International Journal of Multidisciplinary Research and Growth Evaluation.

Improving Science 10 Performance through Inquiry-Based and Collaborative Learning Approaches

Maricel Parilla Limpag [1*], **Nelia S. Raganas PhD** [2]
[1] Tungao National High School, Philippines
[2] Agusan Colleges Inc., Philippines

* Corresponding Author: **Maricel Parilla Limpag**

Article Info

ISSN (Online): 2582-7138
Impact Factor (RSIF): 7.98
Volume: 06
Issue: 06
November - December 2025
Received: 19-09-2025
Accepted: 22-10-2025
Published: 16-11-2025
Page No: 272-277

Abstract
This study determined the effectiveness of Inquiry-Based Learning (IBL) and Collaborative Learning (CBL) approaches in enhancing the academic performance of Grade 10 students in Science. Specifically, it investigated whether significant differences existed between the pretest and posttest scores within each group and in the mean gain scores between the two groups. Employing a quasi-experimental design, the study was conducted at Tungao National High School, Butuan City, during the School Year 2024–2025. Two intact Grade 10 sections were selected, one exposed to IBL and the other to CBL, based on comparable pretest results. A 30-item multiple-choice Science achievement test, validated and standardized by the Division Office, served as the research instrument. After securing necessary approvals, the researcher administered the pretest, implemented the respective interventions over 4 to 6 weeks, and conducted the posttest. Data were analyzed using paired sample t-tests and independent sample t-tests. Results revealed that the CBL group achieved a significant mean gain of 7.43 ($t = 7.894$, $p = .000$), indicating substantial improvement in Science performance. The CBL approach promoted teamwork, real-life relevance, and active participation, which enhanced student engagement and comprehension. In contrast, the IBL group showed a minimal mean gain of 0.87 ($t = .961$, $p = .344$), with posttest scores largely stagnant, suggesting limited effectiveness due to challenges such as lack of scaffolding, confusion with open-ended tasks, and uneven participation. An independent t-test confirmed a significant difference between the two groups ($t = 5.037$, $p = .000$), favoring the CBL approach. The study concludes that while IBL holds potential, its success depends on proper implementation and learner readiness. Overall, CBL proved to be a more effective instructional strategy for improving Science 10 performance, offering a structured, engaging, and collaborative learning environment that supports deeper understanding and academic achievement.

Keywords: Collaborative Learning, Inquiry-Based Learning, Science Achievement, Secondary Education

1. Introduction

An inquiry-based learning (IBL) approach to teaching science engages students in exploring scientific concepts through hands-on experiments, guided discovery, and problem-solving activities. Rather than passively memorizing facts from textbooks, students take an active role in the learning process by formulating questions, constructing hypotheses, designing experiments, collecting data, and drawing evidence-based conclusions (Röllke *et al.*, 2021) [14]. This student-centered approach not only strengthens conceptual understanding but also cultivates critical thinking, creativity, and scientific reasoning. By immersing students in authentic inquiry, IBL bridges classroom learning with real-world applications, fostering curiosity and a lasting appreciation for science.

Complementing IBL, the Collaborative Learning (CBL) approach emphasizes interaction, shared responsibility, and peer engagement in achieving common learning goals. Defined as an instructional strategy where students work together in small groups to solve problems, discuss concepts, and construct knowledge collectively, CBL enhances motivation, communication, and higher-order thinking (Gillies, 2020) [5]. In such settings, learning becomes a social process student exchange idea, challenge one another's reasoning, and co-create understanding while teachers act as facilitators guiding the inquiry and ensuring equitable participation.

The K to 12 Science Curriculum Guide (DepEd, 2016) [3] reinforces these principles by integrating constructivist, contextual, and inquiry-driven pedagogies to promote scientific literacy and 21st-century competencies. Furthermore, DepEd Order No. 21, s. 2019 [4] emphasizes the implementation of learner-centered and inquiry-based teaching methods to develop students' critical and analytical skills. Despite these policies, many science teachers in the Philippines still face challenges such as limited professional development, inadequate instructional resources, and minimal exposure to innovative pedagogies (Sağlam & Şahin, 2017) [15]. These constraints hinder the effective implementation of IBL and CBL in classrooms.

