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The Effectiveness of the Practice-Based Predict Observe Explain (POE) Model on Students' Critical Thinking Skills and Learning Motivation

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ABSTRACT

Laboratory activities in the Entomology course at the Biology Education Study Program, Universitas Serambi Mekkah, have not fully optimized students' active engagement, resulting in limited development of critical thinking skills and learning motivation. Practical activities have tended to focus on procedural completion and have not been systematically integrated with scientific thinking processes. This study aimed to examine the effectiveness of a practicum-based Predict Observe Explain (POE) learning model on students' critical thinking skills and learning motivation. A quantitative approach with a pre-experimental one-group pretest–posttest design was employed. The sample consisted of 38 Biology Education students enrolled in the Entomology course in the 2025/2026 academic year. Data were collected through observations, critical thinking tests, learning motivation questionnaires, and interviews, and analysed using paired sample t-tests, N-Gain, and percentage analysis. The results showed that the practicum-based POE model was implemented very well (94.02%). A significant improvement in critical thinking skills was found, with an average N-Gain of 0.51 (moderate category), while learning motivation was classified as very high (87%). Therefore, the practicum-based POE model is effective in improving students' critical thinking skills and learning motivation in the Entomology course.

1. Introduction

Learning in the Entomology course requires active student engagement through direct observation, data analysis, and an understanding of scientific concepts related to insects. Therefore, the development of critical thinking skills and learning motivation becomes a key factor in supporting successful learning. As a compulsory course in the Biology Education Study Program, Entomology is not only oriented toward conceptual mastery but also aimed at systematically training students' critical thinking skills. However, based on preliminary observations conducted in

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the odd semester of the 2024/2025 academic year, the implementation of Entomology laboratory activities at Universitas Serambi Mekkah has not been carried out optimally. The learning process has tended to be teacher-centered, which has not fully encouraged students to actively engage in critical thinking processes. This condition is consistent with Andalia *et al*. (2019), who state that learning dominated by one-way communication tends to make learners passive because they are not actively involved in thinking processes.

In addition, laboratory activities have not been implemented consistently and integratively due to limitations in time, supervision, and supporting facilities. Practical activities have focused more on completing procedural tasks rather than on analysis, reasoning, and meaningful interpretation of scientific concepts. As a result, students tend to perform laboratory work mechanically without engaging in deep critical thinking. This condition is reflected in students' low levels of critical thinking skills and learning motivation, where students act mainly as instruction followers, show limited engagement in prediction, observation, and reflection, and demonstrate high dependence on lecturers' instructional materials. This situation indicates a gap between the ideal demands of biology learning, which emphasize active learning, and actual classroom practices that remain procedural in nature.

Previous studies have shown that the Predict Observe Explain (POE) model has strong potential to improve the quality of science learning. White and Gunstone (2023) state that the POE model effectively promotes students' active engagement in scientific thinking through the stages of predicting, observing, and explaining phenomena. These findings are supported by Fatmawati *et al*. (2022) and Yildirim and Sensoy (2023), who reported that POE implementation enhances the quality of experiential learning. Moreover, several studies have demonstrated that the POE model positively contributes to the improvement of critical thinking skills, conceptual understanding, and learning motivation (Fatmawati *et al*., 2022; Hasanah *et al*., 2024; Chan, 2023). Nevertheless, most of these studies have focused on primary and secondary education levels and have not specifically examined the effectiveness of practicum-based POE implementation in higher education, particularly in the context of the Entomology course.

Based on this gap, empirical research is needed to examine the effectiveness of a practicum-based Predict Observe Explain (POE) model in improving university students' critical thinking skills and learning motivation. This study is important because it integrates laboratory-based learning with the POE approach, which simultaneously emphasizes students' cognitive and affective engagement. Therefore, this study aims to examine the effectiveness of a practicum-based Predict Observe Explain (POE) model on the critical thinking skills and learning motivation of Biology Education students at Universitas Serambi Mekkah in the Entomology course.

2. Methodology

This study employed a quantitative approach using a pre-experimental design in the form of a one-group pretest–posttest design. This design was used to examine the effectiveness of a practicum-based Predict Observe Explain (POE) learning model on students' critical thinking skills and learning motivation before and after the treatment (Sugiyono, 2021; Maulana et al., 2021).

