RISET :
Jurnal Ilmiah Multidisiplin Ilmu
Published by PT. Ahlal Publisher Nusantara, Indonesia
Volume 1 No 4 Tahun 2026 Issue E-ISSN : 3123-8475
Journal Homepage: https://jurnalriset.com/index.php/riset/index

The Effect Of The Problem Based Learning (PBL) Learning Model And Quizizz Learning Media On The Learning Interest Of Grade IV Students At Gmim IV Tomohon Elementary School

Falda Freiti Kapahang[1], Deitje A. Katuuk[2], Deysti T. Tarusu[3]

[1,2,3]Master's Program in Elementary School Teacher Education, Manado State University, Indonesia

Email : kapahang.f.kapahang@gmail.com , deitjekatuuk@unima.ac.id , deystitarusu@gmail.com

Article Info

Corresponding Author:
Penulis Korespondensi
✉
kapahang.f.kapahang@gmail.com

History:
Submitted: 01-06-2026
Revised: 03-06-2026
Accepted: 10-06-2026

Keyword:
Problem Based Learning, Quizizz, interest in learning

https://doi.org

Abstract

This study aims to determine the effect of the use of the Problem Based Learning (PBL) learning model and Quizizz learning media on the learning interest of fourth-grade students at GMIM IV Elementary School, Tomohon. This study used a quantitative approach with a one-group pretest-posttest experimental design. The research subjects were 30 fourth-grade students. Data collection techniques in this study included observation, questionnaires with a Likert scale, and documentation. The research instrument was a learning interest questionnaire that measured indicators of feelings of pleasure, interest, attention, active participation, and learning motivation. Data were analyzed using validity tests, reliability tests, classical assumption tests, and multiple linear regression analysis. The results showed that there was an increase in student learning interest after the implementation of PBL and Quizizz. The average pretest score in the experimental class was 62.5, increasing to 85.3 in the posttest, with a difference in increase of 22.8, while the control class only increased by 7.1. The partial test results (t) show that the PBL model has a significant effect on students' learning interest (Sig. 0.000 < 0.05), and the Quizizz media also has a significant effect (Sig. 0.002 < 0.05). Simultaneously, both variables have a significant effect on students' learning interest (Sig. 0.001 < 0.05). Thus, it can be concluded that the use of the PBL learning model combined with the Quizizz media is effective in increasing students' learning interest.

Introduction

Basic education plays a crucial role in shaping students' knowledge, skills, and attitudes. One factor influencing learning success is student interest. Students with a strong interest in learning tend to be more active, enthusiastic, and engaged in the learning process, while those with a low interest tend to be passive, easily bored, and less attentive to the material being taught. Therefore, teachers need to implement learning models and media that can enhance student interest in learning.

Developments in educational technology encourage teachers to utilize innovative learning models and digital media in teaching and learning activities. Accordingly, Rorimpandey (in Rahmawati & Setiawan, 2023) stated that developments in educational technology over the past five years have presented new opportunities through game-based learning, including the use of digital board games, which have been shown to increase motivation, focus, and conceptual understanding in elementary school students.

One learning model that can increase student engagement is Problem-Based Learning (PBL). The PBL model places students at the center of learning through problem-solving activities related to real life, thereby developing critical thinking skills, creativity, and student activeness. According to Romrimpandey (2023), in his research, it was found that the role of parents and learning interest have a positive and significant influence on the quality of student learning outcomes. In addition, the use of digital learning media such as Quizizz can create a more engaging learning atmosphere through game features, direct feedback, and healthy competition between students.

Based on observations in the fourth grade of GMIM IV Elementary School in Tomohon, it was found that the learning process was still dominated by lecture methods, the use of learning media was still limited to textbooks and whiteboards, and the use of technology in learning was not optimal. These conditions caused some students to be less active in learning, easily lose focus, and show low interest in learning. Of the 30 students observed, only 8 students actively asked or answered the teacher's questions. Furthermore, the average score of student learning outcomes was still below

the Minimum Completion Criteria (KKM) set by the school.