The situation is evident in the performance of Science 10 learners in Tungao National High School, where results from a division-wide test in School Year 2022–2023 revealed low achievement levels. Factors contributing to this underperformance include insufficient access to learning materials, weak internet connectivity, lack of functional laboratories, limited parental support, and language barriers that impede comprehension of scientific terms. These gaps highlight the urgent need for instructional approaches that not only engage learners but also support diverse learning needs and contexts.

Integrating inquiry-based learning with collaborative learning presents a promising strategy to enhance Science 10 performance. IBL allows learners to investigate and construct understanding through exploration, while CBL fosters teamwork, communication, and shared responsibility. When combined, these approaches can transform science classrooms into active, inclusive, and participatory learning environments where students become both thinkers and collaborators. Hence, this study explores how the utilization of IBL and CBL can significantly improve the academic performance of Science 10 students and provide actionable insights for effective science instruction.

2. Theoretical Framework

The concept of this research study was grounded in the Constructivist learning theory of Piaget (1952) [12] explains how learners actively construct knowledge through experiences and interactions with their environment. Piaget believed that learning is not simply the absorption of information but a process of building understanding based on prior knowledge and new experiences. Rather than passively receiving information, students engage in activities that require exploration, questioning, and problem-solving. This theory highlights that learning is a dynamic and social process influenced by prior knowledge and interaction with others.

Piaget believed that learners actively build knowledge through interaction with their environment, rather than passively receiving information. He stressed the importance of personal experiences in shaping an individual's understanding of the world. Learning happens best through hands-on activities, exploration, and processing new information. Students are encouraged to ask questions, investigate, and seek answers through exploration and experimentation

A key principle of this theory is that new knowledge is influenced by learners' prior knowledge and individual experiences, making their backgrounds crucial to the learning journey. Social interaction is also essential, as learners enhance their understanding through collaboration, discussions, and dialogues with others. Learning becomes most impactful when it is tied to real-life situations, helping students recognize the relevance and application of what they are studying. Constructivism promotes inquiry, problem-solving, and critical thinking, allowing learners to improve their higher order thinking skills. In this model, the teacher takes on the role of a facilitator or guide, supporting and scaffolding the learning process rather than just delivering information, which creates a more personalized and meaningful educational experience.

This theory is closely related to the CBL approach as both emphasizes the learner's active participation and the social aspect of learning. The students work together, share ideas, and solve problems as a group, which aligns with the constructivist idea that knowledge is built through interaction and exploration. By engaging in dialogue and exchanging points of view with others, students familiarize themselves with new ideas, clear concepts, and deepen their understanding- all these are main features of constructivist learning. Thus, CBL approach provides an environment where constructivist principles can be put into practice, allowing students to co-construct knowledge and meaning together.

An inquiry-based learning approach aligns with the constructivist principles by actively engaging students in the scientific process, allowing them to formulate questions, plan experiments, and draw conclusions based on evidence. This hands-on, active approach enhances critical thinking, problem-solving, and scientific literacy, leading to a more profound and long-lasting understanding of scientific concepts. The research could highlight not only academic gains but also holistic development, such as enhanced problem-solving skills, critical thinking abilities, and a more positive attitude toward science.

Bruner's discovery learning theory (1961) [2] is grounded in the idea that education should focus on developing students' ability to think and discover principles independently. Bruner proposed that learners progress through three modes of representation: enactive (learning through actions), iconic (learning through images or visual aids), and symbolic (learning through language and symbols). These stages help learners build deeper conceptual understanding.

The theory highlights the idea that students learn best when they take an active role in their learning journey. Instead of just being handed facts and procedures, learners dive into exploration, experimentation, and problem-solving to build their own understanding of concepts and relationships. Bruner was convinced that this hands-on approach not only deepens comprehension but also sparks curiosity and nurtures critical thinking and analytical skills.

