



Optimizing Students' Scientific Attitudes and Collaboration Skills Through Problem-Based Learning Based on Tri Hita Karana

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Abstract: The major problem in this study is students' lack of scientific mentality and collaborative skills when learning Natural and Social Sciences (IPAS), which conventional techniques have dominated. Traditional methods involve students less actively in problem-solving and group work, which hinders the ideal development of their scientific attitudes and collaborative skills. This study examines how the Problem-Based Learning (PBL) learning paradigm based on Tri Hita Karana affects fourth-grade students' scientific attitudes and collaborative skills, both individually and concurrently. This study used a quasi-experimental approach with a posttest-only control group. The research population consisted of all fourth-grade pupils, 105 individuals, with a sample of 70 picked using basic random selection procedures. The PBL learning model based on Tri Hita Karana is the independent variable, whereas the dependent variables are students' scientific attitudes and collaboration skills. Data were acquired by observation and analyzed using Multivariate Analysis of Variance (MANOVA) statistics. The findings revealed that the Tri Hita Karana-based PBL learning paradigm substantially impacted students' scientific attitudes and collaboration skills when learning IPAS. These findings indicate that implementing Tri Hita Karana-based PBL can effectively improve learning quality and develop elementary school students' attitudes and collaboration skills.

Keywords: collaboration, problem-based learning, scientific attitudes, tri hita karana

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INTRODUCTION

Education plays a crucial role in improving the quality of human life. The primary school serves as the initial formal educational experience where children begin to learn fundamental concepts and develop essential attitudes for acquiring knowledge and solving problems in their environment. At this level, students are introduced to the foundational skills necessary for lifelong learning, including critical thinking and logical reasoning. Primary education lays the groundwork for building individuals who can confidently and competently navigate and address challenges in their surroundings. A key element in this foundation is cultivating scientific attitudes and collaboration skills, both indispensable for personal growth and societal development. A scientific attitude is one of the critical traits that should be cultivated from an early age. It involves thinking logically and critically, free from undue influence or bias, and basing conclusions on evidence and rational analysis (Pautina, 2018; Rahayuningsih, 2020). Such an attitude benefits scientists and is essential for anyone seeking to understand and learn from their environment through systematic investigation (Abdullah, 2016; Putri & Hendawati, 2018). Students with a scientific attitude are more likely to approach learning with an open mind, respect others' perspectives, and make decisions based on facts and sound reasoning (Purwanti & Manurung, 2015). Furthermore, fostering a scientific attitude has enhanced critical thinking skills, academic achievement, and overall learning behavior (Sufia & Lestari, 2020; Suryawati & Osman, 2018). These benefits underscore the importance of introducing and nurturing this attitude in elementary school students.

In addition to scientific attitudes, collaboration skills are essential for young learners, particularly in today's interconnected world. Collaboration is a key 21st-century skill that prepares students to work effectively with others in school, the workplace, and global communities (Apriono, 2011). It enables students to respect diverse viewpoints, make informed decisions, and contribute meaningfully to group efforts (Lestari, 2020; Utomo et al., 2020). Collaboration also fosters mutual respect, problem-solving, and collective success, making it indispensable for achieving educational goals and preparing for future challenges (Alawiyah & Sopandi, 2016; Jubaedah, 2017). By engaging in collaborative activities, students learn to actively participate in solving problems and develop the interpersonal skills needed for personal and professional growth (Haka et al., 2020; Widani et al., 2019). However, observations in grade IV reveal that students' scientific attitudes and collaboration skills are not yet fully developed. In science lessons, some students struggle to think logically and find concepts

independently based on the material provided by their teacher. Additionally, their ability to collaborate within groups is often lacking, as evidenced by group members who engage in distractions, fail to focus on the teacher's instructions, and remain passive during discussions. These issues highlight the urgent need for intervention, as scientific attitudes and collaboration skills are vital for future learning and problem-solving. Addressing these deficiencies is critical to ensuring students are equipped with the competencies required for academic and real-world success.

