quality, and deeper reasoning, rather than basic assistance.

Overall, while both groups value collaboration, Grade 11 students rely on it for foundational support and shared effort, whereas Grade 12 students use it to enhance conceptual accuracy and strengthen their cognitive engagement during problem solving.

Theme 2: Self-Explanation as a Learning Strategy

The Grade 11 and Grade 12 students recognize self-explanation as an effective way to improve their understanding in physics, but their focus and reasons are different to each other. Grade 11 students tend to use self-explanation as a tool for checking their answers, retrieving information, and building independent study habits. On the other hand, Grade 12 students describe self-explanation more as a method to analyze errors, deepen their conceptual understanding, and refine their thinking during problem solving.

Additionally, the findings strongly align with Macaya's conclusion on learning progression. According to Macaya (2020), Grade 11 students often have incomplete mastery of earlier science competency and they rely more on foundational scaffolding to make sense of new content. With this, Grade 11 students use self-explanation strategy to build their foundational learning skills that focuses on understanding the process and verifying recall. While Grade 12 students use self-explanation to refine their problem-solving it includes analyzing errors while solving problems. The results show that as students' progress academically, their use of self-explanation evolves from basic

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comprehension checking to higher order thinking.

Theme 3: Comparative Effectiveness of Problem-Solving Strategies

In comparing the two learning strategies, both the grade level focus on its effectiveness, focus, confidence and learning conditions. Grade 11 evaluates the effectiveness of collaborative learning and self-explanation strategies based on its practical study needs, task management, and personal comfort. Whereas, Grade 12 students compare the two learning strategies based on the feedback availability, learning accuracy, and efficiency in solving physics problems. The results indicate that as students move to higher grade levels, their strategies choices shift from managing feelings and focus toward optimizing reasoning and error correction, which is crucial for their conceptual and procedural understanding.

Additionally, the comparison shows that Grade 11 students tend to switch between strategies depending on the nature of the activity, while Grade 12 students use a more deliberate selection process. Grade 11 learners choose collaboration when they need support or idea sharing and prefer self-explanation when they want to concentrate individually. Grade 12 learners, however, evaluate which method will produce the most accurate solution or deeper understanding before deciding which strategy to use. This demonstrates a progression from situational decision-making in Grade 11 to strategic and purpose-driven selection in Grade 12, reflecting increased cognitive maturity and confidence in independent problem solving.

CHAPTER 4

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter presents a summary of the major findings derived from the study, the conclusions that were drawn, and the recommendations based on the findings of the study

Summary of Findings

The results of this study demonstrate that collaborative learning and self-explanation strategies play complementary and significant roles in improving students' physics learning outcomes. In relation to the first research problem, the literature shows consistent evidence that collaborative learning enhances conceptual understanding and problem-solving accuracy through social interaction, shared reasoning, and reduced cognitive load, while self-explanation strengthens metacognitive monitoring, independent reasoning, and procedural fluency. This aligns directly with the study's conceptual framework, where social constructivism supports collaborative learning and metacognition supports self-explanation.

For the second research problem, the perceptions of STEM students and teachers reveal that both strategies are viewed as effective, but in different ways. Students value collaborative learning for peer support, motivation, and enhanced engagement, while self-explanation is seen as beneficial for focus, discipline, and self-paced comprehension. Teachers likewise recognize that collaborative learning deepens conceptual understanding and that self-explanation improves reasoning and error

detection. These perceptions reinforce the framework's emphasis on motivation, engagement, and conceptual–procedural understanding as key outcomes influenced by instructional strategies.

For the third research problem, findings show that students' problem-solving skills are closely linked to their use of these strategies. Those who practiced self-explanation demonstrated clearer reasoning and stronger procedural steps, while those who engaged in collaboration showed improved conceptual clarity and more accurate final solutions. Together, the findings confirm that both strategies contribute directly to problem-solving performance, supporting the conceptual framework's assumption of a direct relationship between the instructional strategies (independent variables) and learning outcomes (dependent variables).

Overall, the study concludes that the combined implementation of self-explanation and collaborative learning provides the strongest support for physics problem-solving, as each strategy strengthens aspects of cognitive and social learning essential for STEM education.

Limitation of the study

The study has several limitations. First, the sample size was small, consisting of only 8 student participants, which may limit the generalizability of the findings. Second, the study focused on students' perceptions of collaborative learning and self-explanation strategies rather than measuring the actual implementation or efficiency of these strategies in problem-solving tasks. Third, the participants' grade range was narrow, with all students

scoring between 88–89; therefore, categorizing them as low, middle, or high achievers was not possible, which restricts comparisons across achievement levels.

Additionally, the study evaluated students using a limited set of physics problem-solving tasks. Physics topics vary in complexity, so performance may differ across other topics. Finally, the study only captured short-term effects, measuring immediate perceptions and performance without examining whether improvements are retained over time. sample size, focus on perception, or lack of actual classroom implementation.

Practical Applications

The findings show that collaborative strategy and self-explanation strategy can be strategically applied in physics classrooms to enhance the conceptual and procedural understanding of the STEM students. Both learning strategies can be implemented by teachers to support students' cognitive and metacognitive learnings. Teachers can implement structured group activities that can help students to clarify misconceptions, verbalize reasoning and compare solutions.

Also, integrating self-explanation strategy in solving physics problems, which can deepen their internal reasoning. In practical classroom settings, teachers can design an activity that will allow students to do self-explanation strategy and collaborative learning at the same time. The activity will begin with individual self-explanation before transitioning into small group validation and refinement of answers. Combining these strategies not only strengthen the student's computational accuracy and conceptual

understanding but also build essential skills such as communication and teamwork.

Future Research Directions

For Practice

Integrate both self-explanation and collaborative learning systematically in physics instruction. Lessons may begin with individual reasoning tasks followed by structured group discussions to reinforce conceptual understanding and problem-solving accuracy.

Embed explicit self-explanation prompts in learning activities, such as requiring students to justify principles used, explain procedural steps, and articulate sources of error. These prompts strengthen metacognitive regulation and conceptual clarity.

Incorporate periodic feedback sessions during or after problem-solving tasks to correct misconceptions, validate reasoning, and promote continuous improvement in both individual and group performance.

For Policy

Institutionalize the use of self-explanation and collaborative learning by integrating these strategies into instructional guidelines, learning competencies, or curriculum standards, particularly within physics and related sciences.

Strengthen formative assessment policies to include evaluation of students' reasoning processes, explanatory skills, and collaborative behaviors, rather than solely focusing on

final answers.

Provide professional development on metacognitive and self-explanation strategies. Schools should invest in training teachers on self-explanation techniques, think aloud modeling, metacognitive questioning and reflective learning routines.

For Future Research

Studies may investigate the effectiveness of technology-enhanced self-explanation tools, intelligent tutoring systems, or AI-supported platforms in developing students' reasoning and conceptual understanding.

Researchers may examine moderating variables such as group size, group composition, task complexity, and classroom climate to determine the conditions under which collaborative learning is most effective.

Future studies should investigate how student personality traits affect the balance between collaborative and self-explanation. They should explore how personality styles shape preferred learning modes and, and which interventions can help introverted students to engage in collaborative learning.

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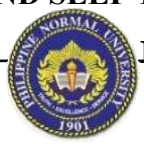

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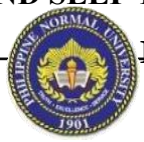

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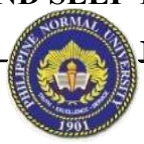

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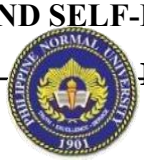

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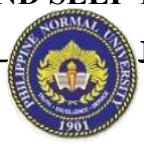

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APPENDIX A

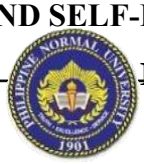
TIMELINE OR

GANTT CHART

Figure 2: Gantt Chart

OBJECTIVES	TARGET ACTIVITIES	TARGET ACCOMPLISHMENTS (quantify, if possible)	Start Date	Due Date	Duration	Term: 1 , SY: 2025 to 2025												Total
						Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10	Wk 11	Wk 12	
Review at least 10 peer-reviewed studies on collaborative and self-explanation strategies among STEM students in solving physics problems	Review at least 10 peer-reviewed studies on collaborative and self-explanation strategies within one week	• Reviewed 10 peer-reviewed studies. • Completed a literature review matrix. • Prepared a narrative synthesis.	Sept 1, 2025	Sept 9, 2025	7 days													7 days
Determine the perception of students and teachers on the effectiveness of collaborative learning and self-explanation strategies on solving problems in Physics.	Conduct interviews with 8 Senior High STEM students and 2 teachers within 6 weeks	• Conducted 10 interviews. • Prepared verbatim transcripts. • Generated four themes through thematic analysis	Sep 10, 2025	Oct 16, 2025	20 days													20 days
Determine the problem-solving skills of the Senior High STEM students in solving problems.	Collect at least 1-2 student work samples of problem-solving outputs within one week.	• Collected student outputs. • Documented samples through photos. • Evaluated using rubric marks.	Oct 20, 2025	Oct 24, 2025	5 days													5 days

During Term 1 of SY 2025–2025, the research team accomplished all targeted activities according to the planned schedule. The first objective involved reviewing at least ten peer-reviewed studies on collaborative and self-explanation strategies. This task was completed from September 1 to September 9, 2025 within seven days. The team successfully reviewed ten relevant studies, prepared a literature review matrix, and produced a narrative synthesis summarizing key findings and research gaps.



