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Implementing a Problem-Based Learning Model in Writing Scientific Articles for Undergraduate Students

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***Abstract*—This study aims to determine the effect of Problem-Based Learning (PBL) on writing scientific articles. The target group was 70 Indonesian students at Universitas Asahan enrolling Indonesian Language course. The duration of the course was 14 weeks. Students were asked to submit individual writing and group projects during the experiment. This study employs a quasi-experiment with a non-equivalent post-test design in two Indonesian Language courses. According to the results, the aggregate mean score of students in PBL class was 79.91. In comparison, the overall mean score of students in the control group or those who did not adopt the PBL approach was 66.51. These results suggest that students in PBL class could write good scientific articles.**

***Index Terms*—problem-based learning, scientific article writing, language learning**

I. Introduction

Writing is a transfer of one's ideas or thoughts into an article. Through writing, human thoughts will be conveyed properly. The audience tends to accept information in the form of writings more readily than verbal communication. At the university level, students are expected to write effectively. By enhancing their writing abilities, students can create conceptual solid, and valuable links between research and independent learning (Sutarman et al., 2019; Williams, 2017). Besides being useful for the provision of the ability to compose a thesis, in general, writing scientific papers such as field research or a book is a mandatory requirement that students must meet as one of the requirements for graduation. One of the objectives of learning Indonesian Language courses is that students can produce high-quality scientific papers. In writing activities, students are trained to express ideas that are complete and easily understood by readers. Scientific work is a written work that contains the results of expressing someone's ideas or ideas obtained through observations, research, or review of a matter which is then compiled through specific methods (Wibowo, 2012). In addition, scientific work is a human product based on knowledge, attitudes, and scientific thinking (Sudjana, 2020). As can be inferred based on these explanations, writing scientific articles is a skill that students need to master because it shows how they think and observe using specific methods or ways. Eventually, learning to write scientific papers would aid students in writing their final assignments (Azizah & Budiman, 2017).

Students are encouraged to engage in frequent writing activities to produce scientific papers such as books, journals, and other publications, and popular science publications such as articles. Generally, scientific works are papers, scientific articles, and final assignments (i.e., undergraduate theses, theses, and dissertations) (Aini et al., 2020). Writing scientific papers is one of the skills that students must have (Grech, 2017). Proficiently writing scientific papers will help students develop communication, critical thinking, and analytical skills (Lu et al., 2019; Walsh et al., 2020). The way that must be done to improve the ability to produce an excellent scientific paper is that it should be prepared accurately, carefully, and thoroughly (Tullu, 2019).

For undergraduate students, basic skills in writing scientific articles are critical. It aims to instill a scientific culture in students (Machmud, 2016). Students not only act as knowledge collectors but also as creators of knowledge. Students can also use scientific articles to disseminate information from research results through publication. Thus, the

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knowledge possessed by students will continuously develop. In addition, sharper imagination, improved language mastery, and confidence are all advantages of being able to write (Oppenheimer et al., 2017).

Unfortunately, as with reading, Indonesian students' writing activities are not well-established (Rahmiati, 2013). It can be proven by the results of previous studies, which state that students' writing skills are still in the low category (Ariyanti & Fitriana, 2017; Emilia, 2016). Students perceive academic writing as complex, while the main problem of student work is mainly assessed in written form (Azizah & Budiman, 2017; Fatimah & Masduqi, 2017). There are several obstacles that students face when writing scientific articles, which ultimately makes the student's writing less qualified. Regarding this, the quality of scientific articles is determined from several aspects, namely the writing system (Franco et al., 2021), research topics (Adelia et al., 2018), literature and empirical data (Aisiah & Firza, 2018), paraphrased citations (Agathokleous, 2022; Chen, 2021; Hafiar et al., 2019), and bibliography (Goyal et al., 2020). Furthermore, students also usually face difficulties finding scientific articles relevant to their research interests.

The lecturer's duty is essential so students can maximize their writing skills with various methods that can be applied in class. Using a learning model is one way to encourage academic writing skills in students. One of the possible learning models is problem-based learning (PBL). The PBL model is a learning approach that employs the diverse cognitive talents of students independently and in groups, as well as in the actual environment, to solve issues that are meaningful, relevant, and contextual (Yew & Goh, 2016). PBL attempts to enhance the ability to apply principles to new or real-world challenges. PBL also aims to teach students future-relevant knowledge, process, and problem-solving abilities. Furthermore, lecturers should prepare students to be researchers, critical thinkers, and creative thinkers to meet the challenges of the twenty-first century (Eldin et al., 2017). Using the PBL model in learning to write will significantly help students complete their final project in writing scientific papers or become an activist with written works that can be read by society. Through PBL, students are required to be able to identify gaps that distinguish them from previous research. Therefore, PBL will help students integrate old knowledge with new knowledge possessed by students and develop problem-solving skills. Based on these explanations, this study aims to determine the significant effect of a PBL model on students' ability to write scientific papers.

