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The effect of the POE2WE model and students' critical thinking on the ability to write argumentations

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ABSTRACT

The performance of students in argumentative writing has not yet met the required standards. This issue stems from the fact that educational activities are not centered around students, and the instructional methods used by lecturers are not suitable, leading to poor results in students' argumentative writing. To enhance these skills, it is essential to adopt an effective instructional model, specifically the prediction, observation, explanations, elaboration, writing, and evaluation (POE2WE) model. This study aims to investigate the impact of the POE2WE model and critical thinking on the argumentative writing skills of students at Indraprastha PGRI University. An experimental approach is utilized, employing a 2 x 2 factorial design to analyze data with SPSS software. The findings indicate that high critical thinking skills are crucial for argumentative writing, regardless of whether the POE2WE or Discovery Learning model is used. Both learning models and critical thinking significantly affect argumentative writing skills. The POE2WE model is particularly beneficial for students with lower critical thinking skills, while the Discovery Learning model suits those with higher critical thinking skills better. Learning models serve as frameworks that lecturers use to create effective learning environments.

1. Introduction

Students are scholars, which means they must provide reliable information in both oral and written communication. The 2013 Curriculum has been updated to Permendikbud Number 20 of 2016 regarding Graduation Competency Standards. This change emphasizes the skills needed for students to be active in the 21st century's globalized era. Therefore, students must develop skills that meet current demands. Educational institutions are responsible for ensuring students acquire skills in creative thinking, critical thinking, problem-solving, communication, and collaboration, known as the 4Cs. This curriculum adaptation anticipates technological advancements and their societal applications (Mulyasa, 2021). According to Nufus et al. (2023), 21st-century skills for college students include confidence, initiative, creativity and innovation, communication, cooperation, discipline, and technology adaptation.

Among the four language skills, writing skills are difficult and complex because writing skills are closely related to other types of skills such as listening, speaking, and reading. The writing course is one of the courses in the Indonesian language and literature education study program at Indraprastha University PGRI Jakarta. Following the experience of researchers and the results of interviews with several lecturers who teach writing courses, 80% of lecturers use conventional learning models in carrying out learning activities. In the learning process, there are still many problems found, including (1) student writing interest is still low; (2) students are less motivated because lecturers still use conventional learning models; and (3) students are unable to think critically in completing the task of writing arguments (Amalia et al., 2021).

To address these issues, improvements in learning activities should be student-centered to ensure they are effective and efficient. Therefore, lecturers must use the appropriate learning model. This study aims to examine how the Prediction, Observation, Explanation, Elaboration, Write, and Evaluation (POE2WE) model and critical thinking skills affect the argumentative writing abilities of

students at Universitas Indraprastha PGRI. There are various learning models available, and this study compares the effectiveness of the POE2WE model with Discovery Learning to determine which is more effective for teaching argumentative writing.

The POE2WE learning model is often used in physics courses, and this research will conduct experiments on the POE2WE learning model in writing courses. This is a novelty in this research. Through the POE2WE learning model and critical thinking, it is hoped that students' argumentative writing skills can improve.

2. Literature review

According to Graham (2019), Writing is a versatile skill for learning new ideas, persuading others, recording information, creating imaginary worlds, expressing feelings, comforting others, healing psychological wounds, recording experiences, and exploring the meaning of events and situations. This is in line with the opinion of Huy (2015) that writing is a complex metacognitive activity that draws on an individual's knowledge, basic skills, strategies, and ability to coordinate multiple processes. Through writing skills, students can express ideas, information, and feelings to add knowledge or entertain others.

Writing is a form of indirect communication aimed at providing information and knowledge to readers. According to Durga and Rao (2018), writing conveys thoughts, ideas, and facts in clear and simple language. Students must learn good writing skills to excel academically and professionally. Good writing is essential for meeting educational and employment requirements. Writing activities require students to think creatively and critically to produce meaningful content for both writers and readers. Proficiency in writing is crucial for university students, teachers, researchers, and freelance writers, as their skills are often judged by the quality of their writing. Institutions often value how information is written over the content itself (Gautam, 2019).

Several types of writing must be mastered by a student, one of which is the type of argumentation writing. Argumentation is a type of writing that is at the highest level compared to other types of writing because writing argumentation requires creative thinking skills and critical thinking in analyzing and solving a problem using relevant data sources. According to Robillos and Art-in (2023), argumentative writing, as a writing genre, revolves around navigating the space between the content of arguments and the intended audience. Developing skills to write argumentative texts based on diverse sources, where they must work within limited time constraints. Jin et al. (2020) argumentation is the process of making claims and using evidence and reasoning to support the claims. Writing arguments requires experience and knowledge, at least in conclusion, which must be supported by relevant data sources, as well as reasons that require that the

conclusions written are correct and can be accounted for.

