Enhanced POE Model: It's Effect on Grade 10 Learners' Conceptual Understanding and Engagement in Biology

Nassiba B. Macapaser[1], Douglas A Salazar, PhD[2]

Department of Science and Mathematics Education Mindanao State University – Iligan Institute of Technology, Bonifacio Ave., Tibanga, Iligan City, 9200, Philippines

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ABSTRACT

This study investigated the effectiveness of the enhanced Predict–Observe–Explain–Assess– Evaluate (POEAE) Model on Grade 10 learners' conceptual understanding and engagement in Biology, specifically in the topic Nervous System. Using a one-group pretest–posttest quasi-experimental design, the intervention was implemented among 26 students from a private school in Lanao del Norte during the 2024–2025 academic year. Researcher-developed and expert-validated instruments—including a 20-item conceptual understanding test and a 10-item engagement checklist—were utilized to measure learning outcomes. Data were analyzed using descriptive statistics and the Wilcoxon Signed-Rank Test. Results from the Wilcoxon Signed-Rank Test revealed a statistically significant increase in learners' conceptual understanding ($p < .05$), with the mean score increasing from 4.85 in the pretest to 15.62 in the posttest, indicating a shift from Beginning/Developing Proficient to Approaching/Advanced Proficient levels. The mean gain score of 10.77 further demonstrated consistent learning improvement among participants. Engagement levels were also notably high, with an overall mean of 4.09, indicating that learners found the POEAE activities stimulating, reflective, and supportive of deeper understanding. Findings confirm that integrating Assess and Evaluate phases strengthens the traditional POE cycle by promoting metacognition, evidence-based reasoning, and sustained engagement. The study concludes that the enhanced POEAE Model is an effective instructional approach for improving both conceptual understanding and learner engagement in Biology.

Keywords: Enhanced POE Model, engagement, Biology instruction, Achievement level, Quasi- Experimental Design

INTRODUCTION

Developing achievement level and sustaining learners engagement remain persistent challenges in science education, particularly when students are required to interpret phenomena, connect prior knowledge with new observations, and construct explanations grounded in scientific principles. The Predict-Observe-Explain (POE) strategy has long been recognized as an effective pedagogical approach for fostering conceptual change because it prompts students to make predictions, confront discrepancies between expectation and observation, and articulate explanations supported by evidence (White & Gunstone, 1992; Liew & Treagust, 1995).

In the present study, the researcher adapted and modified the traditional POE model by integrating two additional phases—Assess and Evaluate—thereby forming the Predict-Observe-Explain-Assess-Evaluate (POEAE) model. This modification was undertaken to address limitations observed in the original POE cycle, specifically its lack of structured opportunities for students to assess their learning progress and engage in reflective evaluation of their reasoning. Research shows that when students are provided with systematic feedback and opportunities to reflect on their thinking, they develop stronger metacognitive skills, retain concepts more effectively, and exhibit deeper scientific reasoning (Zohar & Dori, 2012; Karamustafaoğlu & Mamlok, 2015). Thus, adding the Assess and Evaluate phases strengthens the model by embedding metacognitive monitoring and formative assessment into each learning cycle.

Despite the documented benefits of POE-based strategies, many students continue to struggle with conceptual understanding, often relying on rote memorization rather than meaningful reasoning (Orgill & Bodner, 2007; Duit & Treagust, 2012). Similarly, decreasing student engagement in inquiry-based activities has been reported across educational settings, indicating the need for instructional models that actively involve learners in predicting, observing, explaining, assessing, and evaluating scientific concepts. The enhanced POEAE model addresses this gap by guiding students through a multi-phase learning cycle that incorporates prediction, evidence-based explanation, formative assessment, and reflective evaluation all essential for deeper conceptual change. While previous studies have established the effectiveness of the traditional POE strategy, limited empirical research has examined the impact of extending POE with explicit Assess and Evaluate phases, particularly in junior high school Biology contexts in the Philippines.

