PANTAO
(International Journal of the Humanities and Social Sciences)
Volume 5, Issue 4
ISSN 3028-0877 | e-ISSN 3155-6043 | DOI 10.69651/2022PIJHSS

Bridging the gaps: Targeted remediation for least-learned Grade 10 Biology competencies

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ABSTRACT

Biology is an important component of Science education because it develops learners' understanding of living systems, scientific processes, and concepts that are relevant to health, environment, and everyday life. This study assessed the academic performance of the students in the least learned competencies in Biology at Cabangahan National High School, Cabangahan, Consolacion, Cebu, during the 2nd quarter of the school year 2025–2026, as a basis for innovative professional development framework. Particularly, it answered the control and experimental groups academic performance of the of the targeted remediation intervention in protein synthesis as to their pre-test, and post-test; secondly is the experimental group's level of perception on the effectiveness of targeted remediation; thirdly is significant difference between the pretest and posttest scores of the control and experimental groups; and lastly the significant relationship between students' perception of the targeted remediation intervention and their academic performance.The research design involved a quasi-experimental design. The study was conducted at Cabangahan National High School, Cabangahan, Consolacion, Cebu during the 2nd quarter of the school year 2025–2026 with 50 respondents each group. The questionnaire used in the study was an adapted questionnaire. The statistical analysis of the data in the study involved a descriptive measure such as simple percentage, weighted mean, t-test, and Pearson Product-Moment Correlation R. The study found that the experimental group demonstrated greater improvement in protein synthesis performance than the control group following the targeted remediation intervention. Students in the experimental group also reported favorable perceptions of the intervention, particularly in improving understanding, participation, motivation, and retention. Significant differences were found between pretest and posttest performance in both groups, leading to rejection of the null hypothesis. Moreover, a significant positive relationship was found between students' perceptions of the intervention and their academic performance. Thus, based on the findings, this study recommends the development and implementation of innovative professional development framework.

Keywords: Teaching Biology, academic performance, Pre-and Post-Test, quasi-experimental design, innovative professional development framework, Cabangahan National High School.

Date Submitted: October 01, 2026
Date Accepted: October 08, 2026
Date Published: October 28, 2026

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DOI: http://doi.org/10.69651/PIJHSS05041695

Recommended citation:
Adlaon, E. B. (2026). Bridging the gaps: Targeted remediation for least-learned Grade 10 Biology competencies. Pantao (International Journal of the Humanities and Social Sciences) 5 (4), 1786-1800. http://doi.org/10.69651/PIJHSS05041695

INTRODUCTION

Biology is an important component of Science education because it develops learners' understanding of living systems, scientific processes, and concepts that are relevant to health, environment, and everyday life. However, students often experience difficulty mastering abstract and interconnected biological concepts, which can affect their academic performance. The importance of identifying specific learning gaps rather than relying solely on overall achievement scores, because targeted identification allows teachers to provide appropriate instructional support and intervention (Santos et al., 2021).

At the international level, addressing learning gaps through focused instructional interventions has become increasingly important as schools seek to improve student achievement and mastery of essential competencies. Learners benefit from instructional approaches that provide opportunities for active engagement, conceptual understanding, and meaningful application of scientific knowledge. This supports the view that assessment of academic performance should not only measure achievement but should also guide teachers in selecting appropriate strategies to address specific areas of difficulty. In particular, Santos et al. (2021) recommended inquiry-based and hands-on learning activities after identifying competencies that students found difficult to master.

In the Philippine context, persistent gaps in Biology learning have also been documented. Junco and Nabua (2023) found that Filipino learners demonstrated inadequate mastery of several Biology topics, including energy transformation, cells, biological molecules, genetics, taxonomy, and evolution, providing a basis for the development of appropriate instructional materials. Similarly, Nabua and Gaspar (2024) noted a low overall mastery level among Grade 10 Biology learners, with several competencies classified as least mastered and recommended as bases for remedial instruction. Dumdumaya et al. (2024) reported improved Science learning outcomes following the use of Strategic Intervention Materials, while Labe et al. (2025) specifically developed an intervention for the least-mastered competencies involving the Central Dogma of Molecular Biology, including DNA replication, transcription, and translation.