2.1 Research Design and Participants

The study was conducted in the Entomology course of the Biology Education Study Program, Faculty of Teacher Training and Education, Universitas Serambi Mekkah, during the odd semester of the 2025/2026 academic year. The population consisted of all Biology Education students from the 2022 cohort who were enrolled in the Entomology course, totaling 38 students. The entire population was selected as the research sample using a total sampling technique (Arikunto, 2022).

The research design applied was a one-group pretest–posttest design, in which a single group of participants was given a pretest, followed by a treatment in the form of implementing the practicum-based POE model, and concluded with a posttest. The research design is presented in Table 1.

Tabel 1. *Desain One-Group Pretest–Posttest* (Sugiyono, 2021)

Pretest	Perlakuan	Posttest
O_1	X	O_2

Notes:
O_1 : Pretest
X : Treatment (implementation of the practicum-based Predict Observe Explain (POE) model)
O_2 : Posttest

This design was selected because it allows for a direct comparison of participants' conditions before and after the treatment, enabling observed changes to be attributed to the applied intervention.

2.2 Research Procedures

The research procedures were carried out in several stages: (1) administering a pretest to measure students' critical thinking skills prior to the implementation of the practicum-based POE model; (2) conducting learning activities using the Predict Observe Explain (POE) model, which consisted of the predict, observe, and explain stages; and (3) administering a posttest and a learning motivation questionnaire after the completion of all learning activities. During the learning process, observations were conducted to assess learning implementation and student engagement, and interviews were carried out to explore the perceptions of both lecturers and students regarding the learning process.

2.3 Research Instruments

The instruments used in this study included: (1) a critical thinking skills test in the form of multiple-choice questions administered during the pretest and posttest stages, developed based on the indicators of interpretation, analysis, evaluation, inference, explanation, and self-regulation (Facione, 2021); (2) a learning motivation questionnaire using a five-point Likert scale covering indicators of interest and attention, persistence, achievement motivation, learning independence, and self-efficacy (Keller, 2021; Dörnyei and Ushioda, 2022); (3) an observation sheet used to assess the implementation of learning activities and student engagement during the application of the practicum-based POE model (Nuraini *et al*., 2021); and (4) a semi-structured interview guide used to explore lecturers' and students' perceptions of the learning implementation (Putri and Sari, 2024).

2.4 Data Analysis Techniques

Data analysis was conducted using IBM SPSS Statistics 25 to obtain objective and accurate results. Students' critical thinking skills data were analyzed using descriptive statistics to determine the mean scores of the pretest and posttest, followed by prerequisite testing using the Shapiro–Wilk normality test. Differences in critical thinking skills before and after the treatment were analyzed using a paired sample t-test with a significance level of 0.05 (Pallant, 2023). The level of improvement in critical thinking skills was analyzed using the N-Gain test to determine the effectiveness category of the learning model (Rahman and Sari, 2021). Learning motivation data were analyzed descriptively using percentage scores from the Likert-scale questionnaire and classified into very high, high, moderate, and low categories (Pasya *et all*., 2024). Observation data were analysed by calculating the percentage of learning implementation at each POE stage and

interpreted based on learning implementation quality criteria (Yuliana and Prasetyo, 2022). Interview data were analysed descriptively through the stages of data reduction, data display, and conclusion drawing as proposed by Miles, Huberman, and Saldaña (2022).

3. Results and Discussion

3.1 Implementation of the Practicum-Based Predict Observe Explain (POE) Model

The results of observations on the implementation of learning using the practicum-based Predict Observe Explain (POE) model indicate that the first observer obtained a score of 85 out of a maximum score of 92, with an implementation percentage of 92.39% (very good category), while the second observer obtained a score of 88 out of 92, with an implementation percentage of 95.65% (very good category). A summary of the observation results on the implementation of the learning process is presented in Figure 1.

