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The Impact of Problem Based Learning with *Tri Hita Karana* on Scientific Literacy and Critical Thinking Skills

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ABSTRAK

Literasi sains dan Kemampuan berpikir kritis dua hal yang penting menentukan keberhasilan peserta didik, namun saat ini kedua variabel itu belum bisa dikatakan dimiliki secara optimal oleh peserta didik. Hal ini menjadi alasan mengapa penelitian yang bertujuan menganalisis dampak model problem-based learning berbasis Tri Hita Karana terhadap literasi sains dan kemampuan berpikir kritis mahasiswa PGSD dilakukan. Rancangan penelitian ini adalah quasi-eksperimental design berupa nonequivalent post-test only control group design. Sampel penelitian ini berjumlah 39 orang terdiri dari 20 peserta didik kelas eksperimen dan 19 peserta didik kelas kontrol. Pengumpulan data penelitian menggunakan metode tes dan angket. Teknik analisis data yang digunakan dalam penelitian ini yaitu manova dengan perolehan hasil 0,00 kurang 0,05. Hasil penelitian menunjukkan bahwa terjadi peningkatan literasi sains dan kemampuan berpikir kritis setelah mahasiswa dibelajarkan dengan Model PBL berbasis Tri Hita Karana baik secara parsial maupuan secara simultan. Dilihat dari nilai mean masing-masing variabel, hasil penelitrian juga menunjukkan bahwa variabel kemampuan berpikir kritis lebih dipengaruhi dibandingkan dengan literasi sains. Sehingga bisa direkomendasikan sebagai model pembelajaran inovatif untuk meningkatkan literasi sains dan kemampuan berpikir kritis.

ABSTRACT

Scientific literacy and critical thinking ability are two important things that determine students' success. Still, the two variables cannot be optimally owned by students. The research was carried out to analyze the impact of *Tri Hita Karana*'s problem-based learning model on the Scientific literacy and critical thinking skills of PGSD students. The design of this study is quasi-experimental in the form of a nonequivalent post-test-only control group design. The sample of this study was 39 people consisting of 20 experimental class learners and 19 control class learners. Innovative learning models to improve Scientific literacy and critical thinking skills. Research data collection using test and questionnaire methods. The data analysis technique used in this study was manova with a result of 0.00 < 0.05. The results showed increased Scientific literacy and critical thinking skills after students were partially and simultaneously taught the *Tri Hita Karana*-based PBL Model. Judging from the mean score of each variable, the research results also show that the variable of critical thinking ability is more influenced than Scientific literacy, so it can be recommended as an innovative learning model to improve Scientific literacy and critical thinking skills.

1. INTRODUCTION

The development of the current era requires human resources to have the ability to compete with the global world. One of the abilities that students currently have to master is scientific literacy. Scientific literacy is using scientific knowledge to identify existing problems (Sudarsono et al., 2020; Widi et al., 2016). Scientific ability is the ability to interpret science in everyday life so that you can understand the theory and find solutions to the problems raised (Chusni & Hasanah, 2018; Samsu et al., 2020). The concept of scientific literacy refers to knowledge of science-based science and technology that seeks optimal solutions to human problems (Asyhari, 2019; Yuli Rahmawati et al., 2020). Through reasoning, scientific literacy utilizes science, technology, and societal knowledge (Andriani et al., 2018). Someone with scientific literacy can use

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scientific concepts and has scientific process skills to assess everyday decisions when dealing with other people, society, and their environment (Ariana et al., 2020). Students must have scientific abilities to answer various scientific questions that develop in society (Chusni & Hasanah, 2018). The concept of scientific literacy in its development supports the development of higher-order thinking skills (Asyhari & Putri, 2017). One of the higher-order thinking skills is also one of the abilities that students must possess in the 21st century. 4C skills are mandatory and taught at all levels of education, especially elementary schools, in the context of 21st-century fields of study and themes (Fatmawati et al., 2019; Widodo et al., 2020). It is very important for everyone to master 21st-century skills in order to be successful in facing challenges and problems in 21st-century life (Redhana, 2019). One of the abilities that students must possess is thinking critically.