II. Methods

The research design uses a quasi-experiment with a non-equivalent post-test design. The participants were undergraduate students in the even semester of the academic year 2021/2022 of the Language Education Study Program at Universitas Asahan, North Sumatra. The determination of experimental and control groups was based on the mean score on the midterm examination in five classes. The mean scores of classes A, B, C, D, and E were 87, 85, 80, 75, and 80, respectively. Class B was chosen as the control group, while class D was the experimental group, with 35 students in each class.

The experimental class used the PBL model, while the control class used conventional models (lecturing). At this point, the evaluation is focused on each student's ability to write scientific articles independently. Table 1 summarizes the learning treatment for the two groups.

TABLE 1
EXPERIMENTAL DESIGN

Group	Treatment	Post-test
Experiment	X_1	O_1
Control	X_2	O_2

Notes: X_1: using the PBL model; X_2: without the PBL model; O_1: scientific writing skills of the experimental group; O_2: scientific writing skills of the control group

The writing difficulties of the students served as the instructional material. The semester learning plan was developed, and its validity and reliability were evaluated before conducting the study. A rubric was used to evaluate the student's scientific writing skills. Five aspects were evaluated, including 1) the manuscript format, 2) the originality of the ideas, 3) the topic addressed, 4) the sources of data and information, and 5) the synthesis analysis of information sources. The article assessment of the student's writing abilities was administered after the study. A t-test analysis was carried out using SPSS 29.0 for the *Windows* program with a significant level of 0.05.

III. Results

The results demonstrated that the scientific writing scores in both classes varied. The frequency distribution of students' abilities to write scientific articles is presented in Table 2. Initial data processing was performed using the prerequisite test, a Kolmogorov-Smirnov test for normality with a significance level of 0.05.

TABLE 2
STUDENTS' SCORES ON THE ABILITY TO WRITE SCIENTIFIC ARTICLES

Interval Scores	Category	N (%)	
		Experimental Class	Control Class
91-100	Excellent	-	-
75-90	Very Good	30 (85.71%)	10 (28.57%)
60-74	Good	5 (14.29%)	20 (57.14%)
40-59	Moderate	-	5 (14.29%)
< 40	Poor	-	-
Total		35	35

Table 2 shows that the percentage of students who get very good grades is 85.71% and 28.57% for the experimental and control classes, respectively. Meanwhile, 5 students (14.29%) and 20 students (57.14%) from the experimental and control classes are in a good category. In addition, no students got excellent grades from experimental or control classes. Meanwhile, 5 students from the control class are in the moderate category (the lowest score obtained in this study). Table 3 presents the score distribution to find the difference in scores between the experimental and control classes.

TABLE 3
SCORE DISTRIBUTION ON SCIENTIFIC WRITING SKILLS

Group	N	Minimum	Maximum	Mean	Std. Deviation
Experiment	35	60	89	79.91	6.68
Control	35	45	78	66.51	8.27
Valid N (listwise)	35				

Table 3 shows that PBL significantly affects students' ability to write scientific articles according to the mean score and the standard deviation. The mean scores in the experimental and the control classes are 79.91 and 66.51, respectively, which suggests that the experimental class's skills in writing a scientific article are better than the control class. After obtaining the student scores, the scores of both classes were further processed using a t-test to test the research hypothesis.

TABLE 4
NORMALITY TEST RESULTS

Group	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Control	0.178	35	0.007*	0.910	35	0.007*
Experiment	0.177	35	0.007*	0.920	35	0.014*

*p < 0.05 (not normally distributed)

According to Table 4, the analysis of the prerequisite test for scientific writing abilities suggests that the data distribution is not normal since Sig. is less than a significance level of 0.05. The next step is, therefore, to evaluate the hypothesis using the Mann-Whitney U test (see Table 5).

TABLE 5
MANN-WHITNEY TEST RESULTS

Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
496.000	50.872	4.875	0.001

Based on the results in Table 5, Sig.2-tailed is 0.001 or < 0.05. Therefore, H_0 is not supported, and H_1 is supported, which means that the PBL model affects students' scientific writing skills. These results suggest that using a PBL model in writing scientific articles can significantly affect student writing skills. This result is consistent with prior studies, which claimed that the PBL model could enhance students' writing skills (Chang et al., 2019; Iswandari et al., 2017; Kristyanawati et al., 2016).