The focus of this study is to examine the effectiveness of the POEAE model in enhancing students' conceptual understanding of scientific concepts and improving their engagement during classroom activities. By integrating both (Assess) and (Evaluate) components, the POEAE model allows teachers to identify misconceptions promptly, guide students toward accurate explanations, and encourage learners to self- monitor their understanding. Such structured metacognitive support is increasingly recognized as a critical element in student-centered learning environments (Zohar & Dori, 2012). Considering the growing demand for inquiry-based and metacognitive-rich instructional frameworks, investigating the POEAE model provides valuable insights into effective science teaching strategies that promote long-term understanding and active engagement

Objective of the Study

The prime objective of this study were to determine the effects of enhanced POE Model on Grade 10 Learners' in their conceptual understanding and engagement on the topic Nervous System. To achieve this general objective, the study aims to:

1. Determine the pre-test and post-test achievement levels of Grade 10 learners in Biology.
2. Examine whether there is a significant difference between learners' pre-test and post-test scores after the POEAE intervention.
3. Determine the level of learner engagement during POEAE-based instruction.

Null Hypothesis

H_0: There is no significant differences in the mean gain scores in the achievement level of learners between before and after the intervention

METHODS

Research Design

This study employed a one-group pretest–posttest quasi-experimental design to evaluate the effectiveness of the Predict–Observe–Explain–Assess– Evaluate (POEAE) Model a enhanced POE in improving Grade 10 students' conceptual understanding in Biology. In this design, a single intact class was exposed to the intervention, and their performance was measured before and after the implementation. This approach is appropriate when random assignment and control groups are not feasible but the researcher seeks to determine changes resulting from the treatment (Creswell, 2018). The design allowed the researcher to examine learning gains attributable to the POEAE Model and assess students' engagement using a post-intervention checklist.

Research Locale

The study was conducted at a private secondary school in Lanao del Norte, Philippines. The school offers a standard K–12 science curriculum and utilizes laboratory-based and activity-oriented instruction. The environment is conducive to implementing inquiry-based strategies such as the POEAE Model. The research was carried out inside a Grade 10 science classroom, ensuring that the intervention took place in an authentic learning environment aligned with the school's instructional practices.

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Participants

The participants of the study were 26 Grade 10 students from an intact science class during the Semester of School Year 2024–2025. Prior to the full implementation, a pilot testing was conducted with 30 students to evaluate and refine the research instruments, including the POEAE lesson plans, engagement survey, and pretest–posttest items. A purposive sampling technique was used to select the class to avoid disruptions to the school's schedule and maintain the natural learning environment. All students enrolled in the selected class participated in the study. Since the study utilized a one-group design, no control group was included; instead, the same group completed both the pretest and posttest and accomplished the engagement survey after the intervention.

Research Instruments

Researcher developed instruments, validated by 5 experts, were used in the study:

Conceptual Understanding Test

A 20-item multiple-choice test measured students' understanding of Nervous System Biology concepts. The instrument underwent content validation by science teachers and subject specialists. A pilot test was conducted to examine its reliability, clarity, and level of difficulty before the actual administration.

Student Engagement Survey Checklist

A 10-item Likert-scale checklist measured students' engagement during the POEAE lessons. Responses ranged from 1 (Strongly Disagree) to 5 (Strongly Agree). The checklist was validated by experienced science educators and underwent revision based on their feedback. The tool assessed behavioural, cognitive, and affective engagement.

Intervention

The intervention was implemented over **a** four-week period**,** The study began with the administration of a pilot test to finalize the researcher-made instrument, followed by the pretest to determine the baseline conceptual understanding of the 26 Grade 10 students.

Since the study utilized a one-group pretest–posttest design, all students received the same instructional approach, which centered on the enhanced POEAE Model. The POEAE instructional sequence—Predict, Observe, Explain, Assess, and Evaluate was consistently integrated into all learning sessions throughout the intervention period.

Table 1. Comparison of the Traditional Method and the POEAE Model in Teaching Biology Concepts

Traditional Method	Description	POEAE Model	Description
Teacher Explanation	Teacher directly explains lesson concepts while students listen and take notes.	Predict	Students state their initial ideas or predictions about the outcome of a phenomenon based on prior knowledge.
Demonstration	Teacher demonstrates the experiment while students observe passively.	Observe	Students observe a demonstration or activity, gather evidence, and compare observations with initial predictions.
Guided Practice	Students answer provided questions following a teacher-led procedure.	**Explain**	Students construct explanations based on evidence, clarify misconceptions, and justify results.