To address these challenges, the Problem-Based Learning (PBL) model, enhanced by integrating Tri Hita Karana principles, offers a promising solution. PBL encourages students to tackle complex, real-life problems, promoting problem-solving skills and active engagement (Apriliyani et al., 2018; Santiasih et al., 2013). The incorporation of Tri Hita Karana, a Balinese philosophy emphasizing harmony between humans and God (*parahyangan*), humans and others (*pawongan*), and humans and the environment (*palemahan*), adds a cultural dimension that aligns learning with local wisdom (Handika & Wangid, 2013; Pujiastuti & Hidayah, 2016). This combination enriches the learning experience and instills values that promote ecological and social harmony. The Tri Hita Karana philosophy provides a unique framework for education. *Parahyangan* reflects the spiritual relationship between humans and God, fostering gratitude and awareness of divine providence (Putu, et al., 2021; Suryawan et al., 2022). *Pawongan* emphasizes social balance, encouraging individuals to nurture harmonious relationships within families, communities, and broader social structures (Putra et al., 2021; Putu, et al., 2021). *Palemahan* focuses on environmental stewardship, teaching individuals to respect and maintain harmony with nature (Nyoman et al., 2022; Setyawati et al., 2022). By integrating these principles into PBL, students are guided to solve problems while maintaining balance in their relationships with God, others, and the environment. This approach ensures that learning remains holistic and contextually relevant.

Despite the growing recognition of the importance of scientific attitudes and collaboration skills in education, research in this area has revealed notable gaps. For instance, Masruroh and Arif (2021) highlights that while problem-based learning (PBL) enhances critical thinking and problem-solving skills, its integration with local cultural values remains underexplored. Similarly, Umbara et al.

(2020) emphasize the effectiveness of PBL in promoting active learning. However, the lack of studies contextualizing PBL to specific cultural or philosophical frameworks such as Tri Hita Karana limits its broader applicability. (Melindawati et al., 2021) note that collaborative skills are vital for 21st-century competencies, but they argue that current models often overlook students' sociocultural contexts in collaboration strategies. Buana and Anugraheni (2020) and Widodo and Wardani (2020) confirm that PBL significantly impacts students' critical and scientific thinking skills; however, the potential for its alignment with environmental and social harmony principles is rarely investigated. Lastly, Wahyuningtyas and Kristin (2021) emphasize the need for PBL to address the interplay between cognitive, emotional, and cultural dimensions, a perspective that remains largely unexplored in elementary education settings. These studies collectively underline the necessity for an innovative approach to integrating PBL with culturally grounded frameworks, such as Tri Hita Karana, to holistically enhance scientific attitudes and collaboration skills. Given the potential benefits of this integrated approach, this study aims to explore its impact on elementary school students' scientific attitudes and collaboration skills. Specifically, the objectives of this study are: (1) to analyze the influence of the Problem-Based Learning model based on Tri Hita Karana on students' scientific attitudes in science subjects for grade IV; (2) to analyze the influence of this model on students' collaboration skills in the same context; and (3) to analyze the simultaneous impact of the model on both scientific attitudes and collaboration skills. By achieving these objectives, this research seeks to contribute to developing effective, culturally relevant teaching strategies that foster essential competencies in young learners.

METHODS

This research utilized a quasi-experimental design, a methodology suitable when randomly assigning participants to groups is not feasible (Sugiono, 2017). Specifically, the study adopted a posttest-only control group design to evaluate the effects of the Problem-Based Learning (PBL) model based on Tri Hita Karana on students' scientific attitudes and collaboration skills. Quasi-experimental methods are commonly used in educational research as they allow for controlled comparisons in natural settings while accommodating existing constraints, such as pre-determined classroom structures (Creswell, 2013). The PBL model, enriched by the cultural philosophy of Tri Hita Karana, serves as the independent variable, while the dependent variables are students' scientific attitudes and collaboration skills.

