ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 12| Issue: 4| April 2026|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2026: 8.753 || ISI Value: 1.188

STUDENTS' PERCEPTIONS OF PROBLEM-BASED LEARNING AND ITS EFFECTIVENESS IN ENHANCING SCIENTIFIC UNDERSTANDING, CRITICAL THINKING, AND ENGAGEMENT IN SCIENCE 10

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ABSTRACT

This study aimed to determine the students' perceptions of Problem-Based Learning (PBL) and its effectiveness in enhancing scientific understanding, critical thinking, and engagement in Science 10. Specifically, it sought to describe the respondents' profile in terms of age and gender, assess their perceptions of PBL in terms of activities, instructional methods, assessment tools, and overall effectiveness, identify the problems encountered in the implementation of PBL, and propose appropriate interventions to address these challenges.

The study employed a descriptive research design and involved forty-two (42) Grade 10 students of Calintaan National High School, Calintaan, Occidental Mindoro. Data were collected using a structured questionnaire and analyzed using frequency counts, percentages, and weighted mean.

The findings revealed that most respondents were aged 15 to 16 years old, with a slightly higher proportion of male students. Students perceived that PBL activities such as group work, brainstorming, and sharing of ideas were frequently implemented. Instructional methods and assessment tools related to PBL were also generally rated as "often" utilized. Overall, students demonstrated a positive perception of the effectiveness of PBL in enhancing their scientific understanding, critical thinking, and engagement.

However, several challenges were identified, including issues related to teacher motivation, time constraints, and difficulties in implementing PBL strategies. Despite these concerns, the overall level of problems encountered was considered only slightly serious. Respondents strongly supported interventions such as teacher training, increased motivation, provision of instructional materials, and regular supervision to improve PBL implementation.

The study concludes that Problem-Based Learning is an effective instructional approach in Science 10, as perceived by students. It is recommended that educators continue to implement and strengthen PBL strategies with institutional support. Future research may explore its application in other contexts and the integration of technology to further enhance learning outcomes.

KEYWORDS: *Problem-Based Learning, scientific understanding, critical thinking, student engagement, Science 10, instructional strategies*

INTRODUCTION

Education in the 21st century emphasizes the development of higher-order thinking skills, scientific literacy, and active student engagement to prepare learners for real-world challenges. Traditional teaching approaches, which often focus on rote memorization and passive learning, are increasingly seen as insufficient in fostering critical thinking and meaningful understanding among students. In response, educators have shifted toward learner-centered pedagogies that promote inquiry, collaboration, and problem-solving. One of the most widely recognized approaches in this context is Problem-Based Learning (PBL).

Problem-Based Learning is grounded in constructivist theory, which posits that learners actively construct knowledge through experiences and interactions. In PBL, students are encouraged to investigate complex problems, collaborate with peers, and apply their knowledge to find solutions. This approach enables learners to move beyond memorization and develop deeper conceptual understanding. In science education, where abstract concepts are often difficult to grasp, PBL provides meaningful contexts that help students connect theoretical knowledge to real-world situations. As a result, it enhances not only content knowledge but also essential skills such as critical thinking and problem-solving (Aripin et al., 2025).

Recent studies have shown that Problem-Based Learning is effective in improving students' critical thinking skills. A meta-analysis conducted by Wiratama et al. (2025) revealed that students exposed to PBL demonstrate significantly higher levels of critical thinking compared to those taught using traditional methods. Similarly, a meta-analysis by the European Journal of Educational Research (2024) found that PBL consistently outperforms conventional instructional approaches in fostering critical thinking, with a strong overall effect size across different educational settings. These findings highlight the importance of integrating PBL in science classrooms to develop learners who can analyze, evaluate, and solve complex problems.

In addition to critical thinking, PBL has been recognized for its ability to enhance student engagement. Engagement is a crucial factor in the learning process, as students who are actively involved are more likely to retain knowledge and develop a positive attitude toward learning. According to Amoa-Danquah and Carbonneau (2025), Problem-Based Learning promotes higher levels of student participation, motivation, and collaboration compared to traditional teaching methods. By presenting real-world problems that are relevant to students' lives, PBL encourages curiosity and sustained interest in learning, particularly in science subjects.