Various studies have shown that the implementation of Problem Based Learning and the use of Quizizz media can increase student engagement and interest in learning. However, research examining the influence of these two variables simultaneously on the learning interest of elementary school students is still limited, especially in fourth-grade students at GMIM IV Elementary School, Tomohon. Therefore, this study was conducted to analyze the influence of the Problem Based Learning (PBL) Model and Quizizz Learning Media on the learning interest of fourth-grade students at GMIM IV Elementary School, Tomohon.

The results of this study are expected to contribute to teachers in selecting effective learning models and media to increase students' interest in learning and support the creation of active, innovative, and enjoyable learning.

Research methods

This study uses a quantitative approach with an experimental method to determine the effect of the Problem Based Learning (PBL) Model and Quizizz learning media on the learning interests of fourth-grade students at GMIM IV Elementary School, Tomohon. The research design used is a pretest-posttest, which provides measurements before and after treatment to see changes in students' learning interests.

The research was conducted at GMIM IV Elementary School, Tomohon, in the even semester of the 2025/2026 academic year. The study population was all 30 fourth-grade students. The sampling technique used saturated sampling, so the entire population was used as the research sample.

The independent variables in this study consist of the Problem-Based Learning Model (X_1) and the Quizizz learning media (X_2), while the dependent variable is student learning interest (Y). The PBL model is implemented through the stages of problem orientation, student organization, group investigation, presentation of results, and evaluation of problem solving. Quizizz media is used as a digital-based interactive learning and evaluation tool.

Data collection techniques were conducted through observation, documentation, and the distribution of student learning interest questionnaires. The research instrument used a questionnaire with a 5-point Likert scale consisting of indicators of feelings of pleasure, interest, attention, active participation, and learning motivation. Before use, the instrument was tested for validity and reliability using Pearson Product Moment correlation and Cronbach's Alpha coefficient.

The data obtained were analyzed using descriptive statistics and inferential statistics. Descriptive analysis was used to determine the average value, percentage, standard deviation, minimum value, and maximum value. Next, analysis prerequisite tests were carried out, including normality tests, linearity tests, and multicollinearity tests. Hypothesis testing was carried out using multiple linear regression analysis, t-tests to determine the partial effect of each independent variable on student learning interest, F-tests to determine the simultaneous effect of both independent variables on student learning interest, and coefficient of determination (R^2) tests to determine the contribution of the independent variables to the dependent variable. Data processing was carried out using the SPSS version 25 statistical program with a significance level of 0.05.

Results and Discussion

Research result

A. Research Description

This study aims to determine the effect of the Problem Based Learning (PBL) Model and Quizizz learning media on the learning interests of fourth-grade students at GMIM IV Elementary School, Tomohon. Data on learning interests were obtained through questionnaires administered before (pretest) and after (posttest) the treatment.

Table 4.3 Results of the Protest and Posttest of Students' Learning Interest

Class	Pretes (Averag
Experiment (PBL + Quizizz)	
Control (Conventional)	

Table 4.4 descriptive statistical analysis

Class	N	Mean	Med
Experiment	15	85.3	

Control	15	70.2	70	Active Participation	5.1	62	78	13	18.2	5
				Motivation to learn		13	15.5			

Interpretation:

1. **Mean (Average)**: The experimental class showed a higher average score (85.3) than the control class (70.2), indicating an increase in interest in learning.
2. **Median: The middle value supports the average result, there are no extreme outliers that affect the distribution of the data.**
3. **Standard deviation**: The variability of the experimental class scores was lower (4.5), indicating better consistency than the control class (5.1).

Interpretation:

a. The greatest improvement in the experimental class was in the indicators of feelings of pleasure and active participation, indicating that PBL and Quizizz were effective in increasing student engagement.

b. The control class showed a smaller increase, so conventional methods were less able to encourage changes in learning interest.