At the local level, the need to examine students' Biology performance is particularly relevant because learning gaps may vary according to school context, learners, competencies, and instructional experiences. Villarino and Villarino (2023), in a study involving Grade 8 Biology students in a rural municipality in Cebu, assessed academic performance as a basis for developing appropriate learning activities, demonstrating the value of using local assessment evidence to guide Biology instruction. In this regard, assessing the academic performance of students in the least-learned Biology competencies at Cabangahan National High School, Cabangahan, Consolacion, Cebu, can provide school-specific evidence of learning needs. The findings can serve as a basis for targeted remediation and, ultimately, for developing an Innovative Professional Development Framework that strengthens Science teachers' capacity to address identified learning gaps and improve students' academic performance in Biology.

Statement of the problem

This study assessed the academic performance of students in the least learned competencies in Biology at Cabangahan National High School, Cabangahan, Consolacion, Cebu, during the second quarter of School Year 2025–2026, as a basis for developing an innovative professional development framework.

Specifically, this study sought to answer the following questions:

1. What is the academic performance of the control and experimental groups in protein synthesis, as measured by their pretest and posttest scores following the targeted remediation intervention?
2. What is the experimental group's level of perception regarding the effectiveness of targeted remediation?
3. Is there a significant difference between the pretest and posttest scores of the control and experimental groups?
4. Is there a significant relationship between the experimental group's level of perception regarding the effectiveness of targeted remediation and their academic performance?
5. Based on the findings of the study, what innovative professional development framework can be formulated?

METHODOLOGY

This section presents the methodological process of the study, which comprises the research design, the flow of the study, the research environment, the respondents, the instruments, the data-gathering procedure, the ethical considerations, the statistical treatment, and the scoring procedures.

The study employed a quasi-experimental design, which was best suited to its purpose because it aimed to determine the effectiveness of an intervention by comparing the academic performance of students in an experimental group and a control group. The design was appropriate because the study was conducted in an actual school setting where the researcher worked with existing classes and could not randomly assign individual students to groups. The experimental group received the identified intervention, while the control group continued to receive the usual instructional approach. Pretest and posttest results were compared to determine whether meaningful changes in students' academic performance occurred after the intervention. Thus, the quasi-experimental design provided a practical and systematic means of examining the effect of the intervention while maintaining the natural classroom arrangement and minimizing disruption to regular school operations.

The study took the input-process-output strategy, which demonstrated how the study was carried out, from collecting raw data to organizing and analyzing the data to produce findings, as depicted in Figure 2. The input consisted of the variables in the statement of the problem. The first dealt with the academic performance of the control and experimental groups in relation to the targeted remediation intervention in protein synthesis, as measured by their pretest and posttest results. The second was the experimental group's level of perception on the effectiveness of targeted remediation. The third was the significant difference between the pretest and posttest scores of the control and experimental groups. The last was the significant relationship between students' perception of the targeted remediation intervention and their academic performance. The process showed the steps and procedures undertaken by the researcher to complete the research work. It included the descriptive method of research, administration of the questionnaire, data gathering, data analysis, data organization, and interpretation of data. The researcher personally administered the test to the respondents to ensure the secrecy and validity of the results. Moreover, the timeline of the data collection did not disturb or suspend any class lessons of the teachers. All procedures were conducted systematically and ethically while ensuring the confidentiality, accuracy, and integrity of the collected data. The output of the investigation could lead to the development of an innovative professional development framework focused on addressing students' identified least learned competencies in Biology. The framework may provide targeted training, collaborative lesson

planning, coaching, and instructional strategies aligned with teachers' identified needs. Thus, the proposed framework may strengthen teachers' instructional practices and contribute to improved students' academic performance in Biology. It may also provide a practical guide for sustaining continuous professional growth and improving the delivery of Biology instruction.

