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OPTIMIZING STUDENTS' CRITICAL THINKING AND NUMERACY LITERACY SKILLS THROUGH TASK-BASED LEARNING: AN EXPERIMENTAL STUDY

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Abstract. The suboptimal critical thinking and numeracy literacy skills among students, which can impact the quality of human resources, is the reason this research aims to examine the effects of task-based learning on critical thinking and numeracy literacy. The research method used is a quasi-experimental design with a nonequivalent posttest-only control group design. The focus of this study is on PGSD (Elementary School Teacher Education) students enrolled in numeracy literacy courses, with a total of 120 students divided into 4 classes. Data collection was conducted through tests. Data analysis included descriptive analysis and inferential statistical analysis, with inferential analysis performed using the MANOVA (Multivariate Analysis of Variance) method. The results of the study indicate that the implementation of the task-based learning method has a significant impact both simultaneously and partially on critical thinking and numeracy literacy skills. This is evident from the higher average scores observed in the experimental class that applied this method, compared to the control class that did not use it. Therefore, it is recommended that the task-based learning method be used as a solution to address the issues related to low critical thinking and numeracy literacy skills.

INTRODUCTION

In the rapidly evolving digital era, critical thinking skills have become increasingly essential (Sumandya et al., 2023). With the overwhelming influx of information from various sources, such as social media, online news, and other digital platforms, the ability to discern accurate information from misleading content is crucial. Critical thinking empowers individuals to identify fake news or hoaxes, understand the context and intentions behind the information they receive, and make better decisions based on thorough analysis. Additionally, critical thinking helps us navigate and overcome the "filter bubbles" created by digital algorithms, which often present content that aligns only with personal preferences. With this skill, we can become more open to diverse perspectives, develop strong digital ethics, and be better prepared to face the challenges and opportunities of an increasingly complex world. Critical thinking is a vital element in cognitive development, enabling individuals to evaluate

information objectively and make decisions based on careful consideration (Kumullah et al., 2018; Lestari et al., 2021; Rahmawati et al., 2024; Sakti et al., 2020). The ability to think critically has a significant impact on students' learning outcomes (Saparuddin et al., 2021). Critical thinking skills can have a positive impact on the ability to understand wave concepts (Pramudita et al., 2023). To enhance students' critical thinking abilities, it is essential to implement various educational strategies that encourage analytical thinking, critical evaluation of information, and logical problem-solving (Widana et al., 2023). These approaches include assigning challenging tasks, facilitating interactive classroom discussions, and utilizing student-centered learning methods, such as project-based learning and case studies (Evi Yupani & Widana, 2023). Additionally, it is crucial to create a learning environment that promotes inquiry, exploration, and reflection, allowing students to develop their critical thinking skills in a more profound and focused manner.

In addition to critical thinking skills, students must also possess numeracy literacy skills. Numeracy literacy is one of the essential competencies needed in daily life (Sari et al., 2022). Numeracy literacy is defined as an individual's ability to apply reasoning and critical thinking to analyze and understand statements. This involves engaging in activities that manipulate symbols or mathematical language in daily life, whether through written or verbal communication (Latifah & Rahmawati, 2022; Nurjanah et al., 2022; Widiantari et al., 2022). Numeracy literacy is practical and can be applied in everyday life, encompassing aspects related to citizenship, professional activities, recreation, and culture (Kurniasih & Watini, 2022; Mahmud & Pratiwi, 2019). Numeracy literacy skills have a positive impact on various competencies that learners need to develop. Numeracy literacy encompasses not only the understanding of numbers and basic mathematical operations but also the ability to apply mathematical concepts to everyday situations and solve problems effectively. By developing numeracy literacy, learners can enhance their logical, analytical, and critical thinking abilities, which are crucial for making sound decisions and interpreting quantitative information. Furthermore, numeracy literacy supports understanding across various other fields of study, such as science, economics, and technology, thereby broadening horizons and equipping learners with the skills needed for future success.