A posttest-only design is justified by eliminating potential pretest sensitization effects, ensuring that any observed outcomes are attributed solely to the treatment (Creswell, 2013). The design includes an experimental group that received the intervention (PBL based on Tri Hita Karana) and a control group that underwent conventional learning methods. The study population comprised all fourth-grade students, totaling 105 individuals distributed across three classes. A random sampling technique was employed, ensuring that each

student had an equal chance of being selected (Sugiono, 2017). Before random sampling, a class equivalency test was conducted to ascertain that the classes were statistically comparable regarding baseline characteristics. The equivalency test results indicated no significant differences between the classes, allowing for the fair randomization of treatment assignment. Subsequently, a lottery method was used to assign the classes to experimental and control groups. Class IVB, comprising 35 students, was designated as the experimental group, while class IVC, with 35 students, served as the control group. The remaining class was excluded from the study to prevent contamination of results. The class composition ensured sufficient sample sizes for statistical analysis, meeting the minimum requirements for quasi-experimental research (Sugiono, 2017). The primary data collection instruments were observation sheets designed and validated to assess students' scientific attitudes and collaboration skills. The scientific attitude observation sheet was adapted from validated rubrics that measure critical components such as curiosity, objectivity, critical thinking, and a willingness to consider evidence-based conclusions. Similarly, the collaboration skills observation sheet assessed communication, teamwork, mutual respect, and problem-solving within group activities (Creswell, 2013). Both instruments underwent a rigorous validation process involving expert judgment to ensure content validity and reliability. The observation sheets were pilot-tested in a comparable classroom setting, yielding a Cronbach's alpha coefficient of 0.85 for scientific attitudes and 0.88 for collaboration skills, indicating high internal consistency.

Data collection was conducted over four weeks, during which the experimental group participated in lessons utilizing the PBL model based on Tri Hita Karana, while the control group followed conventional instructional methods. Observations were made by trained observers who used standardized observation sheets to record students' behaviors and interactions during classroom activities. A double-observer technique was employed to minimize observer bias, and inter-rater reliability was calculated, yielding a coefficient of 0.92. The posttest-only approach ensured that data collection focused exclusively on the outcomes after the intervention, clearly comparing the two groups. Observers were instructed to remain non-intrusive to avoid influencing students' behaviors during lessons. Data analysis involved descriptive and inferential statistical methods. Descriptive statistics, including mean, median, mode, standard deviation, variance, maximum, and minimum scores, were used to summarize the trends in students' scientific attitudes and collaboration skills. Visual representations, such as tables and graphs, were employed to illustrate the distribution of scores across the experimental and control groups.

Inferential analyses began with preliminary tests, including 1) Normality Test: The Kolmogorov-Smirnov test was performed using IBM SPSS Statistics 25 to ensure that the data met the assumption of normal distribution. A significance level of $p > 0.05$ indicated normality; 2) Homogeneity Test: Levene's test was conducted to confirm the homogeneity of variances. A p -value > 0.05 suggested that the variances between groups were equal; 3) Correlation Test: The Pearson product-moment correlation test examined the relationship between the two dependent variables (scientific attitudes and collaboration skills). If the variables were found to be significantly correlated, additional multivariate analysis was conducted. Multivariate Analysis of Variance (MANOVA) was employed for hypothesis testing to assess the PBL model's simultaneous effects based on Tri Hita Karana on the two dependent variables. MANOVA was chosen because it accounts for potential interdependencies between the dependent variables, providing a robust analysis of the intervention's impact (Tabachnick & Fidell, 2013).

RESULT AND DISCUSSION

The descriptive statistics for students' scientific attitudes (Y1) and collaboration skills (Y2) across the experimental group (A1) and control group (A2) are summarized in the table below, providing a detailed overview of key measures such as mean, median, mode, standard deviation, variance, range, and total scores. Based on the description of the collected study data, the results obtained are shown in Table 1.