The study was conducted at Cabangahan National High School, located in Barangay Cabangahan, Municipality of Consolacion, Cebu, as shown in the location map of the research environment presented in Figure 3. The school is a public secondary school under the Department of Education (DepEd), Region VII, and is officially identified with School ID 302954. DepEd records confirm its location in Barangay Cabangahan, Consolacion, Cebu, making it an established public school setting for the conduct of educational research. The school provides an appropriate setting for the study because it serves secondary learners within an actual classroom environment where Biology instruction and assessment are conducted. Its location in Consolacion, Cebu, provides a relevant context for examining students' academic performance and identifying least learned competencies in Biology. The school's established status within the public education system also makes the findings relevant to school-level instructional improvement and teacher professional development. Moreover, Cabangahan National High School has a documented history as a public secondary school serving the local community. Its official school records and identification within DepEd documents provide a reliable basis for establishing the research locale. Thus, the school was considered an appropriate research environment for assessing students' performance in least learned Biology competencies and for using the findings as a basis for developing an innovative professional development framework for Science teachers. The school setting also provided direct access to learners and relevant academic data necessary for the conduct of the study. Furthermore, the findings may contribute to strengthening Biology instruction and supporting school-based professional development initiatives.

The respondents of the study were the Grade 10 students of Cabangahan National High School, Cabangahan, Consolacion, Cebu. The purposive sampling method was applied in the selection of the respondents, with a total of 50 students in each group. Two existing classes were selected based on predetermined criteria relevant to the study. One intact class served as the experimental group, while another comparable class served as the control group. This technique was appropriate because students were already organized into existing classes and could not be randomly assigned individually without disrupting the regular school arrangement. Also, the researcher chose these respondents for faster and more convenient administration and survey of the research questionnaire. Table 1 presents the distribution of the respondents according to their assigned groups. The experimental group consisted of 50 respondents, representing 50.00% of the total 100 respondents. Similarly, the control group comprised 50 respondents, also representing 50.00% of the total respondents, which brought the total to 100 respondents, or 100.00%. This indicates that the study maintained an equal distribution of participants between the experimental and control groups, providing a balanced basis for comparing their performance before and after the intervention.

The study utilized a research-based questionnaire and achievement test adapted from the Biological Concepts Instrument (BCI) to gather the data needed to assess students' understanding of the targeted Biology competency on protein synthesis. The adapted instrument was selected because it was aligned with the content and learning objectives of Biology and provided an appropriate basis for measuring students' conceptual understanding. The instrument was reviewed and modified to suit the context, grade level, and specific learning competencies of the respondents. Prior to administration, the adapted instrument was subjected to appropriate validation and reliability procedures to establish its suitability for the study. The instrument consisted of multiple-choice and concept-based items that evaluated students' knowledge of the stages, processes, and differences between protein synthesis. The

validity and reliability of the instrument were established in previous studies, making it suitable for assessing conceptual learning in biology. In addition, a researcher-developed cognitive development checklist, grounded in Piaget's Theory of Cognitive Development, was used to infer students' cognitive stages. The checklist focused on indicators such as logical reasoning, ability to interpret diagrams, and capacity to explain abstract biological processes, and it helped classify students as being in the concrete operational stage or transitioning toward formal operational thinking. The remediation intervention consisted of teacher-designed learning modules aligned with Grade 10 Biology competencies. These modules included visual aids, guided activities, graphic organizers, and formative assessment tasks, and they were validated by subject specialists to ensure content accuracy and developmental appropriateness.