The importance of critical thinking skills and numeracy literacy drives educators to continually innovate in teaching methods. Various innovations have been implemented to enhance both of these abilities. For instance, research indicates that the use of educational videos can improve numeracy literacy skills (Winarni et al., 2021). In addition, project-based learning (PjBL) models have been shown to have a positive impact on literacy (Rediani, 2024). Problem-Based Learning (PBL) models have also been proven effective in enhancing critical thinking skills (Lestari et al., 2021; Rediani, 2022). Furthermore, research shows that the PjBL model can enhance learners' critical thinking skills (Sinta et al., 2022). These innovations highlight the importance of diverse and interactive approaches in education to develop essential skills in the digital age. However, the reality in the field often falls short of expectations. Learners' critical thinking and literacy skills remain relatively low. If this situation is left unaddressed, it could have negative consequences. Learners may struggle to understand and analyze information, make sound decisions, and adapt to the demands of an increasingly complex job market and daily life. The low level of these skills can also hinder the development of other competencies needed for success in the digital era and globalization. Therefore, there is a need for more effective interventions and teaching strategies to enhance learners' critical thinking and literacy skills.

To address the issue of low critical thinking and literacy skills among learners, a task-based learning approach has been selected as a solution. This approach is designed to encourage learners to be more active in the learning process by providing challenging and relevant tasks that require critical thinking and numeracy literacy skills. Through task-based learning, learners are trained to explore various sources of information, analyze data, and solve problems independently or collaboratively (Sholeh, 2022; Purnadewi & Widana, 2023). This not only enhances engagement and motivation in learning but also helps learners develop the critical thinking and numeracy literacy skills necessary to face challenges in the digital age. Task-based learning impacts several learner abilities, including speaking skills (Hassan et al., 2021; Ilyas & Yulianto, 2019), foreign language correspondence skills of students (Rahayu & Achaliyah, 2020), improve speaking skills (Syatriana et al., 2018), learners are more actively involved in the learning process (Umar, 2023). Based on the above descriptions, the implementation of task-based learning is expected to have a positive impact on learners' abilities, particularly in the areas of critical thinking and numeracy literacy. Therefore, this study aims to investigate the impact of task-based learning on these two skills. This research differentiates itself from previous studies by focusing on specific variables, namely critical thinking and numeracy literacy, with the goal of providing new insights into the effectiveness of this learning approach.

The hope for this research is that its findings will contribute significantly to the development of more effective teaching methods. By doing so, education can better prepare learners to face challenges in the digital age and globalization. Additionally, this study is expected to provide valuable insights for the development of educational policies and the implementation of more innovative teaching practices. In the context of science and technology (IPTEK), this research aims to promote the adoption of more advanced and relevant technologies and teaching methods. By understanding the impact of task-based learning on critical thinking and numeracy literacy skills, it is hoped that new ways to leverage technology in supporting the teaching and learning process can be identified. This will also open opportunities to integrate digital tools and resources into more effective learning, as well as strengthen the foundational knowledge and skills necessary for success in a technology-driven society.

METHOD

The quasi-experimental design using the nonequivalent posttest only control group design is often chosen when randomization is not feasible (Rogers & Revesz, 2020). In this design, the experimental and control groups are not randomly assigned, and outcome measurements are taken only after the intervention has been applied to the experimental group. This allows researchers to assess the impact of the intervention without comparing the baseline data of both groups, although it can still provide valuable insights into the effects of the intervention. In this study, this design is used to evaluate the effects of an intervention by measuring outcomes in the group that received the task-based learning and comparing them with the control group that did not receive the task-based learning. Data to be collected in this study include: (1) critical thinking skills (Y1) of students using task-based learning, (2) critical thinking skills (Y1) of students using non-task-based learning methods, (3) numeracy literacy (Y2) of students using task-based learning, and (4) numeracy literacy (Y2) of students using non-task-based learning methods.