Furthermore, scientific understanding is another key area influenced by the use of Problem-Based Learning. Science education requires not only the acquisition of knowledge but also the ability to apply concepts to real-life situations. PBL facilitates this by allowing students to explore scientific concepts through inquiry and experimentation. Instead of passively receiving information, students actively engage in the learning process, leading to deeper comprehension and long-term retention of knowledge. Studies have shown that PBL supports the development of problem-solving skills and scientific reasoning, both of which are essential for understanding complex scientific phenomena (Aripin et al., 2025).

Despite its numerous advantages, the implementation of Problem-Based Learning is not without challenges. Several studies have identified issues such as lack of teacher preparedness, insufficient instructional materials, time constraints, and difficulties in assessment as barriers to effective implementation. The success of PBL largely depends on the teacher's ability to design meaningful problems, facilitate discussions, and guide students without directly providing answers. Additionally, students who are accustomed to traditional learning methods may initially struggle to adapt to the active and self-directed nature of PBL (Amoa-Danquah & Carbonneau, 2025). These challenges highlight the need for proper training, support, and strategic interventions to ensure the successful integration of PBL in classrooms.

Moreover, recent innovations in education, such as the integration of technology with Problem-Based Learning, have further enhanced its effectiveness. Cong and Ironsi (2025) found that combining PBL with digital tools and mobile learning can significantly improve students' problem-solving abilities, critical thinking, and overall engagement. This suggests that PBL can be adapted to meet the demands of modern education and can be effectively implemented in various learning environments.

Given the growing emphasis on student-centered learning, it is essential to understand how students perceive the effectiveness of Problem-Based Learning, particularly in Science 10. Students' perceptions play a vital role in determining the success of any instructional approach. If students perceive PBL as engaging, meaningful, and effective, they are more likely to participate actively and benefit from the learning process. On the other hand, negative perceptions may hinder the effectiveness of the approach, regardless of its theoretical advantages.

In the context of Science 10, where students are expected to develop scientific understanding, critical thinking, and engagement, the use of Problem-Based Learning presents both opportunities and challenges. However, there is a need to examine how students perceive this approach, as well as the factors that influence its effectiveness. Understanding these perceptions can provide valuable insights for educators in improving instructional strategies, addressing challenges, and enhancing learning outcomes.

Therefore, this study aims to investigate students' perceptions of Problem-Based Learning and its effectiveness in enhancing scientific understanding, critical thinking, and engagement in Science 10. It also seeks to identify the problems encountered in its implementation and propose appropriate interventions to address these challenges. The findings of this study are expected to contribute to the improvement of science teaching practices and support the development of more effective, student-centered learning environments.

Objectives of the Study

The study aimed to determine the Students' Perceptions of Problem-Based Learning and Its Effectiveness In Enhancing Scientific Understanding, Critical Thinking, And Engagement In Science 10

Specifically, it sought answers to the following questions:

1. What is the profile of the respondents as to:
   1.1 Age; and
   1.2 Gender?
2. What is the respondents perception of problem-based learning as to:
   2.1 PBL Activities;
   2.2 PBL Assessment Tools;
   2.3 PBL Instruction Methods; and
   2.4 Effectively of PBL?
3. What are problems encountered in the implementation problem-based learning in Science 10?
4. What are Interventions/Measures to Get Across the Problems in Problem Based Learning

METHODOLOGY

This study employed a descriptive research design to determine the students' perceptions of Problem-Based Learning (PBL) and its effectiveness in enhancing scientific understanding, critical thinking, and engagement in Science 10 among Grade 10 students of Calintaan National High School, Calintaan, Occidental Mindoro. Descriptive research is appropriate for this study as it allows the researcher to systematically describe and interpret the characteristics, behaviors, and perceptions of the respondents without manipulating any variables (Creswell, 2014; Fraenkel et al., 2012).

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Sampling Design

The respondents of the study were forty-two (42) Grade 10 Science students enrolled at Calintaan National High School during the School Year 2025–2026. The respondents were selected through purposive sampling, as they were directly involved in Science 10 classes where Problem-Based Learning is implemented. This ensured that the participants could provide relevant and meaningful responses regarding their experiences, perceptions, and engagement in PBL activities.