In the context of this study, discovery learning theory and IBL approach are highly aligned, as both approaches promote active engagement, critical thinking, and self-directed learning. Discovery learning theory supports the idea that the most effective learning happens when students engage in inquiry and guided exploration, allowing them to create knowledge in a way that feels personal and meaningful. The students are not just passive recipients of information; they actively engage in the learning process by exploring, experimenting, and solving problems. The learner draws on his or her own past experience and existing knowledge to discover facts and relationships and new truths to be learned. The focus is on understanding concepts and applying them to solve problems, rather than just memorizing facts. In this process, teachers are essential as facilitators, offering the right guidance and support to help students navigate their educational paths.

Discovery learning theory and the collaborative learning approach are interconnected through their shared emphasis on active participation, exploration, and knowledge construction. Discovery learning encourages learners to uncover concepts and principles through investigation and problem-solving, while collaborative learning involves learners working together to achieve common goals and deepen understanding. Both approaches view learning as a social and cognitive process where students build on prior knowledge and experiences. In a collaborative setting, learners engage in dialogue, share perspectives, and test ideas collectively, which enhances the discovery process by allowing multiple viewpoints to shape understanding. Thus, collaborative learning provides a supportive environment for discovery learning, enabling learners to co-construct knowledge through interaction, reflection, and shared discovery.

3. Problem Formulation

This study aimed to determine the effectiveness of Inquiry-Based Learning (IBL) and Collaborative Learning (CBL) approaches in improving students' performance in Science 10. Specifically, it sought to find out whether there was a significant difference between the pretest and posttest performances of students in each group, and whether a significant difference existed in the mean gain scores of students exposed to both learning approaches. The findings of the study provided insights into how IBL and CBL improved students' understanding and achievement in Science 10.

4. Significance of the Study

This study was significant because it provided empirical evidence on how Inquiry-Based Learning (IBL) and Collaborative Learning (CBL) approaches improved students' performance in Science 10. The results contributed to the growing body of knowledge on learner-centered instruction and offered valuable insights for teachers in enhancing classroom engagement and achievement through active and cooperative learning strategies.

For teachers, the findings served as a guide in adopting innovative, evidence-based methods that promote critical thinking, teamwork, and scientific inquiry. For students, the study highlighted how learning through inquiry and collaboration fostered deeper understanding and stronger motivation toward science. For school administrators and curriculum planners, the study provided data that could support the integration of IBL and CBL into science programs to improve learning outcomes. Lastly, for future researchers, the study served as a reference for further exploration of effective teaching approaches in science education.

5. Scope and Limitations

This study focused on improving Science 10 performance through Inquiry-Based and Collaborative Learning Approaches. It involved Grade 10 students of Tungao National High School, South Butuan District, Division of Butuan City, during the School Year 2024–2025. The investigation was confined to the implementation of Inquiry-Based Learning (IBL) and Collaborative Learning (CBL) in two Science classes during the first quarter of the School Year 2025–2026. The study examined how these approaches influenced students' understanding, participation, and overall academic performance in Science 10.

The limitations of the study included the level of student participation, the development of critical thinking skills, and the extent to which students explored questions and solved problems during the learning activities. Despite these limitations, the study provided valuable insights into the effectiveness of integrating IBL and CBL to enhance the learning outcomes of Science 10 students.

6. Methodology

This study utilized a quasi-experimental research design to determine the effectiveness of Inquiry-Based Learning (IBL) and Collaborative Learning (CBL) approaches in improving the performance of Grade 10 students in Science. The design was appropriate since it allowed the comparison of two intact groups without random assignment while maintaining the natural classroom setup. The study was conducted at Tungao National High School, located in Purok 20, Barangay Tungao, South Butuan District, Division of Butuan City, during the School Year 2024–2025.

Two Grade 10 sections were selected as participants—one was taught using the IBL approach, while the other used the CBL approach. Both groups were chosen based on comparable pretest results to ensure fairness and reliability. The Science achievement test developed and standardized by the Division Office of Butuan City served as the primary research instrument for both the pretest and posttest. The 30-item multiple-choice test aligned with the Science 10 curriculum competencies. The instrument's validity and reliability had already been established by the Division Office; however, it was pilot-tested with another group of students to confirm its appropriateness for this study.