Kleemola et al. (2022) emphasized that all aspects of argumentative writing should be studied, including logic, rhetoric, and dialectics. Writing arguments requires considering the reader's perspective and presenting both sides of a problem, drawing logical conclusions, and supporting them with relevant evidence. Newell and Misar (2022) agreed that classroom argumentation involves students using their ideas about science to reason between evidence and theory. Dialogic argumentation, which seeks tentative consensus, can encourage productive collaboration and engagement with scientific concepts and issues relevant to students' lives. Effective argumentative writing involves presenting problems logically and measurably and using critical and open thinking to collaborate productively with peers, making the reader more likely to accept the writer's conclusions. Benetos and Bétrancourt (2020) noted that argumentative writing involves complex cognitive and metacognitive skills, which are closely related to critical thinking, which involves analyzing and evaluating information and logic to critique or analyze a problem.

Nwuba et al. (2022) stated that critical thinking is a personal trait that enables individuals to analyze, understand, and solve everyday problems. Critical thinking is essential in daily life, as developing these skills allows individuals to address challenges effectively. O'Reilly et al. (2022) recognized critical thinking as a crucial 21st-century skill, enabling informed decision-making based on available information. Critical thinking encompasses various skills students need to analyze, assess, and evaluate information to make decisions and solve problems.

Students are scholars, so their critical thinking skills aim to enhance their ability to reason and make decisions based on their knowledge and experience. Ma and Li (2022) stated that cultivating critical thinking is valuable in all situations, whether related to education, work, or daily activities. Critical thinking skills are essential for problem-solving in all areas of life. Demircioglu et al. (2023) confirmed that critical thinking is frequently used, especially in activities involving argumentation methods. The frequency with which students use critical thinking skills varies depending on the use of these methods.

The success of education relies on lecturers who act as facilitators, motivators, and evaluators in every learning activity. With the advancement of science and technology, current learning activities require lecturers to be creative and innovative in applying learning models. Ruiz-Martín and Bybee (2022) stated that a learning model is a deliberately designed activity to make teaching and learning easier for students. Mannong et al. (2021) added that using learning model activities is essential to achieving learning goals. Appropriate learning models are expected to improve student outcomes by creating enjoyable learning conditions so

students do not feel burdened during the learning process.

The learning model serves as a guideline for planning and implementing learning activities (Kurniawan et al., 2023). Before conducting learning activities, lecturers should analyze which models, methods, and media to use. The choice of learning models depends on classroom conditions and student needs. Therefore, analyzing and evaluating each student's needs and characteristics is necessary for the learning model to be effective.

The POE2WE learning model helps build student knowledge through processes that involve proving predictions and explaining experimental results both orally and in writing. This model, developed with a constructivist approach, combines the POE and TTW models (Mubarok et al., 2020). According to Chaijalearn et al. (2023), POE focuses on challenging students to engage actively in the learning process. The Think Talk Write (TTW) model involves students thinking, discussing with peers, and then writing down their ideas (Kurniaman et al., 2018). Nurnazarudin et al. (2020) argued that the POE2WE model encourages students to be active and creative by discovering concepts through direct observation and experimentation.

The POE2WE model allows students to construct their knowledge and communicate their thoughts both orally and in writing. According to Nana et al. (2014), it aims to develop students' thinking abilities through problem-solving. This model helps students integrate new information with their existing knowledge, promoting active and creative participation in and outside the classroom.

The Discovery Learning model, an important yet debated topic in education, encourages students to analyze using cognitive skills, fostering independence in problem-solving. Abrahamson and Kapur (2018) supported discovery-based learning principles motivated by philosophical and theoretical constructs. Discovery learning involves activities such as observation, experience, and reasoning (Ellizar et al., 2018), requiring students to be active and creative, supported by critical thinking. Ott et al. (2018) highlighted that Discovery Learning is based on cooperative learning, with students working in small groups to enhance understanding. Dyamayanti et al. (2023) outlined the procedures for Discovery Learning: stimulation, problem statement, data collection, data processing, verification, and generalization. This model fosters creativity by encouraging student learning activities.

A literature review on writing conceptual arguments covers logicality, criticality, pattern variability, data accuracy, spelling and punctuation, diction, sentence effectiveness, and paragraph structure. Studies by Herdiani (2020), Malik et al. (2022), Ridho and Sari (2023), and Kanti et al. (2022) found that the POE2WE model makes learning more effective, improving learning outcomes and critical thinking. Argumentative writing requires students to express ideas and thoughts critically using relevant data sources.