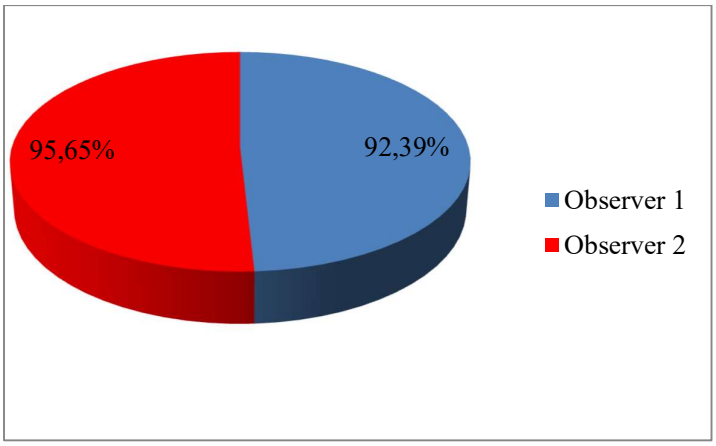

Fig.1. Percentage of Learning Implementation Observation Results

Since there were two observers, the final result was obtained by calculating the average percentage, as follows:

$$P_{Rata-rata} = \frac{92{,}39\% + 95{,}65\%}{2} = \frac{188{,}04}{2} = 94{,}02\%$$

The observations were conducted by two observers; therefore, the percentage of learning implementation was obtained from the average score of both observers, resulting in a value of 94.02%. This result indicates that the implementation of the practicum-based Predict Observe Explain (POE) model in the Entomology course was carried out at a very good level. All POE stages, namely predict, observe, and explain, were implemented systematically, with students actively involved in making predictions, conducting practicum observations, and explaining the results through discussions and presentations. The high level of learning implementation demonstrates that the practicum-based POE model is able to create active and student-centered learning. This finding is consistent with Musriadi et al. (2024), who reported that the application of innovative learning methods significantly increases student engagement. In addition, interviews with lecturers and students revealed that the learning process became more interactive and meaningful despite limitations in time and facilities. This supports the view of Kearney and Treagust (2022) that the POE model provides a structured learning framework that promotes active engagement and

meaningful learning. Therefore, the very good level of learning implementation serves as an important foundation for improving students' cognitive and affective outcomes.

3.2 Distribution of Students' Critical Thinking Ability Data

Students' critical thinking ability was measured using a test administered before (*pretest*) and after (*posttest*) the implementation of the practicum-based Predict Observe Explain (POE) model. A summary of the pretest and posttest scores of students' critical thinking ability is presented in Table 1.

Table 1. Summary of Pretest and Posttest Scores of Students' Critical Thinking Ability

No	Student Initials	Student ID	Critical Thinking Test Score	
			Pretest	***Posttest***
1	UM	2211010025	57	70
2	RNL	2211010020	60	67
3	KU	2211010037	50	73
4	FH	2211010046	60	83
5	RS	2211010036	70	73
6	Y	2211010027	63	90
7	NA	2211010044	67	80
8	NV	2211010012	57	87
9	S	2211010024	53	80
10	MZ	2211010011	57	73
11	NA	2211010044	73	93
12	MS	2211010043	53	67
13	FIIS	2211010005	53	80
14	NA	2211010014	63	67
15	MA	2211010010	63	80
16	R	2211010015	73	90
17	AFZ	2211010049	77	73
18	TE	2211010016	57	77
19	RN	2211010018	73	70
20	ZH	2211010029	60	63
21	PWR	2211010032	77	83
22	JH	2211010031	63	93
23	VM	2211010048	77	93
24	YS	2211010039	63	77
25	EF	2211010003	50	67
26	YF	2211010050	47	63
27	SM	2211010023	57	80
28	DP	2211010002	73	73
29	NA	2211010047	63	83
30	HM	2211010006	70	93
31	ILB	2211010038	63	93
32	ZN	2211010034	53	83
33	RFA	2211010017	53	87
34	K	2211010033	57	90
35	DM	2211010001	77	97
36	RKS	2211010035	50	90
37	WR	2211010026	67	77
38	RA	2211010019	67	90
Total Score			2366	3048

Mean Score ($\bar{X} = \frac{\sum X}{N}$)	62,28	80,26
Minimum Score	47	63
Maximum Score	77	97

Based on descriptive statistical analysis, the pretest scores of students' critical thinking ability showed a minimum score of 47, a maximum score of 77, and a mean score of 62.28, which falls into the moderate category. After the implementation of the practicum-based Predict Observe Explain (POE) model, the posttest scores increased, with a minimum score of 63, a maximum score of 97, and a mean score of 80.26. The increase in the mean score as well as the upward shift in both minimum and maximum scores indicate an overall improvement and more even distribution of students' critical thinking ability after participating in the practicum-based POE learning activities.