B. Validity Test

a. PBL Questionnaire Validity Test

Table 4.6 Results of Instrument Validity X1 Problem Based Learning

No Item	R Table	R Count	C
1	3.61	0.398	
2	3.61	0.687	
3	3.61	0.406	
4	3.61	0.567	
5	3.61	0.544	
6	3.61	0.571	
7	3.61	0.594	
8	3.61	0.391	
9	3.61	0.474	
10	3.61	0.414	
11	3.61	0.432	
12	3.61	0.589	

Table 4.5 analysis of learning interest indicators

Indicator	Experiment Pretest	Experiment Posttest	Difference	Prete Contr
Happy Feeling	12.3	17.5	5.2	12
Interest	11.8	16.8	5	11
Attention	12.5	17.3	4.8	

Difference

1.9

1.3

1.5

13	3.61	0.451	Valid	question 19	0.324	3.61
14	3.61	0.429	Valid	question 20	0.412	3.61
15	3.61	0.544	Valid			
16	3.61	0.421	Valid			
17	3.61	0.498	Valid			
18	3.61	0.66	Valid			
19	3.61	0.451	Valid			
20	3.61	0.632	Valid			

Based on the validity test results table above, it can be concluded that there are 20 questions in the PBL variable. The 20 questions with valid information are because the calculated r value is greater than the r table value. All data that has been tested for validity will be used in the testing process in this study.

Table 4.7 Results of Instrument Validity X2 Media Quizizz

Questionnaire items	R Count	R Table	Conclusion
question 1	0.445	3.61	Valid
questions	0.443	3.61	Valid
question 3	0.371	3.61	Valid
question 4	0.448	3.61	Valid
question 5	0.567	3.61	Valid
question 6	0.443	3.61	Valid
question 7	0.671	3.61	Valid
question 8	0.459	3.61	Valid
question 9	0.612	3.61	Valid
question 10	0.537	3.61	Valid
question 11	0.735	3.61	Valid
question 12	0.671	3.61	Valid
question 13	0.770	3.61	Valid
question 14	0.494	3.61	Valid
question 15	0.645	3.61	Valid
question 16	0.485	3.61	Valid
question 17	0.366	3.61	Valid
question 18	0.432	3.61	Valid

Based on the test results table above, it can be concluded that the number of questions in the Quiziz media variable is 20. The 20 questions with valid information are because the calculated r value is greater than the r table value. All data that has been tested for validity will be used in the following testing process in this study.

Table 4.8 Results of the Validity Test of Y Learning Interest

Questionnaire items	R Table	R Count	Conclusion
1	3.61	0.398	Valid
2	3.61	0.687	Valid
3	3.61	0.406	Valid
4	3.61	0.567	Valid
5	3.61	0.544	Valid
6	3.61	0.571	Valid
7	3.61	0.594	Valid
8	3.61	0.391	Valid
9	3.61	0.474	Valid
10	3.61	0.414	Valid
11	3.61	0.432	Valid
12	3.61	0.589	Valid
13	3.61	0.451	Valid
14	3.61	0.429	Valid
15	3.61	0.544	Valid
16	3.61	0.421	Valid
17	3.61	0.498	Valid
18	3.61	0.66	Valid
19	3.61	0.451	Valid
20	3.61	0.632	Valid

Based on the validity test results table above, it can be concluded that the number of questions on the student learning interest variable is 20. The 20 questions with valid information are because the calculated r value is greater than the r table. All data that has been tested for validity will be used in the following testing process in this study.

C. Classical Assumption Test

1. **Normality Test**

The normality test is used to determine whether the data distribution is normal. The normality test is essentially performed by comparing the current data with normally distributed data with the same mean or total data with the same standard deviation. This study adopted the Shapiro-Wilk test. The results of the normality test are shown in the following table:

Table 4.9 Normality Test Results

Tests of Normality			
	Kolmogorov-Smirnova		
	Statistics	df	Sig.
PBL	.122	30	.200*
Media Quiziz	.120	30	.200*
Student learning interest	.120	30	.200*

Based on the table above, the sig. value of PBL is 0.122 and Quiziz media is 0.120 and student learning interest is 0.120, which means >0.05. Therefore, the data above is normally distributed.