The second objective focused on determining the perceptions of Senior High STEM students and teachers regarding the effectiveness of collaborative learning and self-explanation strategies. The interview process, which included scheduling, conducting, and completing all ten interviews, was carried out from September 10 to October 16, 2025, covering a total of twenty days. After the interviews, the team spent two additional weeks preparing the verbatim transcripts to ensure accuracy and completeness of the collected qualitative data. Following transcription, the researchers dedicated one week to analyzing the transcripts, which resulted in the identification of four major themes that captured the participants' experiences and insights.

For the third objective, the team sought to assess the problem-solving skills of Senior High STEM students. This was completed from October 20 to October 24, 2025, totaling five days. During this period, student work samples were collected and documented through photographs. The outputs were evaluated using rubric-based markings, and all samples were compiled into a portfolio to provide a clear picture of the students' approaches in solving physics problems.

Overall, the research team met all planned objectives and timelines. Each phase, literature review, interviews, transcription, thematic analysis, and evaluation of student outputs, was completed successfully and contributed to the comprehensive understanding of the study's goals.

APPENDIX B

LINE-ITEM BUDGET

Figure 3: Line-item budget

Category	Item	Total Cost (₱)
Supplies and Materials Expenses	Long folders	200
	Binder	200
	Document printing	3,600
Travel Expenses	Transportation	2,000
Participant Incentives	Meal incentives	2,000
Miscellaneous	Contingency Fund	1,000
TOTAL:		**8,000**

The study is allocated its budget across key categories to support the effective conduct of the study. In the supplies and materials expenses, basic supplies, including the two long folders, bond paper, and one binder. The total budget for this study is ₱8,000, which is allocated to cover essential research expenses. Supplies and materials, including long folders (₱200), a binder (₱200), and document printing (₱3,600), account for ₱4,000 to ensure proper organization and distribution of research materials. Travel expenses are estimated at ₱2,000 to cover transportation costs for coordinating with participants and accessing research venues. Participant incentives, specifically meal allowances, are allocated ₱2,000 to acknowledge the time and effort of student participants during data collection. Additionally, a contingency fund of ₱1,000 is set aside to address any unforeseen expenses that may arise. The entire budget will be sourced from personal contributions, ensuring that all necessary resources are available for the smooth implementation of the study.

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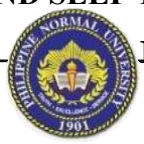
APPENDIX C

EXPECTED OUTCOMES AND IMPACT

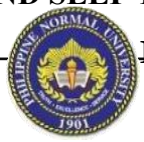
The research findings will be documented and submitted for publication in Philippine Journal of Education Studies (PJES). This will contribute to the academic discourse and provide a foundation for future research. The Philippine Journal of Education Studies (PJES) is a double-blind, peer-reviewed journal published by the University of the Philippines College of Education. It focuses on research related to education systems that promote the development of education in the Philippines. The product will result in a qualitative comparative framework or a set of best practices for using collaborative learning and self-explanation strategies in STEM education, which can be utilized in lesson plans, teaching modules or digital learning resources. The qualitative comparative framework helps to identify the pattern and relationships between studies, which are crucial to understand in order to identify the best learning strategy that students can use in solving physics problems. (Onwuegbuzie, & Weinbaum, 2017)

Findings from this study may influence the curriculum development, particularly in designing student-centered instructional methods for physics education. This will be submitted to PNU Educational Policy Research and Development Office (EPRDO) to support the curriculum development in teaching education. Additionally, this will contribute to improved educational practices in physics education and enhance active learning strategies in STEM education. This study will benefit the students and teachers, improving the learning and teaching processes in physics. The students will develop their



performance in solving physics problems, improving their conceptual and procedural understanding in the subjects of physics. In which will increase their engagement in pursuing STEM careers in the future. Moreover, this will contribute to the teaching strategies for the teachers in teaching physics. The results of this study will help teachers to determine which strategies will develop the problem-solving skills of their students. Additionally, the results of this study will contribute to educational research and policymaking in education. (Lopez-Alvarado, 2017)

To strengthen the study implementation and ensure its practical importance, partnership with school is crucial. Collaboration with schools will strengthen the study and it will further explore innovative problem-solving strategies in STEM education. By means of partnership with schools will have a great contribution to this study, It is going to be more effective if schools are interested in this kind of study. Given that research has a great contribution in improving school, through this partnership will not be limited to what the study receives but this will provide information for the development of different factors that must improve in school, such as policy, teaching practices, teacher quality, etc. (Scott & McNeish, 2013). Furthermore, the study will seek patent copyright for intellectual property protection for the documents that study collected to students such as problem sets and assessment. Ensuring its proper recognition and long-term use, the study will seek copyright protection for the instructional materials, supporting their integration into future physics education programs. In terms of social impact by improving science education, this study will contribute to better engagement, confidence, and interest in STEM careers. A stronger foundation in physics problem-solving may encourage more



students to pursue fields in science and engineering.

Additionally, this study will improve the number of enrollees in the STEM strand and can decrease the number of dropouts in STEM education, since students will be encouraged in solving complex problems in physics (Madriaga & Siobal, 2022). Finally, the study will hold Economic Impact for the long-term benefits of this study can contribute to a more skilled workforce in science and technology fields, benefiting industries that rely on problem-solving and analytical thinking. The development of a highly skilled workforce in STEM fields will address global challenges and drive economic growth, which is crucial for national development. According to Steward-Gambino and Rossman (2021), STEM is essential for solving complex societal challenges, through helping students in their learning area, this is able to build a highly skilled workforce that the society needs for national development.

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APPENDIX D

ABSTRACTION

Abstraction of Student and Teacher Perceptions on Collaborative Learning and Self-Explanation through Interviews

Theme	Categories	Codes	Sample Transcripts
Collaborative Engagement and Peer Support	Peer Interaction and Support	Peer Teaching Promotes Conceptual Understanding	• TB: [21:31]During collaboration, mas marami silang natutulungan. May kaunting enhancement sa learning kasi may nagtuturo sa kanila.
		Limited Peer Support in Individual Work	• TB: [22:04]Pag individual, nakatali lang sila sa sarili nila. Walang nagtutulungan.
		Feedback Positive Receptivity	• SH: 21:16: "kapag nakareceive po ako, tinitake ko po kasi 'yun as hindi po critics, a way to improve. So in the next problem na i-solve ko, hindi na ako magkamali."