The data-gathering procedure was conducted in three phases, namely before, during, and after the data collection, to ensure the systematic implementation of the research. Prior to the conduct of the study, the researcher prepared the research proposal, questionnaire, laboratory activities, observation guide, and other necessary research documents for evaluation and approval by the research adviser and the Dean of Cebu Technological University–Main Campus. After the approval of the proposal, the researcher secured a letter of endorsement from the university and sought permission from the Schools Division Superintendent of the Schools Division of Cebu Province, the Public Schools District Supervisor, and or the School Principal to conduct the study. The research instrument underwent content validation by experts, and the necessary revisions were incorporated based on their recommendations. The researcher also explained the purpose of the study to the respondents and their parents or guardians, distributed informed consent and assent forms, assured the participants that their responses would be kept confidential, and informed them that their participation was voluntary. After obtaining all necessary approvals and informed consent, the researcher conducted the study among the identified Science students. The pretest was first administered to both the experimental and control groups to establish their baseline academic performance in the targeted protein synthesis competency. The targeted remediation intervention was then implemented with the experimental group, while the control group received the regular instructional approach. After the intervention, both groups took the posttest, while the experimental group completed the perception questionnaire. The researcher personally supervised the administration, retrieval, and recording of the instruments to ensure consistency, confidentiality, and accuracy of the collected data. Upon completion of the questionnaire administration, the researcher collected all accomplished instruments and checked them for completeness and accuracy. The responses were encoded, organized, tabulated, and subjected to the appropriate statistical analyses to answer the research questions. All data were treated with strict confidentiality by assigning codes instead of participants' names and storing the records securely. Finally, the researcher interpreted the results and formulated the conclusions.

The study adhered to established ethical principles to protect the rights and welfare of the respondents. Participation was voluntary, and informed consent was obtained after clearly explaining the study's purpose and procedures. The anonymity and confidentiality of all respondents were maintained by safeguarding their identities and responses. The researcher ensured that participation posed no harm or risk and that respondents could provide only what they were comfortable sharing.

The statistical analysis employed the simple percentage, weighted mean, t-test for significant difference, and Pearson Product-Moment Correlation R, together with data analysis. The percentage was used because it was appropriate for determining the academic performance of the control and experimental groups in relation to the targeted remediation intervention in protein synthesis, as measured by their pretest and posttest results. The weighted mean was

used to determine the experimental group's level of perception on the effectiveness of targeted remediation. The t-test was appropriate because it tested the significant difference between the pretest and posttest scores of the control and experimental groups. The Pearson Product-Moment Correlation R was used to determine the significant relationship between students' perception of the targeted remediation intervention and their academic performance.

The study utilized the following scoring procedures, beginning with the Biological Concepts Instrument (BCI), which was administered as both the pretest and posttest to measure students' conceptual understanding of protein synthesis. Each test item was scored using an objective marking scheme. A response was given one (1) point if correct and zero (0) points if incorrect or blank. The total test score for each student was obtained by summing all correct responses, producing an overall score that represented the learner's level of understanding of cell division concepts. To facilitate interpretation, the raw scores were converted into percentage scores using the formula Percentage Score = (Raw Score / Total Number of Items) × 100. The resulting percentage scores would be interpreted using mastery-level descriptors (e.g., low, average, high or beginning, developing, approaching proficiency, proficient), depending on the school or DepEd-based interpretation scheme adopted in the study. The same scoring procedure was applied consistently to both pretest and posttest results to ensure comparability. To determine improvement after the targeted remediation intervention, each student's gain score was computed by subtracting the pretest score from the posttest score, expressed as Gain Score = Posttest Score − Pretest Score. A positive gain score indicated improvement in understanding, while a zero or negative gain score indicated no improvement or a decline in performance. Mean gain scores were also computed to describe the overall improvement of the group after the remediation. The cognitive development checklist, which was researcher-developed and grounded in Piaget's Theory of Cognitive Development, was likewise scored to infer students' cognitive stage (concrete operational vs. emerging/formal operational). Each indicator in the checklist was rated based on students' demonstrated ability (e.g., logical reasoning, interpretation of diagrams, explanation of abstract biological processes). Checklist responses were scored by assigning numerical values per rating option (for example: 3 = Always/Consistently Demonstrated, 2 = Sometimes Demonstrated, 1 = Rarely Demonstrated, 0 = Not Demonstrated), depending on the checklist format used in the study. The total checklist score was computed by summing the item scores for each student. The total score served as the basis for classifying students into cognitive development categories. Students with lower checklist scores were interpreted as being more aligned with the concrete operational stage, while students with higher scores were interpreted as being closer to the emerging or formal operational stage.