Research Instrument

Data were collected using a researcher-made questionnaire developed based on an extensive review of related literature and studies. The instrument consisted of two main parts: Part I focused on the respondents' profile, including age and gender, while Part II measured students' perceptions of Problem-Based Learning in terms of activities, instructional methods, assessment tools, and overall effectiveness.

The questionnaire utilized a five-point Likert scale to measure the frequency, level of agreement, and seriousness of problems encountered. To ensure the validity and clarity of the instrument, it underwent a try-out process among selected teachers who were not part of the study. Their feedback and suggestions were incorporated into the final revision of the questionnaire. The instrument was also reviewed and approved by the research adviser and the Dean of Graduate Studies prior to its administration.

In addition, unstructured interviews were conducted with selected Science 10 teachers to validate and supplement the data gathered from the questionnaire. Documentary analysis of students' academic records in Science was also utilized to support the findings of the study.

Statistical Design

The study employed various statistical tools for data analysis. Frequency and percentage were used to describe the profile of the respondents in terms of age and gender. The weighted mean was utilized to determine the level of students' perceptions regarding PBL activities, instructional methods, assessment tools, effectiveness, problems encountered, and proposed interventions.

The Likert scale was used to interpret the responses in terms of agreement, frequency, and seriousness of problems. Data gathered were systematically tallied, computed, and interpreted to provide meaningful conclusions regarding the effectiveness of Problem-Based Learning in Science 10.

RESULTS AND DISCUSSIONS

Profile of the Respondents

Table 1

Distribution of the Respondents by Age

Particulars	Frequency	Percentage
14	2	4.76
15	12	28.57
16	20	47.62
17 and above	8	19.05
Total	42	100.00

Among the responders, there are two individuals, constituting 4.76 percent, who are 14 years old. There are 12 respondents, constituting 28.57 percent, who are 15 years old. Respondents aged 16 exhibit a frequency of 20, representing 47.62 percent. Eight responders, constituting 19.05 percent, are aged 17 and older. The data indicates that the majority of responders are aged 15 and 16, which corresponds to the average age of grade 10 students.

Table 2

Distribution of Respondents by Gender

Particulars	Frequency	Percentage
Male	24	57.14
Female	18	42.86
Total	42	100.00

Among the responders, 24 individuals, constituting 57.14 percent, are male. The frequency for female respondents is 18, or 42.86 percent. The little disparity in the proportion of male and female responses will not influence the results of the questionnaire, as the questions are not gender-specific and pertain equally to both genders.

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Table 3
Respondent's Perception on the Frequency of PBL Activities

Particulars	Mean	QD	Rank
1. Working in groups	4.64	VO	1
2. Sharing opinions and information	3.84	O	3
3. Hearing different perspectives	3.23	O	12
4. Gathering information of group interest	3.25	O	10
5. Solving a problem	3.53	O	7
6. Flexibility to complete tasks	3.53	O	8
7. Learning from presentations	3.76	O	4
8. Recognizing objectives to consolidate concepts	3.24	O	11
9. Presentation to peers	3.36	O	9
10. Brainstorming	4.01	O	2
11. Problem Analysis	3.67	O	6
12. Testing Ideas	3.68	O	5
Average Weighted Mean	3.64	Often	

The respondent's view of the frequency of PBL activities indicates that "Working in groups" ranks highest, with a mean score of 4.64 and a qualitative description of "Very Often." The second is "Brainstorming," with a mean score of 4.01 and a qualitative description of "Often." The third rank is attributed to "Sharing opinions and information," which has a mean score of 3.84 and is qualitatively described as "Often." The statement "Hearing different perspectives" ranks lowest, with a mean score of 3.23 and is qualitatively described as "Often." The respondent's assessment of the frequency of PBL activities yielded an average weighted mean of 3.64, indicating "Often."