Peer Interaction for Assistance despite Individual Work	• TA: 18:47: "Minsan kasi ang mga estudyante nagtatanong talaga sila sa mga kaklase nila kung tama ba formula na ito, tama ba solution nila. Kumbaga, kahit individual sila, tinatanong nila ang katabi nila
Interacting is sometimes a Problem	• TA: "Minsan, ang usual problema sa akin kasi, it's not really cheating — it's about interacting din."
Ease of Problem-Solving Through Collaboration	• SA [0:16] Kapag nagsosolve po kami ng Physics problem ng mga classmate ko, nagiging mas madali ang pag-answer namin sa problem.
Peer Tutoring and Knowledge Sharing	• SC [10:26] tinulungan po namin 'yung mga hindi pa masyadong gets. Pero hindi naman po kami 'yung parang nag-assume na alam na nila. More on in-assess po namin kung naiintindihan talaga nila. •

Peer Support in Concept Clarification	• SB [17:14]Tinulungan po ako ng mga ka-group ko kung alin ang gagamitin at kailan.
Seeking Clarification Through Peer Support	• SA [4:42] Pag may nagkakamali po, tinatanong po sa kagrupo para mas malaman po.
Informal Peer Learning for Clarification	• SB [34:26]Multiple times po, hindi lang sa isang session, pati sa ibang subjects. Pag may hindi ako maintindihan, may lalapitan akong group. Kahit hindi sinabing "groupings," may kanya-kanya kaming friend groups.
Collaborative Error Checking and Peer Assessment	• SC [33:56]ang ginagawa namin kapag nahihirapan kami sa topic na 'yon, sinusulat po namin sa notebook para hindi namin malimutan. I guess 'yun po 'yung tanong sa number ganito, tapos chine-check na po namin, ina-assess

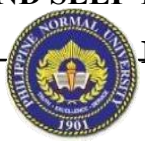
	Collaboration Elevates Lower-Performing Students	• TB [27:01]Sa collaboration, mas marami ang nag-a-achieve. Sa individual, 'yung top students lang talaga ang nagpe-perform. 'Yung below average, umaangat at pumapantay sa average kapag collaborative. At least, confident sila na makakapasa sa subject kasi may group.
	Need for social interaction and peer support	• SD [7:16]Natutunan ko po na dapat may kausap ako. Kailangan po ng support. 'Yun po ang realization ko.
	Peers Offer Help Proactively When Struggling	• SD [9:10] Yes po. Kahit hindi po ako masyadong nagme-message sa kanila, minsan sila mismo ang lumalapit sa akin kapag nakikita nilang nahihirapan ako. Sila po 'yung tumutulong sa akin

Selective Reliance on Peers	• SF 04:47: "Depende po talaga sa topic kung magre-rely po ako sa sinasabi nila, kasi minsan po hindi rin po nila gets."
Peer Support for Focus	• SG 07:22: " Kapag naman po may kasama ka, ang advantage naman po nun — especially if interested po talaga o into studies po talaga ang mga kasama mo — halimbawa po, pag na-distract ka, pwede ka nilang ibalik sa focus. Ang isa pa pong advantage nun is pwede kayong magkaroon ng interactions."
Pro-Active Help Seeking in Friends	• SH 11:02: "Pero kapag ganun po, lumalapit po ako sa pinaka-matalinong kaklase po namin na alam po ang science.

	peer teaching and hands-on collaboration	• SB [36:45]Mas gusto ko po talaga yung hands-on. Parang may designated "teacher" sa grupo — kung sino yung nakakaintindi sa topic, siya yung mag-e-explain. Para kaming estudyante niya tapos nagtutulungan kami unti-unti.
	Validation through Partner Interaction	• SB: Siguro po noong last time na by pair kami. Binigyan kami ng isang question at nakatulong siya sa akin kasi napa-fact-check ko sa partner ko. Sinasabi ko, "Uy, ito 'yung ginawa ko. Ikaw ba, ano 'yung ginawa mo?" Tapos malalaman ko kung tama ba o hindi.
	Informal peer checking and spontaneous collaboration	• SC: [39:13]Nalilito po kasi ako— parang narinig ko 'yung mga katabi ko. Hindi ko po alam kung 'yun 'yung sagot ko. Parang nag-aabang na po sila sa likod. So parang, "Teka nga, i-check ko

		muna sa kabila, i-check ko 'yung sagot ko." Hindi po siya official na group—collaboration lang.
	Active engagement and idea generation through collaboration	• TB: [41:34]Nakikita ko mismo sa klase na nagwo-work siya. Kapag group activity o collaborative task, mas active ang mga estudyante, mas marami silang ideas, at mas engaged silang lahat.
Collaborative Participation	• Active and Visual Learning Preference	• SB: [17:14]Mas hands-on po ako. Kapag nag-e-explain ako, kailangan sinusulat ko.
	• Collaboration in terms of Project to Avoid Burn Out	• SE: 04:52: "na-di-distribute po at hindi po na-bu-burnout ang isang tao."
	• Collective Idea Building	• SB:[11:20]Kailangan talaga ng ideas ng bawat isa para mabuo 'yung pinaka-idea ng group.

	• Mutual Checking	• SB:Nagtatanungan din po kami kung tama yung ginagawa namin habang nagso-solve.
	• Assigned Always in Problem Solving and Sharing of Knowledge	• SF 02:58: "ako po usually ang gumagawa nun kapag by group. Pero kapag may mas kayang maka-intindi, tinutulungan ko po para siya rin po ang gumawa"
	• Avoid Burnout by Task Distribution	• SE "na-di-distribute po at hindi po na-bu-burnout ang isang tao."
	• Peer Explanation	• SB [13:36]May isang magdi-discuss ng topic kung sino yung nakaintindi… pinapakita namin sa isa't isa yung solution.
	• Pre-Group Preparation	• SE 14:11: "Kapag groupings po, I think, better po na mag-list down ng notes po muna."



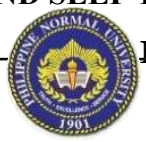
	• Reduce the Burnout Effect	• SE 04:52: "groupings kapag ang project kailangan. Na-di-distribute po at hindi po na-bu-burnout ang isang tao. Individual po may mga times po na ikaw ang kailangan mag-decide kung ano ang gagawin ninyo."
Collaborative Effectiveness and Benefits	• Collaboration Benefits	• SH: 03:31 "And nakakatulong po ang collaboration. Kumbaga kasi, may mga classmates rin po akong nagbibigay sa'kin ng idea on how to solve that Physics problem po."
	• Sharing Ideas; Collaboration Benefits	• SH "05:57 "Kapag may groupings, ang nakakatulong po sa groupings, siyempre po 'yung sharing ng knowledge po, kumbaga parang, inaano n'yo po 'yung flaws n'yo na hindi n'yo po maintindihan."

	• Collaboration as Motivation	• SD [24:30]Siguro po 'yung collaborative, tinitingnan ko po 'yun as motivation sa pagaaral ng physics.
	• Different roles in Groupings Significance	• TA: 16:34: "May gumagawa ng experiment, may tumitingin sa activity sheet, sa laboratory activity sheet, which is maganda kasi nagkakaroon ng interaction between the groupmates. May tumitingin sa procedure kung tama, meron ding humahawak ng lab o nag-e-experiment talaga para makita kung tama at accurate o precise — accuracy and precision.
	• Using the Ideas of Others	• SE: 06:39: "nasabi na po nila or na-share na po nila ang mga karanasan nila sa Life Science, doon po ang time na parang nagkaroon po ako ng idea kung ano 'yung mga topics na dapat kong i-research."

	• Helping in Solving Role	• SG: 05:53: "Usually po kasi ang role ko kapag mga ganyan ay tumutulong po ako sa pag-solve."
	• benefits and challenges of group work	• SB [15:12]Nakakatulong po kasi collaborative siya… pero mahirap kapag may hindi nakakaintindi at nakikisabay lang.
	• Expanded Knowledge Through Peer Interaction	• SA [0:58] Mas nagiging maganda po 'yung koneksyon namin. Pag may groupings po, mas dumadami po ang kaalaman ko dahil marami po akong nakukuhang knowledge sa kanila tungkol sa Physics.
	• collaboration as coping mechanism for workload	• SB: [30:18]Mas preferred ko po collaborative kasi sa dami ng subject, ang daming gawain. Sa panahon ngayon lalo na senior high, hindi mo pwedeng suluhin — kailangan talaga may tulong kahit papaano.

	• collective problem-solving efficiency	• SB [41:01]Mas maraming utak ang gumagana… mas mabilis yung troubleshooting.
	• Using the Ideas of Others	• SE: 06:39: "nasabi na po nila or na-share na po nila ang mga karanasan nila sa Life Science, doon po ang time na parang nagkaroon po ako ng idea kung ano 'yung mga topics na dapat kong i-research."
	• Value for Collaboration Learning	• SH 22:01: "Collaborative po. Mas i-aadvise ko po na i-strengthen po nila 'yung collaboration."
	• Perceived High Effectiveness of the Collaboration/ Collaboration gives the peace that Complete the Puzzle	• SH 19:38: "tingin ko mas effective po ang collaboration. Kasi po as talagang ano haha, kapag collaboration po mabilis lang, saka ang nasa isip ko rin po kasi, kunwari po may sinasabi po silang idea, tapos may nakuha akong idea. Kumbaga, nagagawan mo po

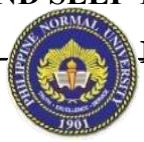
	• Sharing Idea is Benefits of Collaborative Learning	• siya ng ano, kumbaga sa puzzle, last piece sa puzzle para masolve ko sa isip."
	• Peer teaching and promotion of deep understanding	• SE 26:18: "Ang mga learning or ideas ng mga students na nag-e-excel sa Physics, na si-share rin po nila ang ideas nila sa iba." • TB [39:48]Noong tinawagan ako, nagtuturo na rin sila sa iba. Nag-spread 'yung positive vibes. 'Yun ang gusto ko—'yung hindi na nagmi-mimic lang. Dapat ganun talaga. Ang goal ko ay kahit 'yung nahihirapan, makarating man lang sa platinum level of understanding.