For purposes of clarity, the terms used in the study are operationally defined according to their use in the research. Academic performance refers to the scores obtained by the students in the researcher-administered Biology test covering the targeted least learned competency on protein synthesis, measured through the pretest and posttest. The control group refers to the group of 50 students who received the usual or regular Biology instruction during the intervention period and served as the basis for comparison with the experimental group. The experimental group refers to the group of 50 students who received the targeted remediation intervention on protein synthesis during the intervention period. The targeted remediation intervention refers to the structured instructional activities, strategies, visual aids, exercises, and other learning activities specifically designed and implemented by the researcher to address students' identified learning difficulties in the Biology competency on protein synthesis. Protein synthesis refers to the targeted Biology competency involving the processes by which cells use genetic information to produce proteins, particularly the concepts of transcription and translation, as covered in the assessment administered to the respondents. The pretest refers to the assessment administered to both the control and experimental groups before the

implementation of the targeted remediation intervention to determine their baseline knowledge and academic performance in protein synthesis. The posttest refers to the assessment administered to both groups after the intervention period to determine changes in their academic performance in the targeted protein synthesis competency. The level of perception refers to the experimental group's degree of agreement regarding the effectiveness of the targeted remediation intervention, particularly in terms of understanding, participation, motivation, use of visual aids and activities, and retention of Biology concepts, as measured through a researcher-made Likert-scale questionnaire. The effectiveness of targeted remediation refers to the perceived extent to which the intervention helped improve the experimental group's understanding, participation, motivation, comprehension, and retention of the protein synthesis concepts, based on their responses to the perception questionnaire. Finally, the innovative professional development framework refers to the proposed structured framework developed from the findings of the study to guide Science teachers in improving their instructional practices, particularly in addressing least learned Biology competencies through targeted remediation, appropriate teaching strategies, assessment, collaboration, and continuous professional development.

RESULTS AND DISCUSSION

This chapter presents and discusses the data gathered from 100 Grade 10 students of Cabangahan National High School in Consolacion, Cebu, consisting of 50 students in the experimental group and 50 students in the control group, which represented 50.00% each of the total of 100 respondents (100.00%). The study employed a quasi-experimental design because the researcher worked with existing classes and could not randomly assign individual students to groups. Purposive sampling was used to select two intact and comparable classes. The experimental group received the targeted remediation intervention on protein synthesis, while the control group continued with the regular instructional approach. Data were gathered through a research-based achievement test adapted from the Biological Concepts Instrument, administered as both pretest and posttest, together with a researcher-made Likert-scale perception questionnaire completed by the experimental group. The data were analyzed using the simple percentage, the weighted mean, the t-test for significant difference, and the Pearson Product-Moment Correlation r. The discussion is grounded in the data gathered, and the results are interpreted in direct relation to the objectives of the study, namely the academic performance of both groups in the pretest and posttest, the experimental group's level of perception of the effectiveness of targeted remediation, the significant difference between the pretest and posttest scores, and the significant relationship between students' perception and their academic performance.

Academic performance of the control and experimental groups

The control group obtained a pretest mean of 12.45 with a standard deviation of 3.12, interpreted as Developing. After the instructional period, its posttest mean rose to 15.28 with a standard deviation of 2.84, interpreted as Approaching Proficiency. The experimental group obtained a pretest mean of 12.63 with a standard deviation of 3.05, also interpreted as Developing. Following the targeted remediation intervention, its posttest mean was 21.47 with a standard deviation of 2.16, interpreted as Proficient. Both groups therefore began at nearly the same level, with pretest means of 12.45 for the control group and 12.63 for the experimental group, which provides a sound basis for comparison. The experimental group showed a gain of

8.84 points from pretest to posttest, compared with a gain of 2.83 points for the control group. The experimental group also had the smaller posttest standard deviation (2.16 compared with 2.84), which indicates that its scores were more closely clustered around the mean.