Critical thinking is a way for someone to improve the quality of the results using systematization techniques for thinking and producing intellectual power in the ideas initiated (Devi & Bayu, 2020; Fadilah et al., 2017). Critical thinking is the key to developing creativity, and creativity arises because of problems that demand creative thinking (Supriyanto & Mawardi, 2020). Critical thinking skills are a process that allows students to build knowledge through problem-solving and collaboration (Kavenuke et al., 2020; Odebiyi & Odebiyi, 2021; Putri et al., 2019). Critical thinking skills are seen as helping students to compare information, for example, the information they have, with information received from outside. Students with critical thinking skills can decide something with their intellectual abilities (Y Rahmawati et al., 2019; Sadhu & Wijayanti, 2018; Taimur & Sattar, 2018). An innovative learning process is needed that provides opportunities for students to develop critical thinking skills (Haryanti, 2017; Seibert, 2020; Silberman et al., 2021). So, the ability to think critically will positively influence the readiness of students in the learning process, which will certainly impact learning outcomes. In other words, the ability to think critically will impact learning outcomes.

Teachers' learning activities lack innovation and varied creations, so learning is teacher-centered. The approach is still conventional without considering students' activeness in the learning process (Saputra et al., 2019; Trianawati, 2019). In the learning process, the teacher explains more theoretically than the students doing their activities. In addition, students cannot participate actively in the learning process, so they have not been able to improve their 5 M abilities, especially creative thinking in learning activities. In addition, students lack opportunities to develop their thinking skills, courage, and self-confidence in the learning process. The low activity of students in participating in the learning process results in low student learning outcomes. Improving students' creative thinking skills is one sign of achieving learning objectives, which can be applied in everyday life (Mahlianurrahman, 2017; Muazaroh & Surya Abadi, 2020). Apart from these problems, another problem is the problem of scientific literacy. The average scientific literacy of students is still not optimal. They only have content capabilities and cannot communicate and relate their abilities to everyday problems (Wibowo & Ariyatun, 2020). The scientific literacy of Indonesian students is still low, and the books that have been used so far have not trained students to understand the essence of science (Chusni & Hasanah, 2018; Rusdawati & Eliza, 2022). A low understanding of science concepts is often associated with learning activities that are still oriented towards memorizing (retention) activities, learning methods that are still conventional, and the difficulty level of the material being studied by students (Ariana et al., 2020). So it can be said that students with non-innovative, creative, and activity-based learning will lower their creative thinking skills and scientific literacy. If this is allowed, it will impact the quality of education.

One solution is using a problem-based learning (PBL) learning model. PBL is a learner-centered learning model, and the existence of the PBL model will impact the learning process. PBL helps students obtain existing information and compile their knowledge of basic and complex knowledge (Malmia et al., 2019). The existence of PBL will have an impact on the spiritual and social attitudes of students (Bachtiar et al., 2018), increase students' creative thinking skills (Maskur et al., 2020), improve the ability to solve math problems (Aslan, 2021; Hendriana et al., 2018), students' critical thinking skills (Aini et al., 2019; Narmaditya et al., 2018; Saputra et al., 2019), improve understanding of scientific literacy in the form of problem identification, problem investigation, and utilization of scientific facts (Nurtanto et al., 2018). So, applying the PBL model in the learning process will provide opportunities for students to develop critical thinking skills, improve learning outcomes and increase student activity in the learning process and can increase student literacy.

Several studies related to PBL on scientific literacy, research which stated that PBL was effective in increasing scientific literacy (Amaringga et al., 2021). SSI-based PBL affects Scientific Literacy and problem-solving skills (Hestiana & Rosana, 2020). PBL significantly affects students' critical thinking skills and scientific literacy (Suhirman & Khotimah, 2020). So, the presence of the PBL model will have a positive impact on the learning process. Although many PBL models have been used in this study, the difference between this study and the existing PBL model is based on *Tri Hita Karana*. *Tri Hita Karana* means the three

elements that cause happiness and human welfare, originating from a harmonious relationship between humans and God, humans and humans, and humans and nature (Adhitama, 2020; Anjarsari et al., 2017). The existence of the *Tri Hita Karana* concept must be conveyed and carried out comprehensively to all students and Hindus in society (Arsana & Muniksu, 2020). The existence of *Tri Hita Karana* in the learning process will influence the learning process, the character, and learning outcomes (Narayani1 et al., 2019). Based on these descriptions, it can be said that the existence of the PBL and *Tri Hita Karana* models positively impacts the learning process. For this reason, research was carried out to analyze *Tri Hita Karana*-based PBL on scientific literacy and critical thinking skills. This research differs from the existing ones regarding the components of the variables measured, scientific literacy, and critical thinking.