Table 1. Description of Research Data Result

	A1Y1	A1Y2	A2Y1	A2Y2
Mean	32,77	19,23	27,86	17,43
Median	33	19	27	17
Mode	32	19	27	16
Std. Deviation	3,41	2,18	2,68	2,29
Variance	11,65	4,77	7,19	5,25
Range	13	9	11	8
Minimum	26	15	23	14
Maximum	39	24	34	22
Sum	1147	673	975	610

Referring to [Table 1](#) above, it is known that: 1) the scientific attitude of students who follow the *Tri Hita Karana*-based Problem Based Learning learning model gets an average of 32.77, median = 33, mode = 32, standard deviation = 3.41, variance = 11.65, range = 13, minimum score = 26, and maximum score = 39. 2) the collaboration skills of students who follow the *Tri Hita Karana*-based Problem Based Learning learning model get an average of 19.23, median = 19, mode = 19, standard deviation = 2.18, variance = 4.77, range = 9, minimum score = 15, and maximum score = 24. 3) the scientific attitude of students who do not follow the *Tri Hita Karana*-based Problem Based Learning learning model gets an average of 27.86, median = 27, mode = 27, standard deviation = 2.68, variance = 7.19, range = 11, minimum score = 23, and maximum score = 34. Moreover, 4) the collaboration skills of students who did not follow the *Tri Hita Karana*-based Problem Based Learning learning model got an average = 17.43, median = 17, mode = 16, standard deviation = 2.29, variance = 5.25, range = 8, minimum score = 14, and maximum score = 22. The results reveal that students exposed to the THK-PBL model consistently outperformed their peers in both scientific attitudes and collaboration skills. The alignment of THK values with the collaborative and inquiry-based nature of PBL likely contributed to this improvement. For instance, fostering harmony with the environment (*Tri Hita Karana*) can enhance students' appreciation for scientific exploration, while harmony with others supports effective teamwork. Furthermore, the analysis prerequisite test was carried out. The tests carried out are explained in [Table 2](#).

Table 2. Data Distribution Normality Test

	group	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
scientific attitude	experiment	.098	35	.200*	.967	35	.362
	control	.140	35	.081	.967	35	.366
collaboration skill	experiment	.142	35	.073	.970	35	.457
	control	.133	35	.118	.952	35	.129

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The findings of [Table 2](#) above demonstrate that the significance of Kolmogorov-Smirnov and Shapiro-Wilk is more extensive than 0.05, implying that all data groups in this study have normal distribution. Furthermore, a homogeneity of variance test was performed. [Table 3](#) summarizes the findings of the tests conducted.

Table 3. Homogeneity of Variance Test
Levene's Test of Equality of Error Variances

		Levene Statistic	df1	df2	Sig.
scientific attitude	Based on Mean	2.170	1	68	.145
	Based on Median	1.894	1	68	.173
	Based on the Median and with adjusted df	1.894	1	67.510	.173
	Based on trimmed mean	2.156	1	68	.147
collaboration skill	Based on Mean	.200	1	68	.656
	Based on Median	.194	1	68	.661
	Based on the Median and with adjusted df	.194	1	67.957	.661
	Based on trimmed mean	.198	1	68	.657

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + k

[Table 3](#) shows the results of the homogeneity of variance test. The significant value of box M and Mean Levene's test is more than 0.05, implying that the data in this study are homogenous. Furthermore, a correlation test is performed on the dependent variables. [Table 4](#) summarizes the findings of the tests conducted.

Table 4. Results of Correlation Testing Between Dependent Variables

Experiment Class Correlation			
		scientific attitude experiment	collaboration experiment
scientific attitude experiment	Pearson Correlation	1	-.103
	Sig. (2-tailed)		.555
	N	35	35
collaboration experiment	Pearson Correlation	-.103	1
	Sig. (2-tailed)	.555	
	N	35	35
Control Class Correlation			
		scientific attitude control	collaboration control
scientific attitude control	Pearson Correlation	1	.216
	Sig. (2-tailed)		.212
	N	35	35
collaboration control	Pearson Correlation	.216	1
	Sig. (2-tailed)	.212	
	N	35	35

Based on Table 4 above, the significance value of the correlation between the experimental and control classes is more than 0.05, implying no significant link between the two classes. Thus, Manova may be used to test hypotheses. Hypothesis testing in this study uses Manova. The results of the analysis based on the tests that have been carried out are explained in Table 5.