Data collection began after obtaining approval from the Schools Division Superintendent. The researcher personally administered the pretest, implemented the interventions for 4 to 6 weeks, and then conducted the posttest. Scores were computed, with each correct answer earning one point for a total of 30 points. The results were analyzed using paired sample t-tests to determine significant differences between the pretest and posttest within each group, and independent sample t-tests to compare the mean gain scores between the

IBL and CBL groups. These statistical methods were employed to evaluate whether the inquiry-based and collaborative learning approaches produced significant improvements in Science 10 performance.

7. Results and Discussion

Table 1 presents the result of the paired t-test between the pretest and posttest performances of the students in both groups.

Table 1: Paired t-test between the pretest and posttest performances of the students in each group

Group	Test	Mean Score	SD	Mean difference	t-value	p-value	Decision on H_o	Interpretation/Remarks
CBL group	Posttest	16.7	4.656	7.43	7.894**	.000	Reject H_o	Significant
	Pretest	9.23	3.430					
IBL group	Posttest	12.50	3.852	.867	.961	.344	Do not reject H_o	Not Significant
	Pretest	11.63	3.586					

Discussion

For the CBL group, the pretest and posttest performance ($\bar{x}1 = 9.23$; $\bar{x}2 = 16.7$) have standard deviation values ($s1 = 3.430$; $s2 = 4.656$) indicating that the scores are more diverse in the posttest because there are movements of the pretest scores to the higher levels of performance (n=16).

After the paired t-test, the mean score difference of 7.43 came out to be very significant within the .01 level ($t=7.894$; $p=.000$). Thus, the null hypothesis is rejected. This means that the CBL approach was effective in improving the performance of the students in Science 10.

According to Laal & Ghodsi (2021) [11] several insights into student engagement may have contributed to this positive outcome. The CBL approach incorporates real-life scenarios and encourages students to apply initially abstract concepts in practical ways, making learning more meaningful and relevant to them. Such relevance can increase motivation and interest, encouraging students to participate actively in class discussions and activities. When students see the direct connection between what they are learning and their everyday experiences, they are more likely to invest effort and persist in overcoming challenges. Besides, all group members were allowed to bring in new ideas, raise questions, and be part of the discussions, which, in turn, led to the involvement of the group in an active way. Moreover, the success of the team depends on the contributions of everyone; hence, students are more willing to cooperate, work together, and support each other as a result of their interdependence.

Additionally, CBL promoted teamwork where students work together to solve problems, share ideas, and support each other's learning. Such a friendly environment fosters a sense of community and belonging, further enhancing engagement. As a result, students become more involved in the learning process, which can lead to deeper understanding and improved academic performance, as reflected in the significant gains observed in the CBL group.

The pretest and posttest mean scores of the learners in the IBL group ($\bar{x}1 = 11.63$; $\bar{x}2 = 12.50$) shows that the posttest scores are slightly diverse than the pretest scores ($s1 = 3.586$; $s2 = 3.852$). This indicates that there are still many posttest scores that are located way below the mean. In fact, with still many posttest scores found in the lowest level of performance (n=25), there is evidence that the students could not gain much advantage of the IBL approach. The mean difference score of .87 did not come out significant ($t=.961$; $p=.344$). Thus, the null hypothesis is not rejected with respect to these variables. This means that there are certain deficiencies of the IBL approach that may have been left insufficiently implemented or that the approach was not appropriately designed according to its purpose.

Khandagale & Kadam (2020) [9] learner feedback regarding the IBL approach reflected a variety of circumstances and challenges. Some students expressed confusion and uncertainty when faced with open-ended tasks, which showed that they had difficulty in exploring the inquiry process without having a clear direction. Other students feel overwhelmed by the responsibility of independently seeking out information and constructing their own understanding. Besides that, certain learners pointed out that the nature of the group sometimes prevented them from getting involved because not all members contributed equally leading to frustration and disengagement among more active participants. Other students noted that the lack of direct instruction made it difficult to connect new concepts with their existing knowledge, leading to a sense of disconnection from the material. Overall, these experiences suggest that while some students viewed the IBL approach as a valuable opportunity for independent learning, many encountered significant challenges, which may have contributed to the limited improvement in their performance in Science.