Collaboration Preference	• Collaboration Enhances Confidence and Participation	• TB [18:45] Oo, siyempre sa collaborative, nakakapag-share sila ng ideas. Nagkakaroon sila ng input mula sa bawat isa, kaya mas lumalabas 'yung mas magagandang idea. Kahit group activity lang, mas maganda 'yan.
	• Students Struggle with Self-explanation Compared to Collaboration	• TB [19:24]Sa self-explanation naman, may mga estudyante na kaya, pero karamihan nahihirapan. Dito nga sa latest naming activity, pataas na 'yung performance ng iba. Ewan ko kung paano nila nahanap 'yung idea, pero 'yung iba nakakaya.
	• Preference for Individual Task Assignment within Group Work	• SD[12:52]Sa paggawa po namin, nagtutulungan po kami. May mga nagsasabi kung ano ang gagawin, ganito ganyan. Most of the time po, may mga nag-e-express ng ideas. Minsan po, may mga nag-i-implement ng plano.

• Preference for Task Division Over Collaboration	• SA [1:20] Wala pa po kasi. Pag nag-a-ano po kami minsan, by part po kami na sasagutan, at nasasagutan ko naman po siya nang maayos.
• Preference for Collaborative Learning in Physics	• SD [33:50]Sa physics po, mas pipiliin ko 'yung collaborative. Mas marami pong ideas na makukuha, at doon mo ma-co-compare kung okay ba 'yung ginagawa mo. May mapagtatanungan ka rin po.
• Context-Dependent Learning Preference	• SD [21:00] Depende po. Pero most of the time, mas preferred ko po by group sa school, tapos solo po sa bahay.
• Groupings prone in Distractions	• SG 09:51: "Groupings po, kase po pag groupings po, hindi po mawawala diyan ang distraction na, together may agenda dito, gawa ganyan po. "

	• Friends Comfort in Learning	• SG 08:26: "Kaya po more on na kaibigan ko ang kasama ko, kasi po kapag kaibigan ko po ang kasama ko, so kapag kaibigan mo 'yon, kilala mo 'yon, so magiging comfortable ako around them.
	• Situational Learning Mode Preference	• SG 07:22: "Para sa akin po, depende po kasi iyon sa kasama e. Minsan po, better po na meron kang kasama. Ang cons naman po is kapag po ang kasama mo ay negative ang attitude when it comes to study, pwede ka pong maimpluwensyahan. Instead na makapag-review ka, malalaan po ang oras n'yo sa ibang bagay."
	• Groupings in terms of Project	• SE 04:52: "groupings kapag ang project kailangan"
	• Preference on Member Role	• SF 03:33: "Ayaw ko po maging leader."



• Collaborative Problem Solving Preference	• SH 19:38: "tingin ko mas effective po ang collaboration. Kasi po as talagang ano haha, kapag collaboration po mabilis lang, saka ang nasa isip ko rin po kasi, kunwari po may sinasabi po silang idea, tapos may nakuha akong idea. Kumbaga, nagagawan mo po siya ng ano, kumbaga sa puzzle, last piece sa puzzle para masolve ko sa isip."
• No Comprehension if Student cant Explain it	• SH 15:00: "Hanggat, kasi po 'yung saying na sinasabi po nila na, hindi mo talaga gets ang isang lesson kapag hindi mo kayang ituro sa iba or sa sarili mo."
• Preference for Collaborative Learning Among Students	• TB [20:14]Kapag collaborative, mas gusto nila kasi mas confident sila. Hinahabol nila 'yung performance ng mga kaklase nila. Nakikita nila na maraming talent sa group, kaya

			• naiisip nila na sayang kung hindi sila mag-contribute.
Perceptions of Self-Explanation Learning	• Self-Regulated Learning	• Selective Reliance on Peers	• SF 04:47: "Depende po talaga sa topic kung magre-rely po ako sa sinasabi nila, kasi minsan po hindi rin po nila gets."
		• Learning Independently through Note-Taking and Self-Instruction	• SD [10:15] "Mahilig po akong mag-notes. So kapag ganun, tinitingnan ko po 'yung notes ko, tapos iniisip ko kung paano dapat gawin. Tinuturuan ko po 'yung sarili ko. Mabilis din po kasi akong makalimot eh."
		• Preferred the Individual Tasking	• SG 09:43 "Sa akin po kasi, mas gusto ko po individual."
		• Adopting through Others by Observation	• SF Tapos ina-adopt ko po kung ano ang mali na nagawa nila, kung paano ko rin i-rereview ang sarili ko. Basta kung ano ang napapansin ko sa paligid.

	• Stop while explaning Means Need Further Understanding	• SH 18:10: "Nahuhuli ko po talaga ang sarili ko na hindi ko po gets kapag ano, pag medyo di ko na po alam ang next na sasabihin ko. Alam mo po 'yun, or naputol po haha. Pag naputol po 'yung self-talk ko po, usually po ang ginagawa ko ay tumitingin rin po ako sa notes po, ganyan po."
	• Focus on Individual Problem Solving	• SH 08:39: "Kasi po kapag magsolve pa ako mag-isa, ano po ako e, na parang sarili ko lang, ano rin po ako e, focus lang po ako e."
	• Self-Correction and Reflective Learning	• SA [4:19]'Yung self po. Kasi po pag nalaman po natin 'yung mali, mas maayos po natin next time. Doon po tayo magfofocus sa maling ginawa, at babaguhin po natin para maging maayos po 'yung sagot natin next time.

	• Realization of Incompleteness/ Rechecking of Notes	• SE 09:48: "base sa sinulat ko, minsan po kapag may narealize po ako na baka may mali or parang may kulang, so, nirerecheck ko po."
	• Resource Seeking Behavior	• SF 05:40 "Sa sarili ko na lang pong knowledge. Pwede po mag-ask sa teacher o sa leader."
	• Comfort Asking Teacher	• 18:52: "Kasi po mas alam po nila ang gagawin at wala pong second thoughts."
	• Triple-Checking Habit	• SG 12:20: "Ang ginagawa ko po since wala po kaming homework or something, three times po ako nagche-check, triple checking po.
	• Recognition of Learning Gaps	• SH 18:10: "Nahuhuli ko po talaga ang sarili ko na hindi ko po gets kapag ano, pag medyo di ko na po alam ang next na sasabihin ko. Alam

		• mo po 'yun, or naputol po haha. Pag naputol po 'yung self-talk ko po, usually po ang ginagawa ko ay tumitingin rin po ako sa notes po, ganyan po."
	• Self-regulated Improvement	
		• 21:16: "kapag nakareceive po ako, tinitake ko po kasi 'yun as hindi po critics, a way to improve. So in the next problem na i-solve ko, hindi na ako magkamali
	• Self-Assessment and Focus at Home	
		• SE 16:15: "Mas gusto ko po sa bahay kase naa-assess ko po ang sarili ko, ina-assess ko po ang kausap ko."
	• More Immersed in Individual Task Activities in Physics	
	• Preference for Individual Learning	• SG 09:11: "More on individual sa Physics."
	• Self Learning and Discipline is a Must/ Appreciate the Importance of Individual	• SG 17:15: " Mas preferred ko po kase talaga ang individual."

		• SG 17:15: "Ang pinaka-importante po ay self-learning or self-discipline. Mas preferred ko po kase talaga ang individual."
• Self-Explanation Effectiveness	• Explaining Process for Better Understanding	• SC [18:18] "I think mas effective po sa akin kapag ine-explain ko 'yung process. Doon ko po na-check kung naiintindihan ko talaga 'yung topic na dinidiscuss sa klase."
	• Focus and Skill Development Through Independence	• SC [5:00] "Self-explanation po. 'Yun nga po, pag self po mas nahahasa po natin ang sarili natin kasi po nakakapag-focus po tayo kapag mag-isa lang po."
	• Solve on Paper then Recite	• SE 08:28: "sinolve ko po sa paper, then after ko pong isulat, tinago ko po siya, and then nirecite ko siya after."