2. METHOD

Research using quasi-experimental research design. The design of this study was quasi-experimental in the form of a nonequivalent post-test-only control group design (Rogers & Revesz, 2019). The experimental group was treated with a PBL model based on *Tri Hita Karana*, while the control group was treated with a non-PBL model based on *Tri Hita Karana*. The two groups, both the experimental group and the control group, were given a post-test to find out the difference in scientific literacy and critical thinking skills between the experimental group and the control group. First, the data to be obtained in this study are the scientific literacy (Y1) of students taught with the *Tri Hita Karana*-based PBL model. Second, students' scientific literacy (Y1) is taught by learning, not the *Tri Hita Karana*-based PBL model. Third, students' Critical thinking skills (Y2) are taught with the *Tri Hita Karana*-based PBL Model. Fourth, students critical thinking skills (Y2) are taught by non-PBL learning based on *Tri Hita Karana*. The population in this study were all PGSD students who received basic science concept development courses, totaling 66 students spread over four classes. After the equivalence test with One Way-ANOVA (Anaava-A) using the SPSS 25.0 for Windows application, a simple random sampling technique was carried out using a lottery method to take two classes as research samples. From the lottery results, two classes appeared, C and B. Then, the samples were drawn again to determine the experimental and control classes. After the draw, one class was obtained as the experimental group that received the *Tri Hita Karana*-based PBL model treatment and one class as the control group that did not use the *Tri Hita Karana*-based PBL model at the second class C as many as 19.

In this study, the data collection process used was a test and questionnaire method. The test method is one of the ways to indirectly determine the level of individual ability, which is carried out by responding to several stimuli or questions (Evayanti & Sumantri, 2017). The test method determines the *Tri Hita Karana*-based PBL model on critical thinking skills. The instrument used in the test research is in the form of descriptive questions used to measure the increase in students' critical thinking skills. Measuring the validity of an instrument can be done through several stages. The steps that can be taken are making test instrument grids, making questions in the form of descriptions, and consulting the grids. The test instrument designed consisted of 10 items, but the tests given to students only amounted to 10 questions. The questions grid is described in Table 1.

Table 1. Indicators of Critical Thinking Skills

No.	Course Achievements	Indicator
1	Mastering the concept of quantity, unit, and measurement	Analyze quantities and units Analyze the concept of measurement and measuring instruments
2	Mastering the concepts of motion, force, and energy	Analyze the concept of motion, position, distance, and displacement. Analyze the concepts of speed and velocity.
3	Mastering the concept of the solar system, the earth, and their movements	Analyze electric charge Analyzing Coulomb's law in everyday life, analyzing the arrangement of the solar system
4	Mastering the concepts of electricity and magnetism	Analyze electric charge Analyzing Coulomb's law in everyday life
5	Mastering the concept of matter and its changes, acids, bases, and salts	analyze electric charge analyzing Coulomb's law in everyday life, analyzing the arrangement of the solar system

The developed questionnaire consists of 5 choices: strongly agree, agree, sufficient, disagree, and strongly disagree. The number of instruments developed was 30 consisting of 4 dimensions developed into

15 indicators. These four dimensions include knowledge of science, investigation of the nature of science, science as a way of knowing, and the interaction of science, technology, and society. A questionnaire was developed to measure scientific literacy. The data analysis method used in this research is descriptive analysis and inferential statistical analysis. The descriptive analysis carried out in this study was processed with the help of SPSS 26.0 for Windows, and post-test data were analyzed. The scores sought in statistical tests include the mean, standard deviation, maximum and minimum scores. Meanwhile, inferential analysis was carried out using inferential statistical analysis, which was used with the MANOVA test for post-test data. Before the Manova test was carried out before the Manova test was carried out, a prerequisite test was first carried out. The prerequisite test was the normality test with Kolmogrof-Smirnov, the homogeneity test with Levene Statistics and Box's Test of Equality of Covariance Matrices, and the multi-correlation test. The MANOVA and prerequisite tests were carried out with the help of SPSS 25.0 for Windows.

3. RESULT AND DISCUSSION

Result

The results showed increased scientific literacy and critical thinking skills after students were taught the *Tri Hita Karana*-based PBL model. Based on the research results, it was obtained that there were differences in scientific literacy and students' critical thinking abilities. It indicated that there were differences in the mean score. The difference in scientific literacy between students who were taught with the *Tri Hita Karana*-based PBL model and students who were taught not with the *Tri Hita Karana*-based PBL model 8.09. The mean score of the experimental group's scientific literacy is higher. Meanwhile, the difference in students' critical thinking skills taught by the *Tri Hita Karana*-based PBL model and students taught by a non-PBL model based on *Tri Hita Karana* was 8.46. The mean score of students' critical thinking skills in the experimental class is greater than that of the control class. From the analysis results, it appears that the more influenced variable is the ability to think critically compared to scientific literacy. It is indicated by the difference in the mean difference in scientific literacy being greater. The results of the descriptive analysis of scientific literacy and critical thinking skills are presented in Table 2.