The population for this study consists of all PGSD (Elementary School Teacher Education) students enrolled in the numeracy literacy course, totaling 120 students across four classes.

After conducting an equivalence test using One Way-ANOVA (ANOVA-A) with SPSS 26.0 for Windows, a simple random sampling technique was applied through a lottery to select two classes as research samples. The lottery results selected Class C and Class B. Another lottery was then conducted to determine which of these classes would be the experimental group and which would be the control group. Following the draw, Class B was assigned as the experimental group with 30 students, while Class C was assigned as the control group, also with 30 students.

Data collection in this study was meticulously conducted using testing methods, which are specifically designed to directly assess individual abilities by examining their responses to a variety of stimuli or questions. These testing methods are instrumental in providing a comprehensive evaluation of students' critical thinking and numeracy literacy skills, particularly after they have been taught using a task-based learning approach. To facilitate this assessment, the study employed a series of essay questions as its primary testing instruments. These essay questions were carefully crafted to gauge improvements in students' critical thinking and numeracy literacy skills. By analyzing the responses to these questions, the study aimed to capture detailed insights into how effectively the task-based learning method contributed to the enhancement of these key competencies. This approach ensured a thorough evaluation of the impact of the learning method on the students' abilities, providing valuable data on the effectiveness of the instructional strategy.

In this study, data collection methods encompass both descriptive and inferential statistical analyses. Descriptive analysis was carried out using SPSS 26.0 for Windows, with a primary focus on the post-test data. This analysis involves calculating several key statistics, such as the mean (average), standard deviation, maximum value, and minimum value, which provide a comprehensive summary of the data's central tendency and variability. Following the descriptive analysis, inferential statistics are employed to explore the relationships between variables and test hypotheses. Specifically, Multivariate Analysis of Variance (MANOVA) is utilized to analyze the post-test data, as it allows for the assessment of multiple dependent variables simultaneously. Before conducting MANOVA, several prerequisite tests are performed to validate the results. These include normality tests using the Kolmogorov-Smirnov test to ensure the data follows a normal distribution, and homogeneity tests using Levene's Statistics and Box's Test of Equality of Covariance Matrices to check the equality of variances across groups. Additionally, multicollinearity tests are conducted to assess the degree of correlation between independent variables. These tests are essential for meeting the assumptions required for MANOVA. All analyses, including MANOVA and the prerequisite tests, are executed using SPSS 26.0 for Windows to ensure the accuracy and reliability of the results.

RESULTS AND DISCUSSION

The research results indicate a notable improvement in both critical thinking skills and numeracy literacy skills among students who participated in task-based learning. This enhancement is evident from the detailed descriptive analysis presented in Table 1. The study revealed a significant difference in both critical thinking and numeracy literacy skills between students who were engaged in task-based learning and those who were not. Specifically, there is a difference of 12.05 in critical thinking skills, with the experimental group demonstrating higher average scores compared to the control group. Similarly, numeracy literacy skills show a difference of 10.60, with the experimental group again achieving higher average scores than

the control group. The analysis further indicates that critical thinking skills were more significantly affected by the task-based learning compared to numeracy literacy skills.

Table 1: Descriptive Analysis Results for Critical Thinking and Numeracy Literacy Skills

Treatment	Dependent Variable	Mean	Standard Deviation	Maximum	Minimum	Range
Task-based learning	Critical thinking skills	79.32	13.45	99.61	39.52	60.90
	Numeracy literacy skills	74.47	14.13	99.90	41.95	57.95
Non-task-based learning methods	Critical thinking skills	67.27	13.79	87.00	32.00	55.00
	Numeracy literacy skills	63.87	13.64	94.00	45.00	49.03

In this study, several prerequisite tests were conducted to ensure the validity of the statistical analyses. The first prerequisite test was the normality test, performed using the Kolmogorov-Smirnov method. The results of this analysis indicated that all data sets were drawn from populations with a normal distribution, as proven by Sig. values greater than 0.05, as shown in Table 2. With the normality assumption met, the next step was to test for homogeneity. This involved two types of analyses: the test for homogeneity of variances, conducted using Levene's Test of Equality of Variances, and the test for homogeneity of covariance, conducted using Box's Test of Equality of Covariance Matrices. These tests were crucial in verifying that the assumptions required for further statistical analysis were satisfied.