Unlike Discovery Learning, which is widely used in teaching argument writing, this research focuses on the POE2WE model, often used in physics. This study will test the POE2WE model in argumentative writing, aiming to provide lecturers with knowledge and tools to create more effective learning conditions and improve students' argumentative writing skills.

3. Methodology

This research uses an experimental method with a 2 x 2 treatment design. This approach helps to compare the ability to write arguments between students taught using the POE2WE learning model and those using the Discovery Learning model among groups with high and low critical thinking skills. Data analysis was conducted using SPSS.

The study population consists of third-semester students in the Indonesian Language and Literature Education Program at Universitas Indraprastha PGRI. A random sampling technique was used to select the sample, ignoring any strata within the sample. The research sample was divided into two classes: class A as the experimental group and class B as the control group. Students in both classes were assessed for their critical thinking skills, and the results were ranked from highest to lowest. The top 33% were categorized as the high critical thinking group, and the bottom 33% as the low critical thinking group. From each class, 33% of the 45 students were selected, resulting in 15 students for the high critical thinking group and 15 for the low critical thinking group, totaling 60 students. The sample distribution is shown in Table 1.

Table 1: Student distribution in each variable

Critical thinking	Learning model		Number of students
	POE2WE	DISCOVERY	
High	15	15	30
Low	15	15	30
Number of students	30	30	60

The results of the ability to write argumentation were obtained after the test of argumentation writing skills at the end of the research implementation. Assessment of argumentation writing skills is based on the rubric of argumentation writing skills. The hypotheses can be inferred as follows:

- Hypothesis H1: The POE2WE learning model significantly improves students' argumentative writing skills compared to the Discovery Learning model.
- Hypothesis H2: Students with high critical thinking skills will have better argumentative writing skills compared to students with low critical thinking skills, regardless of the learning model used.
- Hypothesis H3: The POE2WE learning model is more effective for students with low critical thinking skills compared to the Discovery Learning model.

A1, A2, B1, and B2 refer to the different groups in the factorial design of the experiment:

- A1: POE2WE learning model
- A2: Discovery Learning model
- B1: High critical thinking skills
- B2: Low critical thinking skills

Therefore:

- A1B1: Students using the POE2WE learning model with high critical thinking skills.
- A1B2: Students using the POE2WE learning model with low critical thinking skills.
- A2B1: Students using the Discovery Learning model with high critical thinking skills.
- A2B2: Students using the Discovery Learning model with low critical thinking skills.

H1 and H0 refer to the null hypothesis and the alternative hypothesis, respectively:

- H0 (Null Hypothesis): There is no significant difference in the argumentative writing skills of students based on the learning model and their critical thinking skills.
- H1 (Alternative Hypothesis): There is a significant difference in the argumentative writing skills of students based on the learning model and their critical thinking skills.

From the statistical results presented:

- The ANOVA tables indicate significant differences in argumentative writing skills based on the learning model and critical thinking skills, supporting the alternative hypotheses (H1).
- The interaction effects between learning models and critical thinking skills also suggest that the effectiveness of the POE2WE model and the Discovery Learning model varies depending on the level of students' critical thinking skills.

This means that the study's findings support the hypothesis that the POE2WE model and the Discovery Learning model have different impacts on students' argumentative writing skills, particularly when considering their levels of critical thinking.

Hypothesis testing using two-track variance analysis (ANOVA 2 X 2) with a significance level of 5%. Design Treatment by level 2x2 is shown in Table 2.

Table 2: Design treatment by level 2x2

Critical thinking (B)	Learning model (A)	
	POE2WE (A_1)	DISCOVERY (A_2)
High (B_1)	$(x,y)_{11}K$	$(x,y)_{21}K$
Low (B_2)	$(x,y)_{12}K$	$(x,y)_{22}K$

Before the data is processed using 2 x 2 variance analysis, prerequisite tests are carried out, which include normality and homogeneity tests of variance.

4. Results and discussion

4.1. Effect between the models

The results of the analysis and description the difference in the ability to write arguments of students who are taught using the POE2WE learning model with the student model whose learning uses the Discovery Learning model. The effect between the two models can be seen in Table 3. Based on Table 3, it can be concluded that there is a difference between the POE2WE learning model and the Discovery Learning with a significant level of 0.012, smaller than 0.05. Thus, the use of the POE2WE learning model has been proven to improve the ability to write arguments. Furthermore, the ability to write arguments of students who have high critical thinking skills is much higher than students who have low critical thinking skills, with a significant level of 0.000 smaller than 0.05. Thus, students' critical thinking skills need to be considered in the ability to write arguments.