3.3 Prerequisite Tests for Data Analysis

The prerequisite tests for data analysis included normality and homogeneity tests. The normality test was conducted using the Shapiro Wilk test because the sample size was fewer than 50 students. The results of the normality test for pretest and posttest scores of students' critical thinking ability are presented in Table 2.

Table 2. Results of the Normality Test of Students' Critical Thinking Ability

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest Critical Thinking	.124	38	.146	.946	38	.065
Posttest Critical Thinking	.133	38	.089	.947	38	.072

a. Lilliefors Significance Correction

Source: SPSS Statistics version 25 output (2025)

The results of the Shapiro–Wilk normality test indicate significance values of 0.065 for the pretest data and 0.072 for the posttest data (Sig. > 0.05), indicating that both datasets are normally distributed. Subsequently, the homogeneity of variance was examined using Levene's test, and the results are presented in Table 3.

Table 3. Results of the Homogeneity Test of Students' Critical Thinking Ability

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Critical Thinking	Based on Mean	.666	1	74	.417
	Based on Median	.669	1	74	.416
	Based on Median and with adjusted df	.669	1	73.756	.416
	Based on trimmed mean	.685	1	74	.411

Source: SPSS Statistics version 25 output (2025)

The Levene's test yielded a significance value of 0.417 (Sig. > 0.05), indicating that the variance of students' critical thinking ability data is homogeneous. With the assumptions of normality and

homogeneity fulfilled, the analysis of differences in students' critical thinking ability could be continued using parametric statistical tests.

3.4 Effect of the Practicum-Based POE Model on Students' Critical Thinking Ability

The difference in students' critical thinking ability before and after the implementation of the practicum-based Predict Observe Explain (POE) model was examined using a paired sample t-test. The results of the paired sample t-test are presented in Table 4.

Table 4. Results of the Paired Sample t-Test

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Posttest	-17.947	10.712	1.738	-21.468	-14.426	-10.328	37	.000

Source: Research data analysis results (2025)

The analysis results show a mean difference of −17.947 with a significance value of 0.000 (Sig. < 0.05), indicating a statistically significant difference between pretest and posttest scores. This finding confirms that the implementation of the practicum-based Predict Observe Explain (POE) model has a significant effect on improving students' critical thinking ability. The prediction, observation, and evidence-based explanation activities embedded in the POE model provide students with systematic opportunities to develop analytical, evaluative, and inferential thinking skills.

3.5 Improvement of Students' Critical Thinking Ability Based on N-Gain

To determine the level of improvement in students' critical thinking ability, an N-Gain analysis was conducted. The results of the N-Gain analysis are presented in Table 5.

Table 5. Results of the N-Gain Analysis of Students' Critical Thinking Ability

No	Student Initials	Skor			Category
		Pret	Post	N-Gain	
1	UM	57	70	0,33	Moderate
2	RNL	60	67	0,18	Low
3	KU	50	73	0,50	Moderate
4	FH	60	83	0,64	Moderate
5	RS	70	73	0,13	Low
6	Y	63	90	0,80	High
7	NA	67	80	0,44	Moderate
8	NV	57	87	0,75	High
9	S	53	80	0,62	Moderate
10	MZ	57	73	0,42	Moderate
11	NA	73	93	0,86	High
12	MS	53	67	0,31	Moderate
13	FIIS	53	80	0,62	Moderate
14	NA	63	67	0,10	Low

15	MA	63	80	0,50	Moderate
16	R	73	90	0,71	High
17	AFZ	77	73	-0,17	Low
18	TE	57	77	0,50	Moderate
19	RN	73	70	-0,14	Low
20	ZH	60	63	0,09	Low
21	PWR	77	83	0,33	Moderate
22	JH	63	93	0,90	High
23	VM	77	93	0,83	High
24	YS	63	77	0,40	Moderate
25	EF	50	67	0,36	Moderate
26	YF	47	63	0,33	Moderate
27	SM	57	80	0,58	Moderate
28	DP	73	73	0,00	Low
29	NA	63	83	0,60	Moderate
30	HM	70	93	0,88	High
31	ILB	63	93	0,90	High
32	ZN	53	83	0,69	Moderate
33	RFA	53	87	0,77	High
34	K	57	90	0,83	High
35	DM	77	97	1,00	High
36	RKS	50	90	0,86	High
37	WR	67	77	0,33	Moderate
38	RA	67	90	0,78	High
Mean Score		62,28	80,26	0,51	Moderate
Maximum Score		97			

Based on the analysis results, the average N-Gain value was 0.51, which falls into the moderate category. The percentage distribution of students' N-Gain achievement across categories is presented in Figure 2.