	• Self-Explanation and Independent learning • Improved Attention to Detail Through Self-Explanation • Awareness of Weak Understanding in Self Explanation • Self Explanation as Evidence in Mastery	• SB [21:40]Kapag ganun po ako magpaliwanag, mas na-naintindihan ko siya, kaya nakakapag self-study po ako. • SC [19:26]Nakatulong po siya lalo na sa attention to small details Kasi po sa solving problems, lalo na sa physics, kailangan talaga natin intindihin 'yung mismong given or 'yung problem na binigay. • SF 23:12: "Kunwari po, mabubulol ka o titigil ka kasi hindi mo alam ang sinasabi — doon mo po mas makikita o mapapansin na "Ay, parang hindi ko 'to alam kung paano sasabihin o i-explain." Mas aware ka po kung

	• ano talaga ang pagkakaintindi mo o kung ano 'yung hindi mo pa nagets."
• Self-Monitoring and Error Detection • Verbalizing Solutions to Reinforce Understanding	• SH 15:00: "Ano po, nakakatulong po siya since, di ba nga po meron po tayong learning method na… ginagawa ko na. Hanggat, kasi po 'yung saying na sinasabi po nila na, hindi mo talaga gets ang isang lesson kapag hindi mo kayang ituro sa iba or sa sarili mo."
• Appreciation of Blurting Method • Efficiency of Self Assessment using Blurting Method	• SB 24:39: "Ni-retrace ko po 'yung steps ko… nakita ko na may mali pala akong napindot." • SC 20:03: "Kapag ginagamit ko 'yung self-explanation… tinatry ko siyang i-solve, tapos ine-explain ko kung paano ko siya nakuha.

• No Comprehension if Student cant Explain it	• SE 13:33: "mas maganda po 'yung blurting method"
• Faster Understanding Through Self-Focus	• " think mas maganda pong method iyon kase parang na-tra-train po ang utak po natin na i-retrieve po ang mga information na nakuha na natin in the past, tapos nakalimutan lang rin pala natin."
• Advocacy of Effectiveness of the Individual Learning	• SH [15:00: "Hanggat, kasi po 'yung saying na sinasabi po nila na, hindi mo talaga gets ang isang lesson kapag hindi mo kayang ituro sa iba or sa sarili mo."
• Effective Self Assessment using Self Explanation	• SA [5:59] Yun nga po, kasi pag mag-isa lang po ako, mas mabilis po akong makagets. Pag sa sarili ko lang po ako nagfofocus.

• Individual Strategy Builds Confidence in High Performers	• SG 28:31: "Kasi po kung gusto po talaga nila ma-enhance ang skills po o ma-enhance ang critical thinking po, para po sa akin mas maganda po talaga ang individual po, regardless sa ano po ng bata."
• More Benefits in Problem Solving in Individual	• SH 15:28: "Kasi di ba po, pag nagsusulat ka, parang may notes ka, parang mas mahirap, or hindi po effective po 'yun pag ganun mag-aral, kasi po, hindi mo po kayang i-explain."
• High Concentration in Individua	• TB [35:38] Effective ang individual kapag problem solving. Frustrating para sa mga hindi nakakuha, pero 'yung iba na nakakakuha, mas confident. 'Yung

		iba nagtatanong lang. Kapag hindi nila makuha, nagiging hopeless sila.
		• TA 44:48:"Self-explanation. Mas nagbe-benefit sila kasi mas natututo sila sa sarili nilang paraan. Kumbaga, natututo sila na sila ang sasagot doon sa problem na 'yun individually.
		• "Mas natututo sila, mas nagko-concentrate sila."
Self Explanation Preference	• Delayed Error Awareness During Self-Explanation	• SA [2:58] "Ahm, kasi po nare-realize ko lang po na may mali ako kapag tapos ko na po lahat gawin. Nakakatulong po siya, pero parang hindi ko po masyadong napapansin kapag nagkakamali. Pag tapos ko na po, saka ko po nakikita."

	• Context-Dependent Strategy Effectiveness	• SC 26:11: "Sa self-explanation naman po, more on assessing kung na-gets mo ba talaga 'yung topic. Pero kapag solving, minsan kailangan mo talaga ng helper kapag hindi mo ma-gets."
	• Lack of Immediate Feedback in Independent Study	• SD [19:59]Kapag self-study, confident po ako na okay 'yung inaral ko—pero walang kasiguruhan kung tama. Wala po kasi akong mapagtanungan kung okay ba 'yung ginawa ko.
	• Preference on Member Role	• SF 03:33: "Ayaw ko po maging leader."
	• Preference for Individual Work	• "Mas okay na sarili po."
	• Difficulty Maintaining Focus Amid Distractions	• SA [5:26]Minsan po mahirap pong intindihin pag marami pong distraction.

	• Admit Self Explanation Preference/ Distinguishing Unfamiliar Factor in Self Explanation	• 12:23: "Mas gusto ko po sa self-explanation kasi po minsan kapag nagsosolve po ako, kapag may nakikita po akong factor na parang kakaiba o parang hindi ko pa po siya familiar, nag-iiba po 'yung nangyayari." SE
	• Preference for Individual • Individual Strategy Preference	• SA 28:31: "Individual po. " • TA 11:13: "Ako kasi, tatapatin ko na kayo — usually kasi, ang ginagamit ko lagi ay more on individual. More individual talaga. Kasi mas natututo ang mga bata kapag nag-iindividual sila." • 27:22: Mas na-e-enhance nila yung problem-solving skills nila in physics kapag individual, kasi mas natututok sila o mas nagko-concentrate sila."
	• High Enhancement in Problem because of Self Concentration	

		• Problem Solving Enhances Learning When Done Individually	• TB.[33:27] So sa problem solving, mas effective ang individual para matuto sila. Pwede naman magtanong habang nag-aaral. Kapag nagtatanong sila, collaborative 'yun. Pero hindi lahat nagtatanong. At least, kapag may batang nahihirapan, pwede mong sabihan na,
Comparative and Influencing Factors	Learning Integrity and Accountability	• Member not Participating on Groupings • Member No Contribution will have Scores too	• TA 20:51: "Actually, sa collaborative meron talaga akong napapansin na problema. May mga students kasi na hindi talaga nagpaparticipate sa klase, lalo sa groupings.
		• Cheating is inevitable in Self Explanation/Individual	• TB Isa pang problema diyan, kapag nagkaroon ng groupings at hindi nagparticipate, magkakaroon pa rin ng grade, magkakaroon pa rin ng score.

• Seeking Help is Different from Copying	• TB Sa self-explanation naman, sa individual naman, ang nakikita kong problema doon ay 'yong silipan, kopyahan, cheating — 'yong kinokopya ang sagot.
• Having a Timer and Robing to Avoid Cheating	• Iba 'yong nagtatanong ka sa kaklase kaysa ginagaya mo ang sagot, which is bawal talaga 'yong kinokopya. - TB
• Perceived Grade Fairness	• So, ang ginagawa ko diyan, inuorasan ko sila — like 10 minutes, 15 minutes, tapos tatlong problem. Kasi 'yon ang nakikita kong paraan para hindi magkaroon ng cheating. Pag binilisan mo 'yong oras, walang mangyayaring cheating. At the same time, umiikot talaga ako." - TB

• Value of Individual Assessment and Self-Monitoring • Strategy Choice Based on Task Complexity and Accountability	• 13:03: "Meron po siyang malaking contribution, kase po… ahh… kapag po kase ako ang leader, kunwari po nag… ako lang po ang may malaking contribution doon sa grade na nakukuha ko. Pero kapag po groupings halimbawa po, mababa po kaming lahat, hatak po iyon sa grade po, ganun po." - SG
• Comfort Asking Teacher	• [31:28] Parang sa akin po, individual. Kasi po 'yun nga po 'yung ginagawa ko—ina-assess ko po 'yung sarili ko. Tapos namo-monitor po natin 'yung individual progress ng students. - SC
• Leadership challenge and autonomy in group work	• [27:26]Sa akin po, naka-base talaga sa complexity. Kasi po kapag hindi mo talaga gets, kailangan mo mag-individual para ma-achieve 'yung grades. Kapag

		• group work, minsan group grade lang 'yung binibigay, kaya nagre-rely lang 'yung iba. - SC
		• 18:52: "Kasi po mas alam po nila ang gagawin at wala pong second thoughts." - SF
	• Copying in Seatwork to Classmates Leads to Low Score in Exams	• [23:42]Meron. May isang student na hindi nahirapan sa content, pero sa leadership. Na-frustrate siya kasi gusto niya maganda 'yung output, pero 'yung members niya hindi cooperative. Sabi ko, "Hindi pwede 'yan." Ihiwalay na lang siya. Nung humiwalay siya, kaya naman niya mag-isa. Naka-stand 'yung group niya, naka-present. Pero bilang achiever, gusto niya 'yung idea niya ang lumabas. - TA
	• No Comprehension and Understanding Effect on Cheating	