Table 2. Results of Descriptive Analysis of Scientific Literacy and Critical Thinking Skills

Treatment	Dependent Variable	Mean	Standard Deviation	Maximum	Minimum	Range
Tri Hita Karana Based PBL Model	Science Literacy	85.35	5.27	93.00	74.00	19
	Critical Thinking Ability	86.20	8.03	100	71.00	29.00
Non-PBL Model Based on *Tri Hita Karana*	Science Literacy	77.26	7.75	93.00	65.00	28.00
	Critical Thinking ability	77.84	8.21	93.00	65.00	28.00

The analysis prerequisite tests included the data distribution normality, variance homogeneity, multivariate homogeneity, and multicollinearity tests. The first prerequisite test is the normality test with Kolmogorov-Smirnov. The results of the analysis show that all data come from groups of data that are normally distributed. The Sig score can indicate this. >0.05. After the normality requirements are met, the next prerequisite test is the homogeneity test. In this study, the homogeneity test was carried out using two analyses: the homogeneity test of variance with Levene's Test of Equality and the multivariate homogeneity test with Box's Test of Equality of Covariance Matrices. The results of the normality analysis are presented in Table 3.

Table 3. Results of Normality Analysis

	Learning Approaches	Kolmogorov-Smirnov[a]		
		Statistic	df	Sig.
Critical Thinking Skills	*Tri Hita Karana* based PBL model	0.10	20	0.20*
	Non-PBL model based on *Tri Hita Karana*	0.11	19	0.20*
Learning Outcomes	*Tri Hita Karana* based PBL model	0.14	20	0.20*
	Non-PBL model based on *Tri Hita Karana*	0.15	19	0.20*

The results of the homogeneity analysis carried out show the same meaning. That is, the research data come from homogeneous data groups. It can be seen from the sig. Each test shows a score of more than 0.05. Sig. Levene's Test of Equality is 0.08 for scientific literacy, while the Sig. Critical thinking ability of 0.63. Meanwhile, the homogeneity test with the Box's Test of Equality of Covariance Matrices obtained a sig. of 0.21 with an F score of 1.51. The next prerequisite test is the multicollinearity test. The analysis results show that the VIF and tolerance scores are close to 1. Thus scientific literacy and critical thinking skills do not correlate. The prerequisite test for MANOVA analysis has been fulfilled, where the research data obtained are normally distributed and homogeneous, and there is no linear relationship between variables, so hypothesis testing with Manova can be carried out. Results of Manova Test Analysis Table 4.

Table 4. Results of the Manova Test Analysis

Effect		Score	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	0.996	4521.869	2.00	36.000	0.000
	Wilks' Lambda	0.004	4521.869	2.00	36.000	0.000
	Hotelling's Trace	251.215	4521.869	2.00	36.000	0.000
	Roy's Largest Root	251.215	4521.869	2.00	36.000	0.000
Treatment	Pillai's Trace	0.349	9.670	2.00	36.000	0.000
	Wilks' Lambda	0.651	9.670	2.00	36.000	0.000
	Hotelling's Trace	0.537	9.670	2.00	36.000	0.000
	Roy's Largest Root	0.537	9.670	2.00	36.000	0.000

Based on the results of the analysis, we obtained several findings. First, the MANOVA results show that the Pilae Trace, Wilks' Lambda Hotelling's Trace, and Roy's Largest Root show that the F coefficient is 4521.87b with a score of Sig. 0.00. This means simultaneous differences in scientific literacy and critical thinking abilities of groups of students taught with the *Tri Hita Karana*-based PBL Model exist. Second, the Tests of Between-Subjects Effects analysis results show an F score of 637,202 with Sig. 0.00, which is smaller than 0.05. It shows that there is an influence of the *Tri Hita Karana*-based PBL model on scientific literacy. Third, the Tests of Between-Subjects Effects analysis results show an F score of 680,633 with Sig. 0.003, which is smaller than 0.05. It shows the influence of the *Tri Hita Karana*-based PBL model on students' critical thinking skills. The results of the Tests of Between-Subjects Effects analysis are presented in Table 5.