Table 2. Results of Normality Analysis

Dependent Variable	Treatment	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Critical thinking skills	Experiment	0.117	30	0.200*	0.947	30	0.140
	Control	0.140	30	0.140	0.919	30	0.026
Numeracy literacy skills	Experiment	0.079	30	0.200*	0.985	30	0.928
	Control	0.142	30	0.125	0.945	30	0.123

The results of the homogeneity analysis indicate that the data from the research came from a homogeneous group, as evidenced by each test's significance values being greater than 0.05. The Levene's Test of Equality produced a significant value of 0.99 for critical thinking ability, while the significant value for numeracy literacy was 0.94. Additionally, the homogeneity test using Box's Test of Equality of Covariance Matrices yielded a significance value of 0.49 with an F value of 0.81. The next prerequisite test is multicollinearity; the analysis results show that the VIF and tolerance values are close to 1, indicating that there is no correlation between the variables of critical thinking ability and numeracy literacy. The prerequisites for MANOVA analysis have been met, with the research data being normally distributed, homogeneous, and showing no linear relationship between variables, thus allowing for hypothesis testing with MANOVA. The complete analysis results are detailed in Table 3 and Table 4.

Table 3. Results of Manova Test Analysis

	Effect	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	0.982	1553.681[b]	2.000	57.000	0.000	0.982
	Wilks' Lambda	0.018	1553.681[b]	2.000	57.000	0.000	0.982
	Hotelling's Trace	54.515	1553.681[b]	2.000	57.000	0.000	0.982
	Roy's Largest Root	54.515	1553.681[b]	2.000	57.000	0.000	0.982
Treatment	Pillai's Trace	0.257	9.866[b]	2.000	57.000	0.000	0.257
	Wilks' Lambda	0.743	9.866[b]	2.000	57.000	0.000	0.257
	Hotelling's Trace	0.346	9.866[b]	2.000	57.000	0.000	0.257
	Roy's Largest Root	0.346	9.866[b]	2.000	57.000	0.000	0.257

Based on the analysis results, several findings were obtained. First, the MANOVA results showed Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root with an F coefficient of 1553.681 and a significance value of 0.00. This indicates that there are simultaneous differences in critical thinking ability and numeracy literacy among students taught using task-based learning. Second, the Tests of Between-Subjects Effects analysis revealed an F value of 11.738 with a significance value of 0.001, which is less than 0.05. This indicates that task-based learning has a significant effect on critical thinking ability. Third, the Tests of Between-Subjects Effects analysis also showed an F value of 8.741 with a significance value of 0.004, which is less than 0.05. This suggests that task-based learning has a significant effect on numeracy literacy.

Table 4. Results of Tests of Between-Subjects Effects analysis

Source	**Dependent Variable**	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	Critical thinking skills	2177.435[a]	1	2177.435	11.738	0.001
	Numeracy literacy skills	1686.248[b]	1	1686.248	8.741	0.004
Intercept	Critical thinking skills	322292.775	1	322292.775	1737.415	0.000
	Numeracy literacy skills	287052.733	1	287052.733	1488.076	0.000
Treatment	Critical thinking skills	2177.435	1	2177.435	11.738	0.001
	Numeracy literacy skills	1686.248	1	1686.248	8.741	0.004
Error	Critical thinking skills	10759.079	58	185.501		
	Numeracy literacy skills	11188.313	58	192.902		
Total	Critical thinking skills	335229.289	60			