• Reminder for Students about their Responsibility and Accountability • Over-reliance on peers despite learning strategy • Resource Seeking Behavior	• 23:56: " Let's say for example, kinokopya nila ang sagot ng katabi. Pagdating ng exam, tapos wala silang mapagkopyahan, it will affect their answers. May tendency na bababa ang score kasi umaasa lang sila sa katabi nila. Kaya napa-perfect nila 'yong seatwork, pero pagdating sa exam, since wala silang katabi, one seat apart pa — mahihirapan talaga sila. - TA • So dahil kinokopya lang nila dati, hindi nila alam kung paano mag-solve. Mahihirapan talaga sila doon. Kasi more on cheating e, puro cheating." - TA

- 25:57: "Kaya lagi kong sinasabi sa mga estudyante ko: "Dito sa Grade 12, hindi pwedeng umaasa ka sa katabi o umaasa sa iba. Dapat ikaw din mismo tinutulungan mo ang sarili mo; ikaw din ang sumasagot sa mga questions ng teacher mo, especially sa problem-solving." - TA

- Para magka-grade ka o magka-score ka, kahit sabihin na collaborative or self-explanation 'yan, at the end of the day, pag nag-exam ka, mahihirapan ka kung umaasa ka lang sa katabi mo at hindi ka nag-aaral." - TA

- 05:40 "Sa sarili ko na lang pong knowledge. Pwede po mag-ask sa teacher o sa leader." – SF

Comparing Learning Strategies	• Individual Learning as Default vs. Collaboration as Contextual	• 11:13: "Ako kasi, tatapatin ko na kayo — usually kasi, ang ginagamit ko lagi ay more on individual. More individual talaga. Kasi mas natututo ang mga bata kapag nag-iindividual sila. Pero, collaborative is ginagamit ko lang siya kapag merong laboratory." - TA
	• More Comprehension in Individual than Collaborative	• 12:53: "Na-observe ko sa mga students na individual learning kasi mas natututo sila sa individual learning kaysa sa collaborative. - TA
	• Enjoyment in Collaboration vs. Seriousness in Individual Learning	• "Mas nage-enjoy sila kapag collaborative. Kasi mga bata ngayon, kapag collaborative, nagiging masaya sila sa mga experiments nila. Unlike sa individual, talagang seryoso sila. Pero when it comes to learning, mas gusto nila ng individual." – TA

• Low Motivation and Isolation in Individual Learning	• [22:36]Mas may problema sa individual. Minsan nawawala 'yung motivation. Sa group, may leader, may nagdi-direct. Isinasama nila 'yung iba sa pag-aaral. Pag individual, hindi lahat nakakasabay. - TB
• Leadership and Inclusion in Collaborative Learning	• [23:01]Sa group, gawahan na lahat. May mga sumasali, may mga hindi, pero mas may benefits talaga 'yung may group. - TB
• Comparison of Social vs. Individual Correction	• [26:05]Sa collaboration po, nagtutulungan kayo para mag-correct at mag-guide sa isa't isa… sa self-explanation naman, more on pagtatama ng sarili. - SB
• Social vs. Individual Learning Process	

• Balancing Shared and Independent Learning	• [26:11]Yung pinagkaiba po, lalo na kapag nahihirapan ka sa topic, mas madali po kapag nagtutulungan. Mas makukuha mo kasi ka-level mo lang 'yung kausap. Hindi katulad kapag online ka, nagse-self study ka sa topic na 'yon—medyo complex 'yung terms, hindi mo agad ma-gets. - SC
• Self-Study Distractions	Pag nakikipag-collaborate ka po, nagkakaroon ng sharing of ideas, at mas lumalawak po 'yung kaalaman ko. Pero pag mag-isa ka naman po, sa self-explanation, nahahasa po 'yung sarili nating kaalaman kasi naiintindihan po natin sa sarili nating paraan. - SA

• Students can do on their own if Individual • Tons of Loopholes in Collaboration	• [49:02] Mas nadidistract po ako kapag self-explanation kasi mag-isa lang ako at may mga bagay na pwedeng makasira ng focus, tulad ng cellphone. Pero kapag collaborative, may isa kaming goal at nasa tamang environment kami — time talaga para mag-aral. Kaya mas nakaka-focus ako. - SB
• Self-Explanation Builds Confidence while collaboration faster Problem Solving	• 27:22: "For me, more on individual ako, kasi mas na-observe ko na kapag nag-individual sila, they can do it on their own." - TA
• Collaboration Needed for Difficult Tasks	• Sa collaborative, walang problema, kaso minsan sa collaborative ang daming loopholes. Ang dami ring loopholes sa collaborative." - TA

	• More Immersed in Individual Task Activities in Physics	• [19:00]Sa collaborative po, mabilis po 'yung pag-iisip kasi nag-share lahat ng ideas. Kapag self-study naman po, hindi ko po agad ma-guess, kaya kailangan ko po aralin nang sarili ko. - SD
		• [32:26]Kapag sobrang hirap, kailangan ko po ng kasama. Kapag kaya naman, individual na lang. - SD
		• 09:11: "More on individual sa Physics." - SG
Instructional Effectiveness	• Teacher Reliance for Clarification	• 20:34: "Mas comfortable po talaga ako sa teacher po. Nadala na po ako." - SG
	• Online and Teacher Sources	• 22:05: "Google po. At sa teacher po." - SG

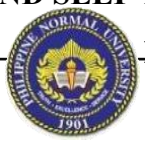
	• Guide from Others	• 24:26: " Then saka niya po gina-guide na kunwari may problem na hindi ko po agad naintindihan" - SE
	• Teacher-imposed individual learning	• [37:24]Sinasanay po talaga kami ni Sir na mag-individual. Pero hindi po maiiwasan na may mga estudyante na nagbibigay ng self-work. May mga estudyante na lilipat ng pwesto para makabuo ng group at sabay-sabay mag-aral. - SC
	• Shift to individual learning due to topic complexity	• [30:58]Naging individual na ako doon kasi mahirap talaga 'yung topic. Sa velocity, displacement, acceleration— nagtatanungan sila, pero minsan nagkakanya-kanya na. Kapag ganun kasi, parang math na rin 'yun. Kailangan masukat kung naiintindihan nila – TB
	• Strategic grouping based on task difficulty	

• Strategy Adaptation Based on Subject Complexity	• [30:58]Naging individual na ako doon kasi mahirap talaga 'yung topic. Sa velocity, displacement, acceleration— nagtatanungan sila, pero minsan nagkakanya-kanya na. Kapag ganun kasi, parang math na rin 'yun. Kailangan masukat kung naiintindihan nila - TB
• Strategy Flexibility Based on Topic Difficulty	• [31:27]Sa physics, hindi masyado nagwo-work ang collaboration. Unlike sa Gen Sci, mas maraming pwedeng collaborative. Sa physical science, karamihan nagta-transition sa individual lalo na sa computation. Pero sa chemistry, may parts na pwedeng collaborative. - TB

	• Instructional adjustment and remediation based on learner difficulty	• [36:43] Kahit alam mong effective ang collaborative, minsan kailangan mong mag-shift sa individual. May times na kahit na-plano mo na collaborative, may estudyanteng magsasabi, "Ma'am, mahirap po ito, partner na lang." So mag-a-adjust ka. Sabi ko, "Sige, partner na lang." Naka-base talaga sa topic at sa student feedback. - TB
		• [37:26]Kapag nahirapan sila sa topic, mag-a-adjust ka. Magre-revisit ka sa susunod na araw. Hindi naman lahat agad master sa computation. - TB
Emotional Dynamics	• Difficulty Initiating Interaction Due to Introversion	• [7:00] Mahirap po mag-approach sa isang tao lalo na kung hindi ko pa sila totally kausap. Introvert po ako, kaya kapag meetings, tahimik lang ako. – SD

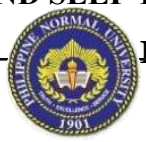
• Positive Intention and Outlook in Peer Teaching	• kapag nabanggit na po ang groupings, parang ang nararamdaman ko po ay parang gusto ko pong turuan sila. Gusto ko pong ituro kung paano ko nakuha 'yun." - SH
• No Trust in Groupmates	• 24:28: "may mga student po na kagaya ko na hindi po nakikinig sa classmates nila." - SF
• Conflict in Group Work as a Barrier to Learning	• [26:58]Yun nga po, kasi may experience kami noon na nagkaroon ng argument sa group… hindi na po kayo makakapag-aral kasi nagfo-focus na lang kayo sa pag-aaway. -SC
• Irritated having No Options	
• Difficulty in knowledge articulation and performance under pressure	• 15:48: "Naiirita po, kasi wala naman pong choice." - SF