These findings imply that the targeted remediation intervention was more effective in improving students' understanding of protein synthesis than the regular instructional approach. The gain of 8.84 points suggests that focused and responsive remediation can address identified learning gaps, and it points to the need for Science teachers to strengthen targeted interventions for least learned Biology competencies. This result is consistent with Aleknavičiūtė et al. (2023), whose biology-focused conceptual change interventions produced large effects on students' conceptual understanding compared with traditional instruction. Carbonari et al. (2026) likewise reported that targeted academic recovery interventions, including tutoring and small-group instruction, had positive effects on student achievement, which highlights the value of intensive and focused learning support. In the Philippine context, Eroy et al. (2026) indicated that strategic intervention materials can significantly improve students' science performance, and Tambong and Malonisio (2025) identified least learned competencies and developed a Remediating Strategic Intervention Material to address students' learning difficulties. Together, these studies suggest that effective Science instruction benefits from interventions deliberately aligned with learners' needs and supported by appropriate instructional strategies. Because such interventions depend on teachers' capacity to design and deliver them, the results also connect to the professional development literature. You et al. (2025), in a meta-analysis of 66 studies, found substantial positive effects of professional development programs in Science education. Visscher et al. (2025) reported that teacher professional development, on average, improves student achievement, with stronger effects when multiple learning principles are applied. Gülhan (2025) emphasized the continuing need for professional development among Science teachers, because Science education requires teachers to continually update their knowledge and instructional practices.

Perception of the effectiveness of targeted remediation

The experimental group's perception of the targeted remediation was assessed through five indicators, and the weighted mean was used to determine their level of agreement. Increased understanding of protein synthesis obtained a mean of 4.52 with a standard deviation of 0.61, and improved participation during Biology lessons obtained a mean of 4.38 with a standard deviation of 0.66. Enhanced motivation to learn Biology obtained a mean of 4.44 with a standard deviation of 0.58, and better understanding through visual aids and activities obtained a mean of 4.63 with a standard deviation of 0.52. All four were interpreted as Strongly Agree. Improved retention of concepts obtained a mean of 4.29 with a standard deviation of 0.71, interpreted as Agree. The overall mean was 4.45 with a standard deviation of 0.62, interpreted as Strongly Agree. Students therefore perceived the remediation activities as highly effective, and they strongly agreed that the intervention clarified Biology concepts and made classroom activities more relevant and purposeful. This corresponds to Vygotsky's theory, which holds that scaffolded learning advances students' cognitive development through support and meaningful collaborative activities. It also agrees with research showing that remediation combined with learner-centered instructional strategies greatly improves students' engagement and understanding of science concepts (Dignath & Veenman, 2021; Hattie, 2023).

Among the indicators, better understanding through visual aids and activities had the highest mean at 4.63, which means that respondents found that visual aids, diagrams, and guided activities made learning easier. This aligns with Mayer's cognitive theory of multimedia learning, which shows that learning is more effective when verbal explanations are paired with illustrations. Yusuf et al. (2024) similarly noted that visual learning resources and

learner-centered activities in Biology instruction cater to learners' needs and promote their understanding of the subject. Improved retention of concepts had the lowest mean at 4.29, interpreted as Agree. Although this mean remained positive and showed that learners appreciated the remediation activities, it suggests that substantial mastery of biological concepts may still be demanding and may require persistence and more frequent re-exposure. This interpretation is supported by studies of retrieval and constructivist learning, which show that long-term retention and mastery are achieved through multiple, well-directed, and repeated reinforcement activities (Dunlosky et al., 2022). The comprehension and retention gains reported by students were attributed to the teaching tools used, and Freeman et al. (2021) similarly found that active learning methodologies greatly improve learners' motivation, engagement, and academic performance in the sciences.

Significant difference between pretest and posttest scores

The t-test for significant difference was applied to the scores of both groups. The control group, with a posttest mean of 15.28 and a standard deviation of 2.84, yielded a t-value of 6.82 with a p-value of 0.000. The experimental group, with a posttest mean of 21.47 and a standard deviation of 2.16, likewise yielded a t-value of 6.82 with a p-value of 0.000. In both cases the p-value was lower than the 0.05 level of significance, so the null hypothesis was rejected and the result was interpreted as significant. This means that both groups showed a statistically significant difference between their pretest and posttest performance, and both therefore demonstrated significant improvement in academic performance after the instructional period. The earlier descriptive results show, however, that the improvement of the experimental group (8.84 points) was considerably larger than that of the control group (2.83 points).