IV. DISCUSSION

In this study, the stages of PBL are as follows: (1) introducing students to the problem; (2) organizing students to learn; (3) directing the investigation; (4) producing and presenting the work; and (5) assessing and evaluating the problem-solving process (Strobel & Barneveld, 2009). Students can learn from a variety of literature during these stages. The PBL model's syntax leads students to think, analyze, conduct research, and compose research reports. The PBL model affects the critical thinking skills students need in analyzing problems, and it refers to the second step in this model, which focuses on organizing the students to learn critically (Wenno et al., 2021). In this step, students and the lecturer decide on the project's topic and the problem-solving method. Students could build the project by collecting information regarding the project, the plan, and the objective. The lecturer facilitates students in getting information from various sources. Meanwhile, in the third and fourth phases, the PBL model includes learning steps that can affect

the capacity to compose articles, namely formulating hypotheses and collecting data from the information needed in problem-solving (Syamsidah & Hamidah, 2018). The primary goal of the PBL model is in the third phase, specifically the investigation phase, which can be completed individually or in groups. In this phase, students collect data, formulate hypotheses, and propose answers to build and hone their problem-solving skills. Implementing research-based learning can help students enhance their metacognitive problem-solving skills (Amaral et al., 2017; Pratama, 2018; Wardoyo et al., 2021). In the producing and presenting work phase, the syntax motivates students to effectively convey their work to other groups to optimally achieve competence in writing scientific articles.

Writing competency requires the allocation of time and the completion of learning activities that enable students to produce writing from the results of their research. The students should write following the rules or the format. The students' manuscript format must be organized regarding the assessment indicators. Then, the student's creativity of ideas is wide-ranging, as each group member may express their opinion communicatively and constructively. In this study, the topics raised were quite interesting for some groups. They chose the latest topics related to the theme. The students perceive that PBL helps them generate ideas to start writing (Nisa et al., 2017). In addition, PBL will increase students' passion, self-assurance, creativity, and capacity for self-directed and collaborative learning. Eventually, it increases instructors' motivation and instructional satisfaction (Luh et al., 2017).

Understanding the problem is essential in the first stage. Problem orientation is a stage that refers to students understanding problems, formulating solutions, and finding the right solution according to the stages and ensuring all stages are carried out correctly (Downing et al., 2009). At this stage, the lecturer guides students to solve the given problem (Syamsidah & Hamidah, 2018). Problem-based learning significantly influences students' ability to write scientific articles in the experiment class. These results can be obtained because the PBL model encourages students to actively participate in investigating authentic problems. Students discuss and communicate more in groups while conducting investigations. Communication between group members effectively obtains quick answers for students unaware of the problems to be formulated and studied. Since students can ask the lecturer directly in the control group, they choose to ask the lecturer rather than discuss in groups.

Based on the study's findings, there are some supported findings from other researchers. In the second phase, students are organized to learn based on the PBL model. It engages the student's critical thinking and problem-solving. The findings suggested that PBL affected students' problem-solving and scientific writing abilities (Sari & Sumarmi, 2021). This research is supported by a study about the effect of group investigation on undergraduate students' capacity to produce scientific articles, which showed that directing the investigation positively influences the quality of students' scientific articles because the data and facts are written according to the actual results (Wardani & Sari, 2017).

Regarding the fourth and fifth learning stages, the students in the experimental class were more active in researching what they already knew about the problem's fundamental causes. They acquired the essential information and tools to solve the problem by assessing synthesis sources of information and evaluating the problem-solving process. Meanwhile, in the control group, the students often asked the lecturer how to get the data and information sources. Sometimes, they got confused in analyzing and evaluating the information needed. Those observation results indicate that PBL enables students to think contextually about the given problems, work well in a group, develop critical thinking, and encourage them to be more explorative (Affandi & Sukyadi, 2016).

Writing ability demonstrates the level of student learning. As a result, these skills need to be developed through the learning process. Lecturers can construct learning processes that direct students' abilities to compose scientific articles by selecting relevant learning models. The learning model depicts the activities involved in the learning process. Professionally, instructors use models selectively to attain specific learning objectives. The choice of an appropriate model can influence the accomplishment of learning objectives. However, lecturers must motivate students to develop their writing abilities to compensate for the limitation that does not exist in the PBL learning phases (Parra & Calero, 2019).

V. Conclusion

Based on the results, the PBL model significantly affects the ability to write scientific articles for Language Education Study Program students at Universitas Asahan. The mean scores on the ability to write scientific articles for the experimental and control classes are 79.91 and 66.51, respectively. Improvements must be made utilizing models with learning syntax targeted toward writing abilities. It is suggested that the lecturer may provide students with additional practice by providing a topic bank or allowing students to choose the topics they want to develop as additional assignments. In addition, additional lecturer feedback is required to clarify any doubts students may have while writing so they can gain more concrete ideas about better structure content and organized written texts.

VI. Suggestion

Students must possess writing proficiency to effectively communicate their ideas and potential solutions to issues arising from the events they face. The subsequent researcher can explore this topic with a broader perspective and may incorporate alternative pedagogic approaches that could augment students' analytical thinking abilities in compiling and producing high-quality scientific work.

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