Independent Practice	Students complete exercises following the teacher's example.	**Assess**	Students answer assessment tasks to check understanding while the teacher provides immediate feedback.
Short Review / Q&A	Teacher reviews lesson content and summarizes key points.	**Evaluate**	Students reflect on their learning, evaluate their explanations, and revise incorrect ideas.

Table 1 provides a comparison between the Traditional Method and the POEAE Model in teaching Biology concepts. The Traditional Method is primarily teacher-centered, where students listen, observe passively, and follow guided or independent practice based on teacher direction. In contrast, the POEAE Model is student-centered and inquiry-driven, guiding learners through the phases of Predict, Observe, Explain, Assess, and Evaluate. Each phase actively involves students in generating ideas, gathering evidence, constructing explanations, and reflecting on their learning. This comparison highlights how the POEAE Model promotes deeper engagement and conceptual understanding by shifting students from passive recipients of information to active participants in the learning process.

Table 2. Summary of Intervention Activities

Session	Activities Implemented
1	Administration of Pretest
2	Lecture integrating POEAE phases
3	POEAE Learning Tasks (Predict–Observe–Explain)
4	POEAE Application Activity (Assess–Evaluate)
5	Administration of Posttest

Table 2 presents the sequence of activities conducted during the implementation of the enhanced POEAE Model. The intervention was carried out across five instructional sessions, each designed to develop students' conceptual understanding through progressive engagement in the POEAE phases. The table outlines the major activities implemented in each session.

In Session 1, the pretest was administered to determine students' baseline conceptual understanding in Biology. This step allowed the researcher to identify learners' initial knowledge levels and document misconceptions prior to the introduction of the intervention.

Session 2 involved a lecture integrating the POEAE phases, where key concepts were introduced while embedding Prediction, Observation, and Explanation prompts within the discussion. This session served as a transition from traditional instruction to POEAE-based learning by orienting students to the structure and expectations of the model.

During Session 3, students engaged in POEAE Learning Tasks, specifically the Predict–Observe–Explain components. These activities required students to articulate initial ideas, collect evidence through observation, and reconcile their predictions with scientific explanations. This phase emphasized active learning and supported conceptual change.

Session 4 focused on the Assess–Evaluate components of the POEAE Model. Students completed application activities designed to measure their understanding, reflect on their explanations, and revise inaccurate concepts. Immediate feedback during this session strengthened the consolidation of learning.

Lastly, Session 5 concluded with the administration of the posttest, which assessed the extent of students'

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conceptual gains after completing all POEAE learning activities. Comparing pretest and posttest scores provided empirical evidence of the effectiveness of the intervention.

This systematic progression of sessions ensured that students were gradually guided through all phases of the enhanced POE Model, enabling both conceptual development and deeper engagement throughout the intervention.

Data Analysis

To analyze and interpret the collected data, the researcher used several methods aligned with the tools employed in the study. The achievement test (Appendix B) was administered before and after the intervention to determine learners' conceptual understanding, and the mean score was computed to compare their pretest and posttest performance. The interpretation of achievement levels followed the transmuted grade ranges specified in DepEd Order No. 8, s. 2015, where scores from 74 and below fall under Beginning Proficient and scores from 75 and above indicate passing proficiency levels. Learners' engagement was assessed using the Engagement Level Questionnaire, with interpretation of mean score ranges adapted from Delmo (2019). To measure improvement, gain scores were calculated and interpreted using the guidelines adapted from Salazar (2016), with minor modifications to fit the number of test items. These combined methods provided a comprehensive analysis of learners' achievement, engagement, and performance growth throughout the intervention.

Statistical Tools/Treatment

The data were analyzed using quantitative methods. Descriptive statistics such as mean and standard deviation were used to summarize the learners' pretest and posttest scores in both engagement and achievement. These tabular presentations provided an overview of learners' performance before and after the intervention. For deeper inferential analysis, the Wilcoxon Signed-Rank Test was employed to determine whether a significant difference existed between the paired pretest and posttest scores, as this nonparametric test is appropriate for data that do not fully meet normality assumptions.