This pattern is consistent with earlier studies. Buitre (2023) found a significant improvement in Grade 7 Biology students' performance after the use of electronic strategic intervention materials, which demonstrates the potential of structured remediation to address learning gaps. García (2022) reported that students exposed to experience-based learning showed improved academic achievement compared with those who received a non-experience-based approach, and that students exposed to brain-based learning obtained significantly higher posttest achievement than the control group. This suggests that appropriately designed instructional interventions can enhance Biology learning outcomes. Tutal and Yazar (2023) found that active learning had significant positive effects on both academic achievement and learning retention among K-12 learners. These findings imply that the significant improvement observed in the present study may be attributed to the focused and active nature of the targeted remediation intervention. Strengthening teachers' capacity to implement targeted, engaging, and evidence-based remediation strategies may therefore be an important component of the proposed professional development framework. This view is supported by You et al. (2025), who found that professional development programs in science education produced substantial positive effects and that active learning was an important factor in their effectiveness. Lynch et al. (2025) reported that mathematics and science professional development interventions positively influenced teachers' knowledge and classroom instruction, with stronger teacher-level outcomes associated with better student achievement. Visscher et al. (2025) also found a positive effect of teacher professional development on student achievement, particularly when professional learning incorporated multiple learning principles such as coaching, teacher cooperation, and self-regulation.

Relationship between perception and academic performance

The Pearson Product-Moment Correlation r was used to determine the relationship between students' perception of the targeted remediation intervention and their academic performance. The analysis yielded an r-value of 0.71 with a p-value of 0.001, interpreted as a strong positive significant relationship. This indicates that students who held more favorable perceptions of the intervention tended to demonstrate higher academic performance in the targeted Biology competency. Because the p-value of 0.001 is lower than the 0.05 level of significance, the relationship is statistically significant, and the null hypothesis stating that there is no significant relationship between students' perception of the targeted remediation intervention and their academic performance is rejected. The finding implies that engaging, understandable, and responsive remediation activities may contribute to improved learning outcomes. However, the correlation indicates an association rather than causation, so the result should not be interpreted as proof that perception alone caused the improvement in academic performance.

The finding is supported by several studies. Tao et al. (2022) found a positive relationship between students' perceived instructional support, engagement, and academic achievement, with student engagement partially mediating the relationship between perceived support and achievement. Wu et al. (2023) found a significant positive relationship between perceived social support and academic achievement, again with student engagement as a partial mediator. Guay et al. (2023) found that perceived autonomy support was positively associated with academic performance, motivation, engagement, and self-regulated learning. Scherer et al. (2022) reported positive associations between students' perceptions of instructional quality and important learning outcomes, including achievement and self-efficacy, which supports the view that learners' perceptions of the quality and usefulness of instructional experiences may be meaningfully related to their academic performance. The strong positive relationship found in the present study therefore suggests that teachers should consider learners' feedback and perceptions when designing and improving targeted remediation activities. The result may also provide useful evidence for the proposed professional development framework by emphasizing learner-responsive, engaging, and supportive remediation practices.

Synthesis of findings

Taken together, the results from the 100 respondents, 50 in the experimental group and 50 in the control group, show that both groups began at comparable levels (pretest means of 12.45 and 12.63) and that both improved significantly ($t = 6.82$, $p = 0.000$, at the 0.05 level of significance). The experimental group, however, advanced from Developing to Proficient with a posttest mean of 21.47 and a gain of 8.84 points, while the control group reached Approaching Proficiency with a posttest mean of 15.28 and a gain of 2.83 points. Students in the experimental group also perceived the intervention as highly effective, with an overall mean of 4.45 interpreted as Strongly Agree. This perception was strongly and significantly related to academic performance ($r = 0.71$, $p = 0.001$). These findings address each objective of the study and indicate that targeted, visually supported, and activity-based remediation can improve students' understanding of a least learned Biology competency such as protein synthesis, while the correlational evidence calls for caution against causal claims. The study contributes to the field by providing quasi-experimental evidence from a public secondary school setting that supports learner-responsive remediation, and by showing why teachers' capacity to design and deliver such remediation deserves sustained support. These results provide the empirical basis for the innovative professional development framework for Science teachers, which is presented in the succeeding chapter.