Table 3: Tests of between-subjects effects for POE2WE and discovery learning models on argumentative writing ability

Source	Type III sum of squares	df	Mean square	F	Sig.
Corrected model	3486.59	3	1162.197	11.249	0.0
Intercept	199407.891	1	199407.891	1930.0	0.0
Kriteria_POE2WE_Discovery	692.852	1	692.852	6.706	0.012
Criteria	2790.062	1	2790.062	27.006	0.0
Kriteria_POE2WE_Discovery * criteria	3.675	1	3.675	0.036	0.851
Error	5785.493	56	103.312		
Total	208679.974	60			
Corrected total	9272.083	59			

4.2. Analysis requirements testing

The normality test for the POE2WE learning model showed a Sig. value of 0.175, and for the Discovery Learning model, it was 0.952. These results indicate that the data is normally distributed. Additionally, the homogeneity tests for groups A1B1, A1B2, A2B1, and A2B2 all had Sig. values of 0.196, which is greater than 0.05. This means that the null hypothesis (H0) is accepted, and the data comes from a homogeneous population, as shown in Table

4. From the results of normality and homogeneity testing, it can be concluded that the requirements that must be met in this study have been met, and then it can be continued with the research hypothesis test.

4.3. Hypothesis testing

After verifying the assumptions to meet the research requirements, an ANOVA 2 test was conducted. Analysis of variance (ANOVA) was used

to test the hypothesis. This multivariate analysis technique allows us to compare the means of more than two groups by examining the variances. The results are shown in Table 5.

Table 4: Test of homogeneity of variances

Variable	Levene statistic	df1	df2	Sig.
Nilai_POE2WE_Discovery	1.710	1	58	0.196

Table 5: A1B1 and A2B1 hypothesis testing

Source	Sum of squares	df	Mean square	F	Sig.
Between groups	297.801	1	297.801	2.506	0.125
Within groups	3327.583	28	118.842		
Total	3625.384	29			

Based on Table 5, the Sig. value of 0.125 is greater than 0.05. Therefore, it can be concluded that there is no significant difference in the argumentative writing skills of students with high critical thinking abilities when taught using either the POE2WE learning model or the Discovery Learning model. This result follows the description that the activity of writing arguments requires critical thinking skills. Students who have high critical thinking skills will not have difficulty in writing arguments. This is in line with the opinion of Hu and Saleem (2023) that argumentative writing is a 'problem-solving' cognitive process and its relationship with critical thinking. Writing arguments is a type of writing that relates to students' ability to reason and produce conclusions that can be accounted for. The ability to think critically of students will not be separated from effective learning activities. In this case, one of the success factors of learning is the use of the right learning model. The use of learning models aims to make it easier for students to achieve good learning outcomes (Yu and Zin, 2023). This is supported by the research of Bekele et al. (2022). Their study found a significant difference in argumentative writing performance between students who received critical thinking-infused instruction and those who did not. This suggests that teaching critical thinking is essential for improving argumentative writing skills. Therefore, it is important to use a learning model that encourages motivation, interest, and creativity in the writing process. Based on Table 6 of the test, Sig. values of 0.003 < 0.05 were obtained. Thus, it can be concluded that there are differences in the ability to write arguments of students who are taught using the POE2WE learning model; students who have high critical thinking skills are higher than students who have low critical thinking skills.

Table 6: A1B1 and A1B2 hypothesis testing

Source	Sum of squares	df	Mean square	F	Sig.
Between groups	1295.604	1	1295.604	10.526	0.003
Within groups	3446.472	28	123.088		
Total	4742.076	29			

Based on Table 7, the Sig. value of 0.042 is less than 0.05. Therefore, it can be concluded that there

are differences in the argumentative writing skills of students with low critical thinking abilities. Students taught using the POE2WE learning model performed better than those taught using the Discovery Learning model.

Table 7: A1B2 and A2B2 hypothesis testing

Source	Sum of squares	df	Mean square	F	Sig.
Between groups	398.727	1	398.727	4.542	0.042
Within groups	2457.910	28	87.782		
Total	2856.636	29			

The POE2WE learning model allows students to identify problems based on their observations and elaborations. This model encourages students to collaborate to solve learning problems. On the other hand, Discovery Learning is a student-centered model where students actively search and investigate systematically, critically, and logically to discover knowledge. This model requires students to be creative in their learning process.

Sudarman (2016) suggested that having good thinking skills equips a person to solve life's problems effectively. Since thinking is essential for problem-solving and decision-making, students with high critical thinking skills can effectively express their ideas through argumentative writing. Raimes (2000) added that a good argument presents problems logically and measurably, using critical and open thinking to persuade readers.