Table 5. Results of Analysis of Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Science literacy	637.202[a]	1	637.202	14.642	0.000
	Critical thinking	680.633[b]	1	680.633	10.322	0.003
Intercept	Science literacy	257650.125	1	257650.125	5920.291	0.000
	Critical thinking	262198.171	1	262198.171	3976.402	0.000
Treatment	Science literacy	637.202	1	637.202	14.642	0.000
	Critical thinking	680.633	1	680.633	10.322	0.003
Error	Science literacy	1610.234	37	43.520		
	Critical thinking	2439.726	37	65.939		
Total	Science literacy	260725.000	39			
	Critical thinking	266177.000	39			
Corrected Total	Science literacy	2247.436	38			
	Critical thinking	3120.359	38			

Discussion

The results showed increased scientific literacy and critical thinking skills after students were taught the *Tri Hita Karana*-based PBL model, partially or simultaneously. This condition is inseparable from how the learning process is carried out. The *Tri Hita Karana*-based PBL model will provide opportunities for students to learn better and, of course, learn more actively because this model is student-centered. The existence of the *Tri Hita Karana*-based PBL model focuses more on what is experienced by students in everyday life. Besides, the activities carried out by students are more related to local *Tri Hita Karana* scores. Students connect the learning process and the solution material provided. This condition will certainly increase student interest in the learning process. Teaching attracts students' attention to foster interest in learning (Nazmi, 2017; Verawati et al., 2020). Students interested in the subject will show a sympathetic,

lazy, and passionate attitude toward learning (Lisma et al., 2019). Student learning interest in the learning process can improve good learning outcomes (Chen et al., 2020; Yeftha et al., 2020). With a good interest, students will be more enthusiastic in carrying out activities to solve problems with scientific steps to develop scientific literacy skills. Scientific literacy is using scientific knowledge to identify existing problems (Sudarsono et al., 2020; Widi et al., 2016). Scientific ability is interpreting science in everyday life to understand the theory and solve problems (Chusni & Hasanah, 2018; Samsu et al., 2020).

Scientific literacy refers to knowledge about science (science) and science-based technology seeking optimal solutions to human problems (Asyhari, 2019; Yuli Rahmawati et al., 2020). Scientific literacy uses scientific, technological, and societal knowledge through reasoning (Andriani et al., 2018). Someone with scientific literacy can use scientific concepts and process skills to assess everyday decisions when dealing with others, society, and their environment (Ariana et al., 2020). In this study, students' scientific literacy increased due to the learning stages that required students to solve problems. In addition, having a *Tri Hita Karana* basis will provide opportunities for students to learn better because the learning process is more emphasized on the scores of *Tri Hita Karana*.

The *Tri Hita Karana*-based PBL model affects critical thinking skills. Critical thinking skills will develop well with a learning model that can accustom students to carrying out activities that hinder the development of thinking abilities. An innovative learning process is needed that provides opportunities for students to develop critical thinking skills (Haryanti, 2017; Seibert, 2020; Silberman et al., 2021). Critical thinking is the key to developing creativity, and creativity arises because of problems that demand creative thinking (Aini et al., 2019; Seibert, 2020; Supriyanto & Mawardi, 2020). Critical thinking skills are a process that allows students to build knowledge through problem-solving and collaboration (Putri et al., 2019; Wijiastuti & Muchlis, 2021). Critical thinking skills are seen as helping students to compare information, for example, the information they have, with information received from outside (Odebiyi & Odebiyi, 2021). Students with critical thinking skills can decide something with their intellectual abilities (Y Rahmawati et al., 2019; Sadhu & Wijayanti, 2018; Taimur & Sattar, 2018). So it can be said that the Trihita-based PBL model is one of the innovative learning models that make students get used to their thinking skills developing well because students usually solve problems related to learning material.

This finding is reinforced by previous research stating that this discovery's results have implications for learning to improve students' critical thinking skills by using interactive multimedia based on problem-based learning (Abdulah et al., 2021). The Problem-Based Learning Model has more influence on critical thinking skills and scientific literacy (Suhirman & Khotimah, 2020). There are differences in the *Tri Hita Karana*-oriented Problem Based Learning learning model for learning outcomes (Tiarini et al., 2019). Applying the Jigsaw collaboration model and problem-based learning (PBL) effectively develops students' critical thinking skills (Saputra et al., 2019). Problem-based learning is an effective alternative for developing students' critical thinking skills (Aini et al., 2019). Based on this description, the *Tri Hita Karana*-based PBL model can positively impact learning. This research differs from the existing ones regarding the learning materials provided and the problems presented related to developing basic science concepts. The materials provided are closely related to the local wisdom of *Tri Hita Karana*.

4. CONCLUSION

The results showed increased scientific literacy and critical thinking skills after students were taught the *Tri Hita Karana*-based PBL model, partially or simultaneously. From the mean score of each variable, the research results also show that the critical thinking ability variable is more influenced than scientific literacy, so it can be recommended as an innovative learning model to improve scientific literacy and critical thinking skills.

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