One point to be drawn from the findings was that Abuhmaid (2020) [1] are very supportive of the IBL potential when they say it can allow students to study the problem themselves, to come up with questions related to the problem, and to create their own understanding, which may lead to curiosity and deeper engagement. Nevertheless, this positive aspect can be noticed mostly when students are properly guided, and the approach is correctly applied. Moreover, Huang *et al*. (2024) [6] also point out that IBL can be a powerful tool to open all the desired student engagement and critical thinking, yet they also warn that for this to happen, there must be enough time, resources, and scaffolding. In the absence of these supports, the students may find developing inquiry skills difficult, which is in line with the observation of the present study that student difficulties and limited performance gains prevail.

Kotsis (2024) [10] highlighted that IBL science teaching activates the students to engage in active investigation and critical thinking, which in turn leads to their more profound understanding of scientific concepts. Still, this research also indicates that students must be guided through the process to get the most out of the approach, which is in line with the present results where the lack of direct instruction caused confusion and disengagement.

Conversely, Jacalan & Castillo (2023) [7] argued that IBL has great potential to improve students' comprehension and critical skills if the approach is well-planned and integrated in science education. Their research revealed that academic performance and motivation of the students practicing IBL were strengthened, which is different from the present study, where only a small improvement was observed. This implies that the IBL can be largely influenced by how well it is put into practice, the extent of teacher support, and the readiness of students to participate in the inquiry-based activities.

Test of Significant Difference in the Mean Gain Scores of the Performance of the Students

Table 2 presents the results of the independent t-test conducted to determine whether there was a significant difference in the mean gain scores of students in both groups.

Table 2: Independent t-test on the mean gain scores of the students in both groups

Group	Mean gain score	SD	t-value	p-value	Decision on H_o	Interpretation / Remarks
CBL group	7.43	5.157	5.037	.000	Reject H_o	Significant
IBL group	0.87	4.939				

While it was obvious that there existed a big difference in the mean gain scores of the students in both groups, an independent t-test was employed to confirm this observation. Table 2 shows that the standard deviation of the mean gain scores of the students in the CBL approach is greater than the standard deviation of the mean gain scores of the students in the IBL approach. This can be explained by the fact that the posttest scores of the students in the CBL group have moved up to the higher levels of performance, away from the mean (n=16). The independent t-test yielded t=5.037 at p=.000, indicating a very significant difference. Thus, the null hypothesis is rejected. This implies that the CBL approach was more effective than the IBL approach in the improvement of the performance of the students in Science 10.

These findings are consistent with related literature discussed in Chapter 2. For instance, Huang *et al*. (2024) [6] found that the CBL approach often resulted in higher academic gains, particularly when students are provided with clear guidance and real-world applications. Similarly, Jacalan & Castillo (2023) [7] reported that students exposed to the CBL learning approach demonstrated greater conceptual understanding and retention compared to those in purely inquiry-based settings. Abuhmaid (2020) [1] also highlighted that while inquiry-based learning can foster engagement, it may not always translate to significant academic improvement without sufficient scaffolding and contextual support.

The greater standard deviation observed in the CBL group suggests a wider range of improvement, likely due to the differentiated impact of context-based strategies on students with varying prior knowledge and skills. This aligns with the findings of Kotsis (2024) [10], who noted that a collaborative learning approach can elevate performance across diverse student populations by making learning more relevant and accessible.

Rahman & Alwi (2021) [13] reported that collaborative learning positively influences students' academic performance and motivation in higher education settings. Students who participated in collaborative tasks performed better in assessments and expressed greater enthusiasm for learning, indicating the broad applicability of collaborative learning across educational levels.