Descriptive Statistics

The descriptive statistics used in this study included simple percentage, mean, standard deviation, and coefficient of variation (CV). Simple percentage was used to determine the frequencies and percentages of responses, while the mean provided the central tendency of learners' scores. The standard deviation measured the consistency of the scores around the mean, and the CV described the relative dispersion of pretest and posttest scores to show changes in performance consistency after the intervention. Since the data did not fully meet normality assumptions, the Wilcoxon Signed-Rank Test—a nonparametric test for paired samples—was employed to determine whether a significant difference existed between the learners' pretest and posttest scores in both achievement and engagement.

RESULTS AND DISCUSSIONS

The Effect of the Intervention on Academic Achievement

Table 3. Mean Score of the Learners Achievement Level

Achievemen T Test	Frequenc Y (N)	Mean Scor E	Standar D Deviation	Minimu M	Maximu M	Interpretatio N
Pretest	26	4.85	1.93	2	9	Developing Proficiency
Posttest	26	15.62	2.40	11	20	Advanced Proficient

Table 3 shows the results of the achievement tests reveal a substantial improvement in learners' performance following the implementation of the intervention. The pretest scores show a mean of 4.85, with a standard deviation of 1.93, indicating that students began with generally low levels of understanding, falling within the Beginning Proficient to Developing Proficient categories. Their scores ranged narrowly from 2 to 9, suggesting that most learners struggled with the concepts prior to instruction. In contrast, the posttest results demonstrate a marked increase in achievement, with the mean score rising to 15.62 and the standard deviation slightly increasing to 2.40, reflecting a wider spread as learners improved to varying degrees. The minimum score increased significantly to 11, while the maximum reached 20, showing that several learners achieved full mastery. Overall, these findings indicate that the intervention was effective in enhancing learners' conceptual understanding, as evidenced by the shift from low pretest performance to predominantly Approaching Proficient and Advanced Proficient achievement levels in the posttest. The data clearly supports the conclusion that the instructional strategy greatly improved academic performance.

3.2. Mean gain scores in the achievement level of learners between before and after the intervention.

Table 4. Mean Gain Scores of Students in the Experimental Group (n = 26)

GROUP	N	Pretest Mean (SD)	Posttest Mean (SD)	Mean Gain Score (SD)
Experimental Group	26	4.85 (1.93)	15.62 (2.40)	10.77 (0.91)

Table 4 shows the experimental group, composed of 26 students, showed a substantial improvement from pretest to posttest. The pretest mean score of 4.85 (SD = 1.93) indicates low initial understanding of the lesson content. After the intervention, the posttest mean rose sharply to 15.62 (SD = 2.40), demonstrating significant learning gains. The calculated mean gain score of 10.77 (SD = 0.91) reflects consistent improvement across students, with minimal variability. Based on the gain score interpretation scale, this corresponds to an Average Increase, confirming the effectiveness of the instructional strategy.

Table 5. Learner's Achievement Level in Probability (Experimental Group Only, n = 26)

Score Range	Pretest f	Pretest %	Posttest f	Posttest %	Interpretation
21–25	0	0	0	0	Advance Proficient
19–20	0	0	3	11	Proficient
17–18	0	0	7	26.92	Approaching Proficient
15–16	0	0	7	26.92	Developing Proficient
14 & below	26	100	9	34.62	Beginning Proficient
Total	26	100	26	100	

Table 5. Shows the results show a noticeable improvement in learners' proficiency after the intervention.During the pretest, all 26 learners (100%) scored within the range of 14 and below, which corresponds to the Beginning Proficient level. This indicates that prior to the instructional intervention, the learners had limited understanding of the concepts in Probability. No learner reached the Developing, Approaching, Prof icient, or Advance Proficient levels based on the initial assessment. In contrast, the posttest results reveal a significant upward shift in learners' achievement levels. A total of 17 learners (65.38%) moved beyond the Beginning Proficient category, demonstrating improved mastery of the lesson. Specifically, 7 learners (26.92%) reached the Developing Proficient level, another **7** learners (26.92%) attained the Approaching Proficient level, and 3 learners (11.54%) achieved the Proficient level. Although 9 learners (34.62%) remained in the Beginning Proficient category, the overall distribution shows that the intervention effectively enhanced students' performance.