• Collaborative support and emotional regulation	• Sa first quarter po, about project and projectile. Nahirapan po ako kapag alam mo naman 'yung topic, pero kapag tinanong ka na, hindi mo masagot. Doon po ako nahihirapan sa physics, lalo na sa recitation. Siguro po 'yung pinaka-challenge sa akin, - SD
• Negative Feelings towards Peer Members • Avoid Conflict to Others when Individual Study	• [42:07] Para sa akin po, I think mas okay po 'yung madalas mag-collaborate, lalo na 'yung mga times na sumusuko na o nagse-self-doubt. - SC
• Reason for Avoiding Collaboration:Inevitable Distraction	• 12:26: "Pet peeve ko na po mismo, ayaw ko na po sa kanila, naiinis po ako sa kanila." -SF



		• 11:14: "Mas okey na po sa akin na sarili ko po ang kalaban ko, kesa nagkakaroon po ako ng tampo or parang… ano sa iba na. Kunwari parang sisi, parang ganun po - SG • 25:58: : Distractive po. Nakakadistract po na imbis makafocus ka sa isa, nababaling po ang atensyon, lalo na po kapag kaibigan mo ang kasama mo." -SF
Learning Motivation	• Hands-On Projects Benefit from Collaboration	• [21:06]Kapag gumagawa ng models. 'Pag nagme-make sila ng models, mas nagwo-work 'yung collaborative. Parang may care sila sa ginagawa. - TB

	• Lower Motivation in Individual Work	• [21:25]Pero kapag individual, nawawala 'yung interest. Sa mga group na gumagawa ng models o nagpe-present ng project, mas engaged sila. - TB
	• Inquiry/Curiosity in Physics in Fun Way	• 04:41: "Sa mga Viking rides po, nagtatanong po kami kung paano raw po nakaka-balance ang mga tao dun sa taas kahit minsan walang kinakapitan. Nae-explain po 'yon ng Physics. Ang ginagawa po namin, nagse-search po kami." - SG
	• Confidence and Efficiency in Independent Work	• [3:51]Mag-isa po. Pag mag-isa po kasi ako, mas mabilis ko pong nagagawa 'yung solving at mas confident po ako kasi ako lang po gumagawa. Pag iba po, hindi po natin sure kung tama 'yung ginawa nila. – SA
	• Self Learning and Discipline is a Must/ Appreciate the Importance of Individual	



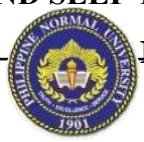
		• 17:15: "Ang pinaka-importante po ay self-learning or self-discipline. Mas preferred ko po kase talaga ang individual." - SG
Confidence development	• Confidence Building Through Peer Validation	• [27:15]Mas collaborative po ako kasi minsan may hesitation ako sa sagot ko. Mas nakakagaan po ng anxiety kapag may naco-confirm akong tama. - SB
	• Emotional Strain from Studying Alone	• [27:10]Opo, mas nade-depress po ako kapag wala akong kasama mag-aral. Pero feeling ko po, sa inyo may understanding. Mas naintindihan kopo. Pero napre-pressure pa rin po ako. – SD
	• Learning by Imaginative Thinking	

		• Confidence in Knowledge in Self Explanation •	• 12:26: "Ano po, pag self-explanation po, parang haha, tinuturuan ko po ang sarili ko about dun sa ano na 'yun. Ano po, pag nasa bahay po, parang tumitingin lang po ako sa mirror, tinitingnan ko lang po ang reflection ko as ibang estudyante." - SH
			• 23:12: "Yung sinasabi po, kasi mas prefer ko po 'yun. Bukod sa less work or energy na nakokonsume po, mas alam mo po 'yung sinasabi mo." - SF
Strategies in Solving Physics Problem	Conceptual Understanding	• Enhanced learning through peer interaction	• SC [12:00]Nadadagdagan talaga 'yung insights at ideas kapag may kagrupo.

	• Learning from more knowledgeable peers	• SC [12:14]May kagrupo kami na mas marami pong alam… valuable 'yung input niya. Imbes na surface level lang 'yung alam ko, mas napapalalim pa po 'yung understanding ko sa topic.
	• Deeper Conceptual Understanding through Collaboration	• SB [56:01] Opo. Kasi kapag collaborative, may kanya-kanya kaming understanding at nakikita namin kung pareho ba o iba-iba ang pag-intindi namin. Kung iba man, natutulungan naming linawin kung ano talaga ang gusto ng teacher. Kaya para sa akin, mas maganda talaga ang collaborative.
	• Need for Peer Validation in Understanding Concepts	

	• Deeper Understanding Through Self-Teaching	• SD [28:45] Ang bilis nila magsagot. Gusto ko naman po, gets ko 'yung lesson, pero parang kino-confirm ko pa sa kanila kung naintindihan ko talaga. Minsan po, ang bilis nila, nahuhuli po ako. Parang naisip ko, "Ang bagal ko ba mag-solve?" Ganun po. Kaya minsan, napre-pressure ako lalo na sa physics.
	• Effective Use of Self-Explanation in Conceptual Topics	• SA [1:40] Hindi po ako familiar. Ngayon ko lang po siya narinig. Ahm, sa sarili ko po, pag nag-e-explain po ako, mas naiintindihan ko po 'yung isang bagay kasi para na rin po akong nagtuturo sa iba. Mas naiintindihan ko po lalo 'yung topic.
	• Effectiveness of collaborative learning for conceptual understanding	

		• SA [8:00] Sa resultant vector po. Diyan ko po mostly nagagamit 'yung self-explanation kasi marami pong formulas at methods na ginagamit. Kaya po naiintindihan ko dahil may step-by-step solution.
		• TB [40:16]Para sa akin, mas effective 'yung collaborative strategy. Kasi kapag nagtutulungan 'yung mga estudyante, mas napapadali sa kanila maintindihan 'yung concept.
Task Management	• Task is Finish Quickly	• SE 22:58: "groupmates mo may ibang way ng pagso-solve, mga short formula, mas natutunan ko rin po."
	• Concentration in Individual but When Disrupt no one will Call Out	



• Making Time to Study Physics	• SG 07:22: "Ang advantage po ng mag-isa ka lang is nakakapag-focus ka sa studies mo. Ang cons naman po nun, kapag na-distract ka po, tuloy-tuloy po 'yon."
• Role for Task Completion • Groupings in terms of Project	• SF 08:51: "Ah, siguro po, hindi po ako masyadong fan ng Physics. Pero since hindi po ako magaling sa Physics, parang inaral ko po siya.
• Avoid Burnout by Task Distribution	• SE 02:33: "Important po noon ay nagkaroon kami each ng role para ma-complete ang project"
• Pre-Group Preparation	• 04:52: "groupings kapag ang project kailangan"

	• On-the-Spot Completion Preference	• "na-di-distribute po at hindi po na-bu-burnout ang isang tao."
	• Reduce the Burnout Effect	• 14:11: "Kapag groupings po, I think, better po na mag-list down ng notes po muna."
	• Historical Study Habit: Individual	• SF 07:15: "ayaw ko na po gawin sa bahay. Dederetsuhin ko na pong gawin dito."
	• Efficiency in time and understanding of Individual	• SE 04:52: "groupings kapag ang project kailangan. Na-di-distribute po at hindi po na-bu-burnout ang isang tao. Individual po may mga times po na ikaw ang kailangan mag-decide kung ano ang gagawin ninyo."

	• Student Preference vs. Task Requirement in Strategy Use	• SF 26:33: " Pag Physics po kasi talaga, mag-isa lang po talaga ako."
		• SF 23:12: "Yung sinasabi po, kasi mas prefer ko po 'yun. Bukod sa less work or energy na nakokonsume po, mas alam mo po 'yung sinasabi mo."
		• TB [38:11] mas prefer nila ang collaborative. Pero alam naman nila na kapag computation na, kailangan talaga nila gawin nang mag-isa. Kaya 'yung iba, nagpapaturo muna sa kaklase. Kapag nakuha na nila, masaya sila. Nagiging katuwang na rin namin 'yung mga marurunong sa math. Pero sa individual, lalo na sa computation, hindi sila confident. Mas gusto nila hati-hati ang task— kawawa pa nga

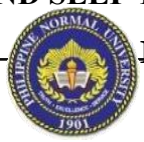
		'yung iba
Critical and Analytical Thinking	• Reflective thinking and error analysis	• SB [18:49]Tapos pag hindi parehas, tapos sa kanila tama pala, iniisip ko po sa sarili ko kung saan ako nagkamali. Babalikan ko po 'yung solution ko, hahanapin ko kung saan kami nagkaiba, at doon ko po nafi-figure out na ah, mali pala ako sa computation. Doon ko po ini-improve 'yung sarili ko.
	• Simplifying concepts for deeper understanding development of critical thinking skills	• [21:25]Mas naiintindihan ko po kapag ini-explain ko siya na parang kausap ko ay bata.
	• Development of critical thinking skills	• SC So kailangan po talaga ng critical thinking. Doon po nakatulong sa akin 'yung self-explanation.
	• Error detection through self-explanation	• SC [20:23]Na-realize ko na iba pala 'yung sagot ko… doon ko nakita 'yung mistake.