8. Conclusion

The study concluded that the Collaborative Learning (CBL) approach significantly outperformed the Inquiry-Based Learning (IBL) approach in enhancing the academic performance of Science 10 students. The CBL group demonstrated notable gains in posttest scores, underscoring the effectiveness of structured teamwork, shared problem-solving, and active engagement in fostering deeper scientific understanding. In contrast, the minimal improvement observed in the IBL group suggests that open-ended inquiry, when not adequately scaffolded, may hinder student progress. These findings highlight the value of collaborative learning environments in promoting meaningful learning experiences, improved comprehension, and sustained academic achievement in secondary science education.

9. Thank-You Note

The researchers extend their sincere appreciation to all fellow scholars and contributors who participated in the study by providing thoughtful responses to the test questionnaire. Their insights and expertise played a vital role in enriching the research process and strengthening the validity of the findings. The generosity of these participants in sharing their knowledge reflects a shared commitment to advancing educational inquiry and collaborative scholarship. Their contributions are deeply valued and gratefully acknowledged.

10. References

1. Abuhmaid, A. M. (2020). The efficiency of online learning environment for implementing project-based learning: Students' perceptions. International Journal of Higher Education, 9(5), 76–83. https://doi.org/10.5430/ijhe.v9n5p76
2. Bruner, J. S. (1961). The act of discovery. Harvard Educational Review, 31(1), 21–32. https://doi.org/10.17763/haer.31.1.vh87ya8065w2u10p
3. DepEd 2016 K-12 Curriculum Guide
4. DepEd Order No. 21, s. 2019 Policy and Guidelines on the K to 12 Basic Education Program
5. Gillies, R. M. (2020). Promoting academically productive student dialogue during collaborative learning. British Journal of Educational Psychology, 90(1), 1-14.
6. Huang H-W, Mills DJ, Tiangco J.A.N.Z. (2024). Inquiry-based learning and technology-enhanced formative assessment in flipped EFL writing instruction: Student performance and perceptions. SAGE Open, 14(2).
7. Jacalan, L. T., & Castillo, A. A. (2023). Effect of Inquiry-Based Learning Approach on the Students' Performance in Physics. International Journal of Science and Management Studies (IJSMS), 6(3), 230–233.
8. Khalid, M. S., & Azeem, M. (2023). The impact of collaborative learning on students' problem-solving skills in science education. International Journal of Science Education, 45(1), 56-72.
9. Khandagale, A. M., & Kadam, P. (2020). Effectiveness of Inquiry-Based Learning on Students' Academic Achievement and Interest in Science. International Journal of Education and Psychological Research (IJEPR), 9(3), 1–4.
10. Kotsis, K. T. (2024). The significance of experiments in inquiry-based science teaching. European Journal of Education and Pedagogy, 5(2), Article 815.

11. Laal, M., & Ghodsi, S. M. (2021). Benefits of cooperative learning in education. International Journal of Instruction, 14(2), 243–256. https://doi.org/10.29333/iji.2021.14214a
12. Piaget, J. (1952). The origins of intelligence in children (M. Cook, Trans.). International Universities Press. (Original work published 1936)
13. Rahman, M. M., & Alwi, N. F. (2021). Collaborative learning and students' academic performance: A study in Malaysian higher education. International Journal of Instruction, 14(3), 423-438.
14. Röllke, K., Sellmann-Risse, D., Wenzel, A., & Grotjohann, N. (2021).
15. Impact of inquiry-based learning in a molecular biology class on the dimensions of students' situational interest. International Journal of Science Education, 43(17),2843–2865. https://doi.org/10.1080/09500693.2021.1993377
16. Sağlam, M. K., & Şahin, M. (2017). Inquiry-based professional development practices for science teachers. Journal of Turkish Science Education, 14(4), 66-76. http://tused.org/index.php/tused/article/view/174

How to Cite This Article

Limpag MP, Raganas NS. Improving Science 10 performance through inquiry-based and collaborative learning approaches. International Journal of Multidisciplinary Research and Growth Evaluation. 2025;6(6):272-277.

Creative Commons (CC) License