Level Engagement level of the learners

Table 6. Mean Engagement Scores per item (N=26)

Item	Description	Mean	Interpretation
1	I actively participated in the POEAE lesson.	4.04	High Engagement
2	The Predict phase made me think deeply.	4.00	High Engagement
3	The Observe activity helped me understand the topic.	4.23	Very High
4	I enjoyed comparing my predictions with results.	3.88	High
5	The explanations helped me correct misunderstandings.	4.38	Very High
6	The Assess phase showed me what I needed to improve.	3.77	High
7	I felt motivated throughout the activity.	4.08	High
8	I worked well with my classmates.	4.00	High
9	I found the activity interesting and engaging.	4.23	Very High
10	I would like similar lessons in the future.	4.31	Very High
	Overall Mean	**4.09**	**High Engagement**

Note. 4.21–5.00 = Very High Engagement; 3.41–4.20 = High Engagement; 2.61–3.40 = Moderate Engagement; 1.81– 2.60 = Low Engagement; 1.00–1.80 = Very Low Engagement

This Table 6 shows the results of the Student Engagement Survey, which revealed a high level of engagement among the 26 Grade 10 students after the implementation of the POEAE model. As shown in the table, item means ranged from 3.77 to 4.38, with the highest ratings observed in items related to understanding the lesson (Item 5: M = 4.38) and finding the activity interesting (Item 9: M = 4.23). The overall mean engagement score of 4.09 indicates that students generally agreed that they were motivated, actively involved, and supported by the structure of the POEAE lesson.

These findings suggest that the POEAE instructional model effectively enhanced learners' engagement during the science instruction. This is consistent with Kearney et al. (2001), who found that Predict–Observe–Explain approaches increase student engagement and promote deeper involvement because students become active participants rather than passive receivers of information. The structured phases of the POEAE model particularly observing, explaining, and evaluating create meaningful learning experiences that sustain student attention and participation.

CONCLUSION AND RECOMMENDATIONS

The findings of this study demonstrate that the enhanced POEAE Model significantly improved the achievement level and engagement of Grade 10 learners in Biology. The substantial increase in mean test scores from pretest to posttest indicates that students benefited from the structured learning cycle incorporating prediction, observation, explanation, assessment, and evaluation. This multi-phase approach effectively addressed misconceptions, encouraged evidence-based reasoning, and supported metacognitive reflection. Likewise, the high engagement scores suggest that the POEAE model created an interactive and motivating learning environment, allowing students to actively participate, collaborate, and reflect on their learning. Overall, the results provide strong evidence that the enhanced POEAE Model is a powerful instructional framework that promotes deeper comprehension and sustained engagement, making it a valuable strategy for improving science learning outcomes.

Limitations of the Study

Despite the positive findings, the use of a one-group pretest–posttest quasi- experimental design limits the ability to draw strong causal conclusions. The observed improvements in learners' conceptual understanding may have been influenced by testing effects, maturation, or other external factors that were not controlled in the study. Additionally, the relatively small sample size and the absence of a comparison group restrict the generalizability of the results. Future studies employing a true experimental design with control groups and larger samples are recommended to strengthen internal validity and confirm the effectiveness of the enhanced POEAE Model.

Based on the results of the study, it is recommended that science teachers adopt the enhanced POE Model as a regular instructional approach to promote achievement level and engage learners more meaningfully in scientific inquiry. Teachers should incorporate structured opportunities for prediction, observation, explanation, assessment, and reflection to support students in developing metacognitive skills and correcting misconceptions. Schools are encouraged to provide training and professional development on POEAE-based instruction to equip teachers with the necessary skills for effective implementation. Future researchers may extend the model to other grade levels, science disciplines, or larger sample sizes, as well as explore its impact using a true experimental design for stronger causal validation. Additionally, integrating technology-based simulations into the POEAE phases may further enhance student engagement and conceptual mastery in complex scientific topics.

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