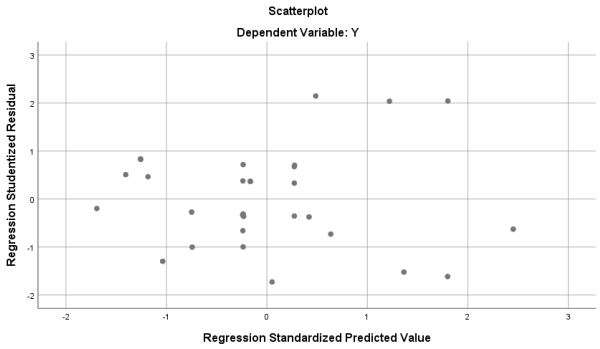
It is known that the significant value for all test variables is greater than 5% or 0.05 resulting from the research model, which indicates that the data from the regression model and the confounding or residual variables have been normally distributed.

Table 4.10 Multicollinearity Test

Coefficientsa			
Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	X1	0.834	1,199
	X2	0.834	1,199
a. Dependent Variable: Y			

Based on the data from the results of the Multicollinearity Test, the VIF results were less than 10 and the Collinearity Tolerance value was greater than 0.01 for all test variables, so it was stated that there was no multicollinearity in the data used by the researcher.

Figure 4.1 scatterplot



As shown by the scatterplot results, the data (points) are randomly distributed both above and below the number 0 on the Y-axis. Therefore, it can be concluded that there is no heteroscedasticity, so the regression model can be used. The heteroscedasticity test in this study also uses the Spearman test. The results of the Spearman test in this study can be seen in the following table:

value of both is greater than 0.05, there is no relationship between the independent variable and the residual. Thus, it can be concluded that the regression model does not experience symptoms of heteroscedasticity.

Table 4.11 Heteroscedasticity Test (sperm)

Correlations					
			X1	X2	Unstandardized Residual
Spearman's rho	X1	Correlation Coefficient	1,000	-0.326	0.070
		Sig. (2-tailed)		0.079	0.713
		N	30	30	30
	X2	Correlation Coefficient	-0.326	1,000	0.097
		Sig. (2-tailed)	0.079		0.611
		N	30	30	30
	Unstandardized Residual	Correlation Coefficient	0.070	0.097	1,000
		Sig. (2-tailed)	0.713	0.611	
		N	30	30	30

Based on the results of the heteroscedasticity test using the Spearman's rho method, a significance value was obtained between variable X1 with a residual of 0.713 and variable X2 with a residual of 0.611. Because the significance

1) **Multiple Linear Analysis Test**

This analysis is used to answer the research objective, namely to determine the magnitude of the influence of two or more independent variables on one dependent variable. The magnitude of the influence is indicated by the

regression coefficient with the following formula: Y = a + βX1 + βX2

Table 4.12
Multiple Linear Regression Analysis

Coefficientsa						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	91,605	2,393		38,288	0,000
	X1	-0.072	0.018	-0.640	-4,004	0,000
	X2	-0.054	0.016	-0.548	-3,429	0.002
a. Dependent Variable: Y1						

Information:

Dependent variable (Y1) = Student Learning Interest

X1 = PBL Model

X2 = Quizizz Media

1. The Effect of PBL on Interest in Learning (H1)

   The t-value for X1 = -4.004 with Sig. = .000 < 0.05.

   This shows that PBL has a significant influence on student learning interest. This means that implementing the PBL model can increase student participation, interest, and motivation because students are actively involved in solving real-world problems, discussing them, and finding solutions independently.

2. The Effect of Quizizz on Interest in Learning (H2)

   The t-value for X2 = -3.429 with Sig. = .002 < 0.05.