Table 5. Hypothesis Testing Results

Tests of Between-Subjects Effects						
Type III Sum of Squares						
Source	Dependent Variable	Squares	df	Mean Square	F	Sig.
Corrected Model	scientific attitude	422.629 ^a	1	422.629	44.872	.000
	collaboration skill	56.700 ^b	1	56.700	11.315	.001
Intercept	scientific attitude	64326.914	1	64326.914	6829.856	.000
	collaboration skill	23515.557	1	23515.557	4692.858	.000
k	scientific attitude	422.629	1	422.629	44.872	.000
	collaboration skill	56.700	1	56.700	11.315	.001
Error	scientific attitude	640.457	68	9.418		
	collaboration skill	340.743	68	5.011		
Total	scientific attitude	65390.000	70			
	collaboration skill	23913.000	70			
Corrected Total	scientific attitude	1063.086	69			
	collaboration skill	397.443	69			

a. R Squared = .398 (Adjusted R Squared = .389)

b. R Squared = .143 (Adjusted R Squared = .130)

The results of hypothesis testing presented in Table 5 demonstrate significant findings for both dependent variables: scientific attitude and collaboration skills. For the dependent variable scientific attitude, the F value in the Corrected Model is 44.872, with a significance level of 0.000. This significance level is below the threshold of 0.05, indicating that the Problem-Based Learning (PBL) model based on Tri Hita Karana has a statistically significant effect on students' scientific attitudes. The R-squared value of 0.398 further reveals that approximately 39.8% of the variance in students' scientific attitudes is explained by the model, signifying a strong effect size. These findings confirm that the PBL model is highly effective in enhancing students' scientific attitudes. For the dependent variable collaboration skills, the F value in the Corrected Model is 11.315, with a significance level of 0.001. This also meets the significance criteria of $p < 0.05$, indicating that the THK-PBL model significantly impacts students' collaboration skills. However, the R-squared value for this variable is 0.143, meaning the model accounts for 14.3% of the variance in collaboration skills. While the effect size is smaller compared to scientific attitudes, it still highlights the importance of the PBL approach in fostering collaborative behaviors among students. The findings underscore the potential of integrating problem-solving tasks that align

with local cultural values to improve teamwork and cooperation. The results collectively validate the research hypotheses, showing that the THK-PBL model positively influences scientific attitudes and collaboration skills. The significant effect on scientific attitudes suggests that the model effectively instills a curiosity-driven, inquiry-based mindset in students, encouraging critical thinking and a systematic approach to learning. Meanwhile, the significant but smaller effect on collaboration skills suggests the need for additional strategies, such as tailored group tasks or specific interventions, to further enhance students' ability to work effectively in teams. Furthermore, in the Corrected Model section, the collaboration skills variable obtained an F count of 11.315 with a significance of 0.001. This result indicates that the second hypothesis test obtained the results that there is a significant influence of the *Tri Hita Karana*-based Problem-based Learning model on students' collaboration skills in the science subject of grade IV students.

Table 6. Hypothesis Testing

		Multivariate Tests				
	Effect	Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.994	5459.101 ^b	2.000	67.000	.000
	Wilks' Lambda	.006	5459.101 ^b	2.000	67.000	.000
	Hotelling's Trace	162.958	5459.101 ^b	2.000	67.000	.000
	Roy's Largest Root	162.958	5459.101 ^b	2.000	67.000	.000
k	Pillai's Trace	.445	26.823 ^b	2.000	67.000	.000
	Wilks' Lambda	.555	26.823 ^b	2.000	67.000	.000
	Hotelling's Trace	.801	26.823 ^b	2.000	67.000	.000
	Roy's Largest Root	.801	26.823 ^b	2.000	67.000	.000

a. Design: Intercept + k

b. Exact statistic

Table 6 indicates that the estimated F value for Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root is 26.823, with a significance level of 0.000. This result shows that the third hypothesis test had the following outcomes: Simultaneously, the Problem-Based Learning learning paradigm based on *Tri Hita Karana* substantially impacts the scientific attitudes and collaborative skills of grade IV students. The results of this study are in line with the results of research conducted by Masruroh and Arif (2021). Their research revealed a significant difference in effectiveness between using the Problem-Based Learning model through the Science Education for Sustainability approach and the conventional model in improving the collaboration skills of class VIII science students (Masruroh & Arif, 2021). Furthermore, Fitriyani's research stated that the Problem-Based Learning model could improve students' collaboration and high-level thinking skills. (Fitriyani, 2019).