	Numeracy literacy skills	299927.295	60
Corrected Total	Critical thinking skills	12936.514	59
	Numeracy literacy skills	12874.562	59

The results of the study show that the implementation of the task-based learning method has a significant impact both simultaneously and partially on critical thinking and numeracy literacy skills. This is evident from the comparison of higher average scores in the experimental class that applied this method, compared to the control class that did not use it. The increase in scores can be attributed to the quality and structure of the learning process applied in this study. During the task-based learning process, students were given a series of tasks specifically designed to enhance their critical thinking and numeracy literacy skills. These tasks involved not only solving mathematical or numerical problems but also required in-depth analysis, evaluation of various potential solutions, and solving complex problems that often do not have a single answer. As a result, students were required to think critically and creatively when facing the given challenges. Furthermore, this process allowed students to apply the knowledge they had learned in more practical and realistic contexts. This provided them with an opportunity to develop deeper analytical skills and a better understanding of the material. Additionally, the tasks were designed to encourage students to actively participate in discussions, collaborations, and reflections, which further contributed to the overall improvement in learning outcomes. Overall, task-based learning has proven effective in enhancing students' critical thinking and numeracy literacy skills, as evidenced by the better results in the experimental class. The implementation of this method has a significant positive impact on both the learning process and outcomes, reinforcing the importance of integrating challenging tasks into the educational curriculum.

These explanations illustrate that involving students directly in the learning process, particularly through task-based methods, can have a significant positive impact on learning outcomes. By engaging students actively in every stage of the learning process, they become not just passive recipients of information but also active participants who must apply and manipulate the knowledge they have learned (Amna Saleem et al., 2021; Kumar, 2019). The task-based learning process encourages students to engage more deeply (Hima et al., 2021; Inayanti & Halimi, 2019), allowing them to tackle complex and challenging problems that require creative and analytical solutions (Khalaf & Altaee, 2022; Merita Ismaili, 2013). This direct involvement helps students not only to understand the material theoretically but also to apply it in practical and relevant contexts. In this way, students can develop better critical thinking skills, problem-solving abilities, and numeracy literacy. Furthermore, active participation in the learning process also boosts their motivation and engagement, as they feel more connected to the material and the learning process they are undergoing. Overall, involving students directly in the learning process through well-designed tasks has been shown to significantly enhance the quality and effectiveness of learning, as well as improve learning outcomes.

The results of this study align with previous research findings. For example, research indicates that the implementation of the Task-Based Learning (TBL) model positively impacts communication and collaboration skills (Ni Nyoman et al., 2023). Similarly, found that Task-Based Learning in both English and Mandarin significantly improved students'

foreign language correspondence abilities (Rahayu & Achaliyah, 2020). Demonstrated that the Task-Based Learning (TBL) method has a significant effect on students' abilities to analyze, identify, and classify information(Ahmad & Setyowati, 2020). Based on these findings, it can be concluded that the implementation of task-based learning has a positive impact on students. This method has proven effective in enhancing various skill aspects, such as communication, collaboration, foreign language transmission, as well as analysis and classification skills. Previous studies supporting these findings show that Task-Based Learning (TBL) significantly improves these skills. The consistency of these results with earlier research strengthens the argument that TBL is an effective approach in the educational context, with the potential to produce better and more in-depth learning outcomes.

CONCLUSION

The results of the study show that the implementation of the task-based learning method has a significant impact both simultaneously and partially on critical thinking and numeracy literacy skills. This is evident from the higher average scores observed in the experimental class that applied this method, compared to the control class that did not use it. Therefore, it is recommended that the task-based learning method be used as a solution to address issues related to low critical thinking and numeracy literacy skills. Implementing this method can effectively help students develop critical thinking skills and improve their numeracy literacy, contributing to better learning outcomes and overall enhancement of educational quality.

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