• Detecting and correcting personal errors	• SE 11:33: "And parang may napansin po akong time na parang nabaliktad ko po ang equations, and then, nung chineck ko po, baliktad po talaga siya. So, umulit po ako."
• Self-monitoring and error detection	• SB [6:43] Self-explanation po. 'Yun nga po, sa focus po at sa critical thinking din. Pag nag-aaral po tayo on our own, mas mabilis po natin naiintindihan ang isang bagay.
• Enhanced Focus and Critical Thinking in Solo Study	• SB [28:07]Sa collaborative, pwede ka magtanong anytime, tapos may feedback ka agad—pero walang permanent consequence. Pwede mo pang baguhin at i-correct. Kaya mas helpful po siya

• Strategic and Reflective Learning	• Self Explanation and Observing Others	• SF 08:51: "Siguro po nung Grade 9, nung may Physics po kami, tinry ko pong i-explain sa sarili ko tapos pinapakinggan at tinitingnan ko rin po ang iba kung paano sila mag-review."
	• Personal Self Explanation Method	• SH"12:26: "Ano po, pag self-explanation po, parang haha, tinuturuan ko po ang sarili ko about dun sa ano na 'yun. Ano po, pag nasa bahay po, parang tumitingin lang po ako sa mirror, tinitingnan ko lang po ang reflection ko as ibang estudyante."
	• Effective Self Assessment using Self Explanation	• 15:28: "Kasi di ba po, pag nagsusulat ka, parang may notes ka, parang mas mahirap, or hindi po effective po 'yun pag ganun mag-aral, kasi po, hindi mo po kayang i-explain."
	• Improved Comprehension and Flexibility	

	• Reduced Time Pressure Enhances Understanding and Confidence	• SA [2:10]Pag naiintindihan mo po kasi 'yung topic, mas madali po nating masasagutan ang mga katanungan tungkol doon, at mas magiging flexible po tayo kahit ano pong itanong sa atin. Mas madali po lahat.
	• Self Assessment of Weak Understanding • Sequential learning and written reinforcement	• SD [10:46]Siguro po kasi hindi ako masyadong na-pressure sa time, kaya nakatulong siya sa pag-intindi. And dahil mataas po 'yung score ko, nakakatulong din po siya sa confidence ko.
	• Repetition for memory retention	• SE 09:38: "nalalaman ko po kung saan ako mahina at ano ang dapat kong i-improve."

• Weaknesses Easily can Spot	• SB [21:25]Sinusulat ko muna step by step… para matandaan ko.
• Review-based reinforcement and memory retention	• [24:39]Paulit-ulit ko na siyang nakikita… natatandaan ko pa rin kasi alam ko na 'yung flow.
• Write before Self Explanation	• SH 16:55: "Kase mas makikita mo kung saan ang kahinaan"
• Self Assessment of Weak Understanding	• SC [19:48]Yes po, mas gusto ko po 'yung may whiteboard, sinusulat ko po talaga
• Mirror-Assisted Self-Explanation	• SD [11:00]Opo. Kapag may quiz o seatwork, binibigyan po kami ng review activity bago mag-quiz. Doon po siya nakakatulong sa akin kasi fresh pa sa utak ko



	• Self-Questioning to Reflect and Improve Strategy	• SE 09:38: "nalalaman ko po kung saan ako mahina at ano ang dapat kong i-improve."
	• Adaptive Use of Strategies Based on Learning Environment	• SH 12:26: "Ano po, pag self-explanation po, parang haha, tinuturuan ko po ang sarili ko about dun sa ano na 'yun. Ano po, pag nasa bahay po, parang tumitingin lang po ako sa mirror, tinitingnan ko lang po ang reflection ko as ibang estudyante."
	• Preference for individual problem-solving • Use of visual aids for self-instruction	• SD [15:40]Tinitingnan ko po kung may kailangan akong baguhin. Parang tinatanong ko po 'yung sarili ko, "Okay ba 'yung ginawa ko?"
	Situational Strategy in Lesson plan	

	• Consider the Learning and Comprehension of Students • Content Base Strategy in Lesson Plan	• SC [32:01] Para po sa akin, naka-base po sa setting. Kapag sa school, may mga taong pwede mong tanungin. So kapag nagkamali ka, may mag-a-assess, kaya doon kami nagiging successful. Sa bahay naman po, doon ako nagre-rely sa self-explanation. • SD [31:30]Pero sa physics po, mas pipiliin ko po mag-individual kapag nagsa-solve.
	• Recommending both strategies to see the Real Benefits of two • Complexity Collaboration	• SA [19:14]Gumagawa rin po ako ng flashcards, tapos tinuturo ko sa sarili ko. • TA 46:15: "sasabihin ko, "Both." Bakit? Depende 'yan e. Kasi sila ang gagawa ng lesson plan, sila ang gagawa ng content. Kayo, gagawa kayo ng content, gagawa kayo ng lesson plan.

		• So based on the lesson plan at sa gusto niyong mangyari para matuto 'yung bata, doon ako. • "kayo mag-practice teaching kayo, gusto ko both collaborative and self-explanation para at least makita niyo bilang susunod na teacher, future educator, kung alin ba talaga ang mas makaka-benefit." • 49:39: "Ako kasi, kung complexity na naman ang pag-uusapan, kung alam ko sa sarili ko kung ano ang strategy na gagamitin ko, gagamit ako ng collaborative."
Applied and Skill-Based Learning	• Use of Writing as Reflection Tool • preference for visual and kinesthetic learning	• SA [2:38] Na-try ko na po magsulat habang nagsosolve • SC [19:48]Yes po, mas gusto ko po 'yung may whiteboard, sinusulat ko po talaga

	• Active Learning Through Verbalization	• SF 08:51: "Tinry ko pong i-explain sa sarili ko tapos pinapakinggan"
	• Memorizing the Formula While Reviewing • Efficiency of Individual Work	• SG 10:43: "Minsan po aaralin ko po talaga siya ng buo, para po doon po pag mag-quiz na, doon po ako nagre-review. Kase gagawa po ako ng… tinatandaan ko po ang formula"
	• Knowledge Retention	• SF 06:15: "Mas mabilis po matapos kasi wala na po yung parang need mag-brainstorming."
	• Multimodal Learning Preference (Visual + Auditory)	• 28:57: " Naalala ko na lang po 'yung mismong topic kung paano siya isolve."

		• SB [39:13]Definitely po collaborative. Mas naiintindihan ko kapag may nag-e-explain habang nagsusulat ako. Kahit sa self-explanation, umaasa pa rin ako sa ibang medium tulad ng videos. Pero sa collaborative learning po, may explanation plus visualization, kaya mas natututo ako.
	• Hands-On Collaboration Enhances Conceptual Understanding	
		• SD [34:15]May actual activity po kami. Kunwari po, kailangan namin mag-measure ng time. So gagawin mo talaga 'yung experiment—hindi lang siya base sa formula. Actual na ginagawa para makuha 'yung sagot.
	• Real-life Knowledge in Teaching based on Personal Experience	

- TA 50:57: "My experience. Yes, my experience. Kasi hindi ko sasabihin sa mga future teachers kung hindi ko na-experience. I'm just going to say it's my real-life experience 'yung ganung strategy."

A COMPARATIVE ANALYSIS OF SENIOR HIGH STEM STUDENTS' PERCEPTIONS OF COLLABORATIVE AND SELF-EXPLANATION STRATEGIES IN SOLVING PHYSICS

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The National Center for Teacher Education

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With Highest Honor (Senior High School)

Most Outstanding SK sholar (2021-2022)

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2019-2020	Alcohol Use and Misuse: The Causes and Effects of Drinking Alcohol on the Early Stage of Life Among Young People (Grade 10)
2021-2022	Impact of Social Media on the Political Behavior and Values of Senior High School Students