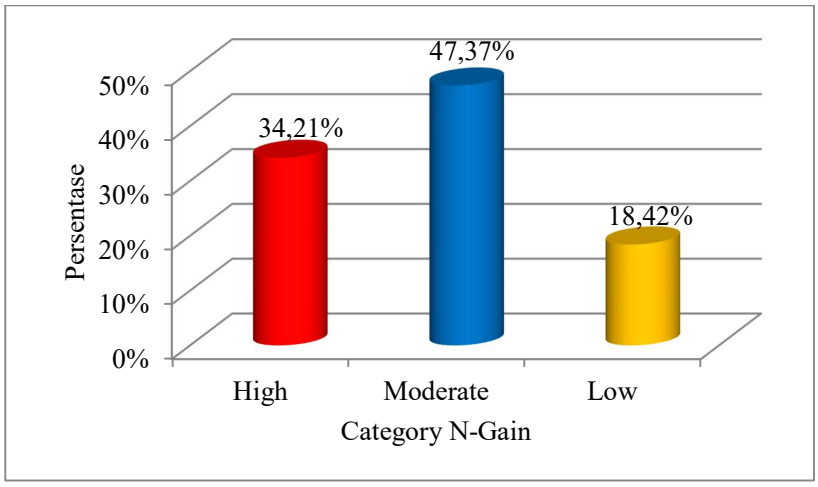

Fig. 2. Percentage Distribution of N-Gain Achievement in Students' Critical Thinking Ability

The majority of students were classified in the moderate category (47.37%), followed by the high category (34.21%) and the low category (18.42%). These results indicate that the implementation of the practicum-based Predict Observe Explain (POE) model was reasonably effective in improving students' critical thinking ability. This finding is supported by interview results showing that students became more accustomed to comparing their predictions with observational results and articulating scientific reasoning logically. The results are consistent with Facione (2021) and Rahmawati *et al*. (2024), who emphasize that active engagement in evidence-based reasoning can enhance critical thinking skills.

3.6 Results of Students' Learning Motivation

Students' learning motivation was measured using a Likert-scale questionnaire and analyzed using descriptive quantitative methods. The recapitulation of the percentage of students' learning motivation is presented in Table 6.

Table 6. Recapitulation of Students' Learning Motivation Percentage

No	Student Initials	Skor	Persentase	Category
1	UM	84	84%	Very High
2	RNL	99	99%	Very High
3	KU	86	86%	Very High
4	FH	81	81%	Very High
5	RS	85	85%	Very High
6	Y	91	91%	Very High
7	NA	92	92%	Very High
8	NV	84	84%	Very High
9	S	90	90%	Very High
10	MZ	87	87%	Very High
11	NA	93	93%	Very High
12	MS	86	86%	Very High
13	FIIS	82	82%	Very High
14	NA	84	84%	Very High
15	MA	81	81%	Very High
16	R	84	84%	Very High
17	AFZ	77	77%	High
18	TE	99	99%	Very High
19	RN	89	89%	Very High
20	ZH	92	92%	Very High
21	PWR	81	81%	Very High
22	JH	96	96%	Very High
23	VM	94	94%	Very High
24	YS	86	86%	Very High
25	EF	79	79%	High
26	YF	85	85%	Very High
27	SM	91	91%	Very High
28	DP	92	92%	Very High
29	NA	84	84%	Very High
30	HM	90	90%	Very High
31	ILB	87	87%	Very High
32	ZN	93	93%	Very High
33	RFA	86	86%	Very High
34	K	82	82%	Very High
35	DM	84	84%	Very High
36	RKS	81	81%	Very High
37	WR	84	84%	Very High

38	RA	77	77%	High
Total Score		3298		
Maximum Score		3800		
Average percentage			87%	Very High

The analysis results indicate that students' learning motivation was classified as very high, with an average percentage of 87%. Most students (92.11%) were categorized as having very high learning motivation, while 7.89% were in the high category. The distribution of students' learning motivation categories is presented in Figure 3.