   This shows that the use of Quizizz significantly impacts student learning interest. This means that this interactive, game-based medium can increase student engagement through gamification, scoring, leaderboards, and immediate feedback, resulting in more motivated and focused learning.

3. The Effect of Simultaneous PBL and Quizizz on Learning Interest (H3)

   Both variables simultaneously had a significant influence on learning interest, as indicated by the significance of each variable <0.05. This means that the combination of the PBL model and Quizizz media was more effective in increasing learning interest than if they were applied separately.

   The implementation of PBL provides a meaningful learning experience, while Quizizz provides additional motivation through interaction and games, so that

students' interest in learning increases optimally.

4. Interpretation of Coefficients

Beta coefficients X1 (-0.640) and X2 (-0.548) show the magnitude of the contribution of each variable to Y1.

Negative coefficient values typically relate to the direction of the instrument's measurement (e.g., high scores = low interest). However, in practice, the better the implementation of PBL and the use of Quizizz, the greater the student's interest in learning.

3) t-test

Partial tests are used to determine the effect of each independent variable individually on the dependent variable. The results of the partial tests in this study can be seen in the following table:

Table 4.13

Partial Test (t)

Coefficientsa						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	91,605	2,393		38,288	0,000
	X1	-0.072	0.018	-0.640	-4,004	0,000
	X2	-0.054	0.016	-0.548	-3,429	0,002

a. Dependent Variable: Y1

From the table above, the following conclusions can be drawn:

1. The previous table shows that the significance test findings show a probability value of 0.000 < 0.05. This figure can indicate the validity of the hypothesis being accepted, meaning that the variable is accepted, meaning that the Problem Based Learning model variable significantly influences student learning interest.
2. As can be seen from the previous table, the significance test findings show a probability value of 0.000 < 0.05. This value can prove that the hypothesis is accepted, meaning that the Quiz learning media significantly influences students' learning interest.

2) **Simultaneous Test (F)**

The simultaneous F test is used to determine whether or not there is a simultaneous or joint influence

between the independent variables on the dependent variable. The results of the simultaneous test in this study can be seen in the following table:

Table 4.14

Simultaneous Test (F)

ANOVA						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	1,763	2	0.882	9,952	.001b
	Residual	2,392	27	0.089		
	Total	4,155	29			
a. Dependent Variable: Interest in Learning						
b. Predictors: (Constant), Quiz, PBL						

Referring to the table above, the significance test findings show a probability value of 0.001 < 0.05. This value proves that the hypothesis is accepted, meaning that the PBL and Quiziz variables simultaneously influence student learning interest. Based on the significance test analysis, the following criteria are found:

Ha is accepted if significance < 0.05

Ho is rejected if the significance level > 0.05

Furthermore, based on the table above, the calculated F figure resulting from the ANOVA test is9.952 with a significance level of 0.001. Since the probability value Sig. = 0.001 < a = 0.005, Ho is rejected and Ha is accepted. This means that there is a significant influence between the PBL learning model (X1) and Quiziz Learning Media (X2) on students' learning interest (Y).

3) Simple and Multiple Regression Analysis

Table 4.15 PBL Model (X1) on Learning Interest (Y)

Model Summary				
Model	R	R Square	Adjusted R Square	Sta Er Est

1	.998a	0.997	0.997	0.169
a. Predictors: (Constant), PBL				

From the table above, it can be seen that the R Square value is 0.997, which means that the ability of the PBL variable influences the student's learning interest variable by 97.7%, which means that the dependent variable can be explained by the variability of the independent variable.

Table 4.16 Quizizz Media (X2) on Student Learning Interest (Y)

Model Summary				
Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	.999a	0.999	0.999	0.098
a. Predictors: (Constant), X2				
b. Dependent Variable: Y1				

From the table above, it can also be seen that the R Square value is 0.999, which means that the ability of the quiziz media variable influences the learning interest variable, which means the variability of the dependent variable.