Table 4
Respondent's Perception on the Frequency of PBL Instruction Methods

Particulars	Mean	QD	Rank
1. The problem or task is introduced FIRST, before any learning occurs.	3.96	O	2
2. Problems are designed to emulate real-world problems	3.95	O	3
3. Problems used are complex and cover multiple objectives.	3.41	O	7
4. Learning procedures, facts, and concepts occurs within the context of finding a solution to the problem.	3.71	O	6
5. Specific procedures or algorithms are learned as needed	3.72	O	5
6. Additional structure for learning is proportional to the experience level of the learner.	3.84	O	4
7. Much of the structure for learning is provided through in-depth questioning by the instructor	3.38	O	8
8. Students work in cooperative or collaborative groups to gain multiple perspectives on possible solutions	4.08	O	1
Average Weighted Mean	3.76	Often	

The respondent's impression of the frequency of PBL instructional techniques ranks highest for the statement, "Students using this process usually work in cooperative or collaborative groups to gain multiple perspectives on possible solutions," which had a mean score of 4.08 and is qualitatively described as "Often." The problem or task is offered initially, prior to any learning taking place, with a mean score of 3.96 and a qualitative description of "Often." The third-ranked item is "Problems are designed to emulate real-world problems," with a mean score of 3.95 and a qualitative description of "Often." The statement “Much of the structure for learning is provided through in-depth questioning by the instructor” ranks lowest, with a mean score of 3.38 and is qualitatively described as “Often.” The respondents' perception of the frequency of PBL instructional approaches yielded an average weighted mean of 3.76, indicating "Often."

Table 5
Respondent's Perception on the Frequency of PBL Assessment Tools

Particulars	Mean	QD	Rank
1. Knowledge Exam	3.93	O	2
2. Teamwork Assessment	4.20	VO	1
3. Talk-back Sheet	3.44	O	3
4. Reflective Essay	3.26	O	4
Average Weighted Mean	3.71	Often	

The respondent perceives the frequency of PBL evaluation tools, ranking "Teamwork Assessment" first with a mean score of 4.20, categorized as "Very Often." The second assessment is the "Knowledge Exam," which has a mean score of 3.93 and is qualitatively described as "Often." The third spot is held by “Talk-back Sheet,” which has a mean score of 3.44 and is qualitatively described as “Often.” The statement "Reflective Essay" ranks lowest, with a mean score of 3.26 and is qualitatively described as "Often." The respondents perceived the frequency of PBL evaluation tools to have an average weighted mean of 3.71, indicating "Often."

Table 6
Respondent's Perception on the Problems Encountered in Problem-Based Learning

Particulars	Mean	QD	Rank
1. Time consuming	2.14	SS	6
2. Teachers offer to much advice to solve a problem	2.27	SS	5
3. Teachers have problems implementing the PBL method	2.58	SS	3
4. Pupils have trouble adjusting from the "Traditional Method" to "Problem Based Learning"	2.37	SS	4
5. Pupils have problems working in groups	2.11	SS	7
6. PBL sessions feel unstructured and chaotic	1.88	SS	8
7. It takes a lot of time to complete the PBL process	2.64	MS	2
8. The teacher properly motivates us to solve a problem	3.72	S	1
Average Weighted Mean	2.46	Slightly Serious	

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The respondent's evaluation of the challenges faced in problem-based learning indicates that the foremost issue is "The teacher adequately motivates us to solve a problem," which has a mean score of 3.72 and is qualitatively described as "Serious." The second statement is, "The PBL process requires considerable time to complete," with a mean score of 2.64 and a qualitative assessment of "Moderately Serious." The third-ranked issue is "Teachers encounter difficulties in implementing the PBL method," with a mean score of 2.58 and a qualitative assessment of "Slightly Serious." The statement "PBL sessions feel unstructured and chaotic" ranks lowest, with a mean of 1.88 and a qualitative description of "Slightly Serious." The respondent's assessment of the challenges faced in problem-based learning yielded an average weighted mean of 2.46, indicating a "Slightly Serious" level of concern.