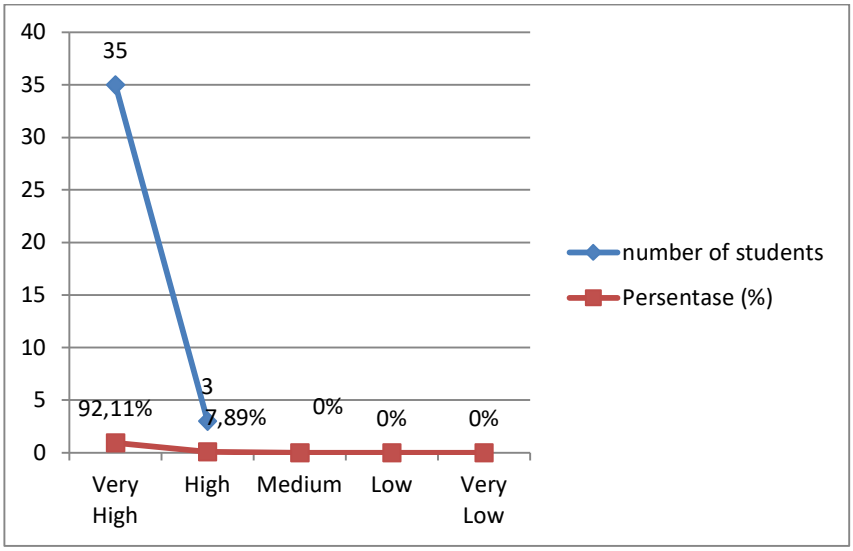

Fig. 3. Percentage Distribution of Students' Learning Motivation Levels

Furthermore, to obtain the average percentage of students' learning motivation, an analysis was conducted using the percentage formula as follows:

$$P = \frac{Obtain\ Score}{Max\ Score} x100\%$$

$$P = \frac{3298}{3800} x100\% = 87\%$$

The questionnaire analysis results indicate that students' learning motivation was categorized as very high, with an average percentage of 87%, where 92.11% of students were in the very high category and the remaining 7.89% were in the high category. The high level of students' learning motivation suggests that appropriate instructional design and learning management play an important role in achieving successful learning outcomes. Jalaluddin *et al*. (2025) state that effective learning management can enhance motivation, although it does not always have a direct impact on other learning aspects. In the context of this study, the implementation of the practicum-based Predict Observe Explain (POE) model was proven to optimally promote students' learning motivation, particularly through challenging and non-monotonous practicum activities and POE-based discussions. Interview findings further revealed that students felt more enthusiastic, less easily bored, and better able to understand Entomology concepts. These results are consistent with

the motivation theory proposed by Deci and Ryan (2022), which emphasizes that learning environments supporting autonomy and active participation can enhance intrinsic motivation. Previous studies by Pratiwi *et al*. (2024), Kim and Park (2023), and Lee *et al*. (2025) also reported that practicum-based POE learning improves students' motivation and engagement in science learning. Overall, the findings of this study confirm that the practicum-based POE model is effective in improving learning quality in terms of implementation, critical thinking ability, and students' learning motivation, and is therefore recommended for Entomology courses and other biology subjects in higher education.

4. Conclusions

Based on the results of the study, it can be concluded that the implementation of the practicum-based Predict Observe Explain (POE) model in the Entomology course of the Biology Education Study Program at Universitas Serambi Mekkah was carried out very well, with an implementation level of 94.02%. The practicum-based POE model was proven to be effective in improving students' critical thinking ability, as indicated by a significant difference between pretest and post-test scores and an average N-Gain value of 0.51, categorized as moderate. In addition, students' learning motivation was classified as very high, with an average percentage of 87%, reflecting strong student interest and engagement in the learning process. Therefore, the practicum-based POE model is effective in improving learning quality in terms of instructional implementation, critical thinking ability, and learning motivation, and is recommended for Entomology courses and other biology-related subjects in higher education.

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