The learning process is most effective when lecturers manage engaging activities, fostering interaction between students and lecturers. The POE2WE learning model promotes student independence and enhances critical thinking skills. Aprilia et al. (2020) confirmed that the POE2WE model is designed to develop students' abilities to think critically, communicate, collaborate, and be creative. This is supported by research results by Sarigoz (2023). The research results show that students with 21st-century learning skills use critical thinking techniques as a basis for argumentation-based learning. High critical thinking skills will result in higher learning outcomes than low critical thinking skills. Thus, it can be concluded that critical thinking skills are needed in argumentation writing activities. Both learning models are effective, but for students with low critical thinking skills, the POE2WE learning model is more suitable. This model challenges students to solve problems by finding reliable data sources. Writing arguments requires critical thinking because it involves analyzing data and facts deeply to draw justified conclusions. Students with low critical thinking skills struggle to express their ideas and analyses in argumentative writing. Therefore, writing arguments demands high critical thinking skills to analyze and evaluate problems effectively. Based on Table 8, the Sig. value of 0.000 is less than 0.05, indicating a significant difference in argumentative writing skills between students taught using Discovery Learning. Students with high critical

thinking skills perform better than those with low critical thinking skills.

Table 8: A2B1 and A2B2 hypothesis testing

Source	Sum of squares	df	Mean square	F	Sig.
Between groups	1498.133	1	1498.133	17.934	0.000
Within groups	2339.021	28	83.536		
Total	3837.154	29			

Students who have high critical thinking skills will get higher argumentation writing skills, and students who have low critical thinking skills will get low argumentation writing skills. Critical thinking can reflect students' minds when expressing their ideas based on data and fact analysis. Critical thinking is the ability to analyze and interpret information as a basis for evaluating ideas, arguments, and beliefs to be used as a conclusion.

The use of Discovery Learning will make students creative and independent in reasoning because students who have high critical thinking skills will find it easy to complete lecture assignments well. Conversely, students who have low critical thinking skills will make little effort to complete complex or strenuous tasks, not because they are lazy but because they assume their efforts will not succeed. According to Aldalur and Perez (2023), the discovery learning model aims to motivate students to learn and involve students in the learning process. This is supported by research results (Solissa et al., 2023). The research results show that the discovery of learning models has a positive influence on students' critical thinking abilities. The discovery model helps students be more active and have higher-level thinking abilities in learning. This learning model provides an experience for students to seek their knowledge, thus providing challenges for students in learning activities. Based on this, students who have high abilities are more appropriate to use discovery learning.

5. Conclusions

This research examines the influence and efficiency of the POE2WE learning model combined with critical thinking, comparing it with the Discovery Learning model. The key findings and recommendations based on the analysis are:

- There is no difference in the argumentative writing abilities of students with high critical thinking skills, whether taught using the POE2WE learning model or Discovery Learning. This indicates that high critical thinking skills are crucial for writing arguments, and learning models help lecturers motivate students to learn and think critically.
- There are differences in the argumentative writing abilities of students taught using the POE2WE learning model, depending on their critical thinking skills. Students with high critical thinking

skills perform better than those with low critical thinking skills.
- Among students with low critical thinking skills, those taught using the POE2WE learning model perform better in argumentative writing than those taught using Discovery Learning.
- For students taught using Discovery Learning, those with high critical thinking skills perform better in argumentative writing than those with low critical thinking skills.

The implications of these findings are:

- High critical thinking skills are essential for writing arguments, regardless of the learning model used.
- Both learning models and critical thinking abilities impact students' argumentative writing skills.
- The POE2WE learning model is more effective for students with low critical thinking skills, fostering their confidence in problem-solving.
- Discovery Learning is more effective for students with high critical thinking skills.

Based on these conclusions, several suggestions are:

- Lecturers should use learning models tailored to student characteristics.
- Lecturers should assess students' critical thinking skills to choose the appropriate learning model, which can be done by administering critical thinking tests before lessons begin.
- Lecturers should use the POE2WE learning model for students with low critical thinking skills to enhance their reasoning abilities.
- Lecturers should use Discovery Learning for students with high critical thinking skills to improve their argumentative writing skills.

Compliance with ethical standards

Ethical considerations

This study was conducted in compliance with ethical standards. All participants provided informed consent before participating in the study. Their privacy and confidentiality were maintained throughout the research process. The study protocol was reviewed and approved by the Ethics Committee of Sultan Ageng Tirtayasa University and Indraprastha PGRI University. There were no foreseeable risks associated with participation in this study.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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