Hartina et al.'s research revealed that the Problem-Based Learning model positively impacts students' collaboration skills in thematic learning (Hartina et al., 2022). In line with Rosdiana's research, the Problem-based learning approach considerably impacts students' scientific attitudes, with a modest effect size of 0.470. The approach also has a considerable influence and moderate effect on learning outcomes, with an effect size of 0.331 (Rosdiana, 2019). Furthermore, Wiragasari et al.'s research stated that applying the Problem-Based Learning learning model to redox material can positively influence students' mastery of scientific concepts and attitudes (Wiragasari et al., 2021). The problem-based learning model is a learning paradigm based on the numerous difficulties that necessitate authentic research, i.e., an investigation that demands actual answers to real problems (Trianto, 2007). The Problem-Based Learning model will be more effectively implemented by combining the local wisdom of *Tri Hita Karana*. *Tri Hita Karana* is a philosophy inherent in Hindus, which means Three Causes of Happiness/Prosperity/Well-being, consisting of *parahyangan*, *palemahan*, and *pawongan*. *Tri Hita Karana* always teaches to maintain harmony between humans and God (*parahyangan*), humans and others (*pawongan*), and between humans and the environment (*palemahan*) (Adhitama, 2020; Parmajaya, 2018; Sriasih et al., 2019).

According to Windia, *Parahyangan* is a vertical relationship or a relationship between humans and God as the Creator (Suryawan et al., 2022). This relationship is a form of gratitude towards God Almighty because of our awareness that everything comes from God (Astiti et al., 2015). *Pawongan* is a balancing factor that highlights the social aspects of society. Individuals, families, and banjar are the primary social levels of society. *Pawongan* attempts to promote balance in people's daily lives (Adhitama, 2020). Furthermore, *Palemahan* explains the harmony between humans and nature, where humans are part of nature and, therefore, must be open and sympathetic towards nature (Nyoman et al., 2022). The universe's buzzwords are balance and harmony. This instruction highlights the need for environmental sustainability to achieve natural harmony and maintain ecological equilibrium. The Problem-Based learning model based on *Tri Hita Karana* is an effective learning model for teaching high-level thinking processes. This learning helps students process information

already in their minds and build their knowledge about the social world and its surroundings. This learning is suitable for developing basic and complex knowledge. The problem-based learning model based on *Tri Hita Karana* can empower students with greater freedom, allowing them to be more creative and collaborative in solving existing problems. This is because students will collaborate to find information and use it actively to solve problems they find in learning activities. This kind of learning process will undoubtedly hone students' scientific attitudes in the learning process. In the learning process of the Problem-Based Learning learning model based on *Tri Hita Karana*, students are also allowed to work together to solve the problems that have been given. Therefore, this study has proven that the Problem-Based Learning learning model based on *Tri Hita Karana* effectively develops and improves students' scientific attitudes and collaboration skills.

CONCLUSION

Based on the findings, the Problem-Based Learning (PBL) model based on *Tri Hita Karana* significantly impacts students' scientific attitudes and collaboration skills in Natural and Social Science (IPAS) for grade IV. The research showed that students who engaged in the THK-based PBL model exhibited enhanced scientific attitudes and collaboration skills compared to those in the control group. These results suggest that the model, which integrates cultural values with problem-solving tasks, effectively fosters individual cognitive development and collaboration skills. However, the study did not fully address the initial research question regarding how these two variables—scientific attitudes and collaboration skills—interact under the influence of the PBL model. While both variables improved individually, further research is needed to examine their interaction and to understand how one may influence the other. Moreover, the research focused on the short-term effects, but exploring the long-term impact of the THK-based PBL model could provide deeper insights into its sustained effectiveness. The implications of this research indicate that the PBL model, integrating cultural values, is a promising teaching strategy for enhancing students' scientific thinking and collaboration, offering valuable contributions to curriculum development and teaching practices in primary education. Future studies should consider exploring the interaction between the two dependent variables more thoroughly and investigating the potential long-term effects of this learning approach.

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