B. Discussion

Based on the results of the research data analysis, several things can be concluded regarding the effectiveness of the application of the Problem-Based Learning (PBL) model combined with Quizizz media on the learning interests of fourth-grade students at GMIM IV Elementary School, Tomohon.

1. Effectiveness of PBL Model
   - The implementation of PBL encourages students to actively seek solutions to real problems, discuss with peers, and think critically in understanding science concepts. This increases learning independence, higher-order thinking skills, and active student involvement during the learning process.
   - The results of the study showed that the post-test score in the experimental group increased by ±14.2 points compared to the pre-test, which

confirms that PBL is proven to be effective in improving learning outcomes.

2. The Role of Quizizz Media
    - Quizizz media provides instant feedback, leaderboards, and gamification elements that make students more motivated, focused, and enthusiastic in participating in learning.
    - According to ARCS theory (Keller, 2010), Quizizz increases Attention, Relevance, Confidence, and Satisfaction, so that students are more motivated to actively learn and complete assignments.
    - The results of the higher post-test improvement in the experimental group compared to the control (±11 points) show the real contribution of interactive media in supporting PBL.
3. Comparison with Control Group
    - The control group that only received conventional learning also showed an increase in post-test scores (±11 points), but the increase was lower than the experiment.
    - This confirms that problem-based learning with interactive media is more effective than conventional methods in increasing student interest and learning outcomes.
4. Regression Analysis
    - Regression analysis shows that the combination of variables X1 and X2 explains 38.2% of the variation in learning interest (Adjusted R^2 = 0.382).
    - These results confirm that the PBL model and Quizizz media simultaneously influence learning interest, although there are other factors that also influence it.
    - Simple regression models for each variable showed significant effects, especially when used together in learning.
5. Educational Implications

- Teachers can apply PBL combined with digital media to increase student interest in learning and engagement.
- The use of interactive media such as Quizizz makes learning more interesting, fun, and challenging, so that students are more motivated to actively learn.
- Schools can utilize technology to support the achievement of curriculum objectives and improve the quality of learning.

Conclusion

Based on the results of research on the influence of the use of the Problem-Based Learning (PBL) model combined with Quizizz media on the learning interests of fourth-grade students at GMIM IV Elementary School, Tomohon, several conclusions can be drawn as follows:

a. The PBL learning model is effective in increasing students' interest in learning because it encourages active involvement, critical thinking, and collaboration.
b. Quizizz media increases student motivation and attention through gamification mechanisms and instant feedback.
c. The combination of PBL and Quizizz simultaneously provides an optimal impact on students' learning interest, so that learning becomes more interesting, interactive, and meaningful.

BIBLIOGRAPHY

Arends, RI (2012). Learning to teach (9th ed.). McGraw-Hill.

Barrows, H. S., & Tamblyn, R. M. (1980). Problem-based learning: An approach *to medical education*. Springer.

Bell, S. (2010). Project-based learning for the 21st century: Skills for the future.. The Clearing House, 83(2), 39–43.

Hmelo-Silver, C.E. (2004). Problem-based learning: What and how students do *learn*? Educational Psychology Review, 16(3), 235–266.

Hwang, G. J., Wu, P. H., & Chen, C. C. (2012). An online gaming approach for *improving students' learning performance in web-based problem-solvingn activities.*Computers & Education, 59(4), 1246–1256.

Hamzah, R., & Setiawan, D. (2020). The effectiveness of problem-based learning

*which combines digital media with students' learning interests.*Journal Indonesian Science Education, 9(3), 375–382.

Hmelo-Silver, C.E. (2004). Problem-based learning: What and how students do *learn?*Educational Psychology Review, 16 (3), 235–266.

Keller, J. M. (2010). Motivational design for learning and performance: The ARCS *model approach*. Springer.

Kusuma, AR (2022). The influence of integrating problem-based learning and media interactive learning on elementary school students' learning interests. Journal of Education *Basic, 13*(2), 145–154.