Table 7
Respondent's Perception on the Interventions/ on the Problems Encountered in Problem-Based Learning

Particulars	Mean	QD	Rank
1. Organizing of seminars on how to use PBL method	3.97	A	2
2. Provision of English coordinator to incorporate the method in DLL	3.80	A	4
3. Regular supervision by the school heads to ensure the effective use of PBL in the daily log plans	3.83	A	3
4. The improvisation of the local instructional materials for teaching by the teacher under PBL	3.56	A	5
5. The teachers should be intrinsically motivated to explore PBL	4.02	A	1
Average Weighted Mean	3.84	Agree	

The respondent's opinion regarding the interventions and challenges associated with problem-based learning indicates that the foremost concern is "Teachers must possess intrinsic motivation to engage with PBL," which received a mean score of 4.02 and is qualitatively described as "Agree." The second item is "Organizing seminars on the utilization of the PBL method," which has a mean score of 3.97 and is qualitatively described as "Agree." The third-ranked item is "Regular supervision by school heads to ensure the effective implementation of PBL in daily log plans," with a mean score of 3.83 and a qualitative assessment of "Agree." The fourth-ranked item is "Provision of an English coordinator to integrate the method in DLL," with a mean score of 3.80, indicating "Agree." The statement "The teacher's improvisation of local instructional materials for teaching under PBL" ranks last, with a mean score of 3.56 and a qualitative description of "Agree." The respondent's perception of the interventions and the challenges faced in problem-based learning yielded an average weighted mean of 3.84, indicating "Agree."

CONCLUSION

The following are the conclusions for the study that are based on the previously presented findings and their implications.

1. The majority of the Grade 10 Science students of Calintaan National High School are aged 15 and 16 years old, which is consistent with the typical age range for this grade level. The slight difference in gender distribution does not significantly influence the outcomes of the study since the questionnaire items are applicable to all respondents.
2. Students frequently engage in Problem-Based Learning (PBL) activities such as working in groups, brainstorming, and sharing opinions, indicating that PBL effectively promotes active participation and cooperative learning among learners.
3. PBL instructional methods are regularly implemented, particularly in terms of collaborative learning and the introduction of real-world problems prior to formal instruction. However, structured guidance through in-depth questioning by teachers is less frequently observed, reflecting the student-centered nature of PBL.
4. Assessment tools in PBL, especially teamwork assessments and knowledge examinations, are commonly utilized and effectively measure both individual and group performance, thereby reinforcing students' problem-solving, critical thinking, and collaboration skills.
5. Although students recognize that PBL can be time-consuming and sometimes challenging, the problems encountered are generally perceived as only slightly serious. Teacher motivation and proper implementation are identified as key factors in addressing these challenges.
6. The respondents agree that interventions such as enhancing teacher motivation, conducting training seminars, ensuring regular supervision, and providing appropriate instructional materials are effective in improving the implementation of PBL.
7. Overall, Problem-Based Learning in Science 10 is perceived as an effective instructional approach that enhances students' scientific understanding, critical thinking, and engagement. It fosters a student-centered learning environment that promotes active participation, collaboration, and practical problem-solving skills, while emphasizing the importance of teacher support, preparedness, and structured guidance for successful implementation.

RECOMMENDATION

Based on the findings and conclusions of the study, the following recommendations are proposed:

1. **Teachers** should continue to implement Problem-Based Learning (PBL) in Science 10 by ensuring that students actively participate in collaborative activities such as group work, brainstorming, and sharing of ideas to enhance engagement and learning outcomes.
2. Teachers are further encouraged to provide **structured guidance through in-depth questioning** to help students develop and refine their problem-solving and critical thinking skills while maintaining a student-centered learning environment.
3. **School administrators** should support the effective implementation of PBL by organizing seminars and training programs, providing adequate instructional

materials, and conducting regular supervision to ensure proper application of PBL strategies in the classroom.

4. Teachers should be **intrinsically motivated** to explore, innovate, and adapt PBL methods in their teaching practices to improve student engagement, scientific understanding, and critical thinking.
5. **Students** should be encouraged to actively participate in PBL activities, collaborate with their peers, and take responsibility for their own learning to maximize the benefits of this instructional approach.
6. **Parents** may support their children's learning by fostering curiosity, encouraging independent thinking, and reinforcing problem-solving skills at home.
7. **Future researchers** are encouraged to expand this study by exploring the effectiveness of PBL in other subject areas, grade levels, or student populations, as well as investigating the integration of technology-enhanced PBL to further improve instructional practices and student outcomes in science education

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