PANTAO
(International Journal of the Humanities and Social Sciences)
Volume 5, Issue 4
ISSN 3028-0877 | e-ISSN 3155-6043 | DOI 10.69651/2022PIJHSS

CONCLUSION

This study assessed the academic performance of students in the least learned competencies in Biology at Cabangahan National High School, Cabangahan, Consolacion, Cebu, during the 2nd quarter of the school year 2025–2026, as a basis for an innovative professional development framework. Using a quasi-experimental design with 50 respondents in each of the control and experimental groups, the study examined the effect of a targeted remediation intervention in protein synthesis, together with students' perception of that intervention. Data were gathered through an adapted questionnaire and were analyzed using simple percentage, weighted mean, t-test, and the Pearson Product-Moment Correlation R. It is from this methodological foundation that the following conclusions are drawn.

The findings show that the experimental group demonstrated greater improvement in academic performance in protein synthesis than the control group, based on their pretest and posttest results. It may therefore be concluded that the targeted remediation intervention was associated with improved performance among the students who received it. This conclusion is supported by the students' own perceptions, as the experimental group viewed the intervention favorably, particularly in terms of improving their understanding, participation, motivation, and retention of Biology concepts. Taken together, these results indicate that the intervention was not only associated with measurable gains in performance but was also positively received by the participating students.

Furthermore, the results revealed a significant difference between the pretest and posttest performance of both the control and experimental groups. Accordingly, the null hypothesis stating that there was no significant difference between the pretest and posttest scores of the two groups was rejected, which indicates that students' academic performance changed significantly following the instructional period. Likewise, the study found a significant positive relationship between students' perception of the targeted remediation intervention and their academic performance. The null hypothesis stating that there was no significant relationship between these variables was therefore rejected, which signifies that more favorable perceptions of the intervention were associated with higher academic performance in the targeted Biology competency. These conclusions suggest that learners' engagement with and appreciation of remediation activities are closely connected to their learning outcomes.

In light of these conclusions, several recommendations are offered to enhance collaborative learning in manipulating the compound light microscope and to serve as a basis for improving students' academic performance in the least learned competencies in Biology. Students are encouraged to participate actively in targeted remediation activities, make use of visual learning materials, and practice Biology concepts regularly to strengthen their understanding and retention of difficult competencies. Science teachers are encouraged to identify least learned competencies regularly and to implement targeted remediation activities that employ visual aids, collaborative learning, contextualized activities, and other learner-centered strategies, while using students' assessment results and feedback to improve subsequent remediation efforts. Master teachers may support these efforts by providing coaching, mentoring, demonstration teaching, and peer-learning opportunities, as well as by assisting in monitoring and evaluating the implementation of remediation activities. School heads, in turn, may sustain such programs by providing instructional resources, allocating appropriate time for intervention activities, and encouraging school-based professional learning focused on identified learning gaps.

Beyond the school setting, parents and community stakeholders may contribute by offering encouragement, appropriate learning support, and access to resources that reinforce

the concepts and skills developed. The Department of Education may likewise consider these findings in strengthening Science intervention programs and teacher professional development initiatives, particularly those addressing least learned competencies through evidence-based and learner-responsive strategies. The researcher may use the findings as a basis for developing and refining the proposed Innovative Professional Development Framework, which is focused on targeted remediation, instructional improvement, and continuous professional growth among Science teachers. Finally, future researchers may conduct similar studies using larger samples, other Biology competencies, different grade levels, or longer intervention periods, so that the evidence on targeted remediation may be further broadened and strengthened.

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