Keller, J. M. (2010). Motivational design for learning and performance: The ARCS *model approach*. Springer

Krajcik, J., & Blumenfeld, P. (2006). Project-based learning. In R. K. Sawyer (Ed.), Cambridge handbook of the learning sciences (pp. 317–334). Cambridge University Press

Katuuk, DA et al. 2021 Learning Model

Ndraha, L., Mendrofa, HK, & Lase, F. (2022). Elementary school students' learning interests

in thematic learning. Scientific Journal of Education, 8(1), 55–63.

Nurhasanah, S., & Sobandi, A. (2016). Interest in learning as a determinant of learning outcomes

Student learning. Journal of Office Management Education, 1(1), 128–135.

Pratiwi, N., & Nugroho, A. (2019). Using Quizizz media to improve *Motivation and Science Learning Outcomes in Elementary School*. Journal of Educational Technology, 21(2),45–52.

Purba, ON, Siregar, R., & Situmorang, D. (2022). Utilization of the Quizizz application

as a digital learning medium. Journal of Educational Technology, 14(1),15–22.

Rahmawati, D. (2021). The effect of using Quizizz on motivation and learning outcomes.

elementary school students' learning. Indonesian Journal of Science Education, 10(3), 385–392.

Rorimpandey, W., & Sumampow, ZF (2023). The Influence of Parental Roles and Learning Interest on the Learning Outcomes of Grade VI Students of SD Negeri 1 Airmadidi. Jurnal Elementaria Edukasia, 6(2), 314-327.

Salsabila, UH, Habiba, IS, Amanah, IL, & Istiqomah, NA (2020).

Utilization of the Quizizz application as a learning medium in the middle of

pandemic. Scientific Journal of Education, 5(2), 163–171.

Santika, Y. (2023). Using Quizizz to Increase Learning Motivation

elementary school students. Journal of Elementary School Teacher Education, 7(1), 45–52.

Sardiman, AM (2018). Interaction and motivation in teaching and learning. Rajawali Pers.

Sinaga, R., & Yunilisa. (2024). Elementary school students' learning interests and their implications

on learning outcomes. Indonesian Journal of Elementary Education, 9(1), 1–10.

Sugiyono. (2020). Quantitative, qualitative, and R&D research methods. Alfabeta.

Sumilat, M., & Tuerah, RMS (2023). Elementary school students' learning interest in

technology-based learning. Journal of Elementary Education, 14(2), 98–107.

Surjono, HD (2013). Implementation of problem-based learning models

(Problem-Based Learning) to improve critical thinking skills student. Journal of Education, 18(1), 21–30.

Savery, J.R. (2006). Overview of problem-based learning: Definitions and *distinctions.*Interdisciplinary Journal of Problem-Based Learning, 1(1), 9–20. https://doi.org/10.7771/1541-5015.1002

Trianto. (2015). Integrated learning model: Concepts, strategies, and *its implementation in KTSP*. Earth of Letters. Tarusu, DT (2018).

Elementary school mathematics pedagogical abilities in college students *Elementary School Teacher Training Faculty of IP UNIMA*. Mosharafa: Journal of Mathematics Education, 7(2), 263–272.

Thomas, J. W. (2000). A review of research on project-based learning. The Autodesk Foundation.

Uno, HB (2019). Motivation theory and its measurement: An analysis in the field of *education*. Earth of Letters.

Lapian, SLHVJ, Sondakh, DSI, Lapian, ALCP, & Yapanto, LM (2022). The Effect of Marketing Mix for Logistics Services on User Decisions in Manado (Case Study of PT. Pos Indonesia Logistics).(2020).

The impact of knowledge management on the performance of employees: The case of small medium enterprises. Productivity Management, 25(1), 554–567.

Li, X., Hu, Q., Wang, B., Yapanto, L.M., & Zekiy, A.O. (2021). Application of artificial neural networks and fuzzy logics to estimate porosity for Asmari formation. Energy Reports, 7, 3090-3098.