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Prediction of Elementary School Student Performance and Writing Interest Competency Based on Learning Engagement: Analysis with Binary Logistic Regression

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Abstract: This study aimed to predict the influence of age, grade level, and gender on learning engagement, writing interest competencies, and academic achievement of elementary school students. This study used a non-experimental quantitative approach with data collection techniques through structured observation and questionnaires, involving 240 elementary school students in the Cirebon City area. Data analysis was carried out using binary and multinomial logistic regression as well as Partial Least Squares Structural Equation Modeling (PLS-SEM) modeling through SmartPLS and SPSS software. The results showed that grade level was a significant predictor of writing interest competency and learning engagement while age and gender did not show a significant influence. In addition, learning engagement has a very strong positive impact on writing interest, and writing interest competency significantly affects academic achievement indicating the mediating role of writing interest in the relationship between engagement and learning outcomes. These findings confirm the importance of learning approaches that are able to increase students' active engagement to support the development of writing skills and academic achievement. This study contributes to educational practice by providing an empirical basis for the development of more contextual and interest-based learning strategies at the primary school level.

Keywords: Academic Performance, Binary Regression, Competency of Writing Interest, Learning Engagement, Multinomial Regression.

INTRODUCTION

Education plays an important role in human life, so every Indonesian citizen has the right to education and is expected to continue to develop through the process (Alpian et al., 2019). According to Law Number 20 of 2003 concerning the National Education System, education is seen as a conscious and planned effort to create an atmosphere and learning process that encourages students to actively develop their potential, both in aspects of religious spirituality, self-control, personality, noble morals, and skills needed in the life of society, nation, and state (Fajri, 2021). Educational success is measured through the evaluation of student learning outcomes both regularly and comprehensively (Margiati & Puspaningtyas, 2021).

Educational success can also be achieved in teaching and learning activities, especially in elementary school students by providing opportunities to learn according to their needs, one of which is in the competency of writing interest (Hikaya et al., 2025). The competence of writing interest is based on the goals to be achieved, namely having potential and self-abilities to be explored, students who like or enjoy writing, and practicing skills in developing various ideas or ideas (Rinawati et al., 2020). To achieve this goal, this writing activity strategy must be well designed and the right approach, because some elementary school students still find it difficult to convey ideas through writing (Rinawati et al., 2020). In this learning, it is hoped that we can see how much students are involved in writing who can equip writing skills by understanding the rules. That way the results will show the academic performance of students (Kholifah et al., 2024).

In addition, students' interest in writing is not only influenced by their technical ability in writing, but also by factors such as assessment literacy, academic self-effectiveness, and intrinsic motivation (Cao et al., 2025). When students have a good understanding of how their writing is graded, they tend to feel more confident and motivated to write better. A supportive learning environment and constructive feedback also play an important role in shaping an interest in writing (Woreta, 2024). Furthermore, students' perceptions of the educational environment also affect their engagement in learning, which in turn impacts academic performance. This suggests that systemic approaches involving classroom atmosphere, teacher teaching styles, and social interactions between students can strengthen or weaken the three main variables in this model.

This research was conducted in one of the schools in the Cirebon City area, by examining the academic performance of students in the competence of writing interest reviewed based on student involvement. The results of observations showed that most students showed high learning involvement in writing skills. However, the ability to write interest in each class has a difference in academic performance. Therefore, this research is designed so that researchers can find out whether age, class, and gender can affect students' ability to write interest.

The results of another study revealed that increased academic stress and decreased academic achievement of elementary school students indicate the importance of a more in-depth study of the factors that affect academic success (Saputra et al., 2025). The results of another study showed that students in the control class had a score below kkm, meaning that learning with the conventional model was not able to improve writing skills optimally, but in experimental classes that applied the project-based learning model they got a score above kkm, so that the project-based learning model had a positive influence on improving the writing skills of grade IV students (Mukhsinah et al., 2023). Another study states that one of the main challenges in online learning is low student learning engagement (Gusrina et al., 2021).

This study aims to determine the prediction of students' academic achievement, competence, writing interest, and student involvement can be seen based on predictor variables (age, class, and gender).

H.1 Age can have a direct effect on the competence of writing interests, academic achievement

H.2 Classes can have an impact on the competence of writing interests, students' academic performance and learning engagement.

H.3 Gender can have a direct effect on the competence of writing interests, students' academic performance and learning engagement.

METHODS

This study uses a non-experimental approach (ex post facto) with a quantitative method. Quantitative methods are research procedures that are carried out in a systematic, planned, and structured manner to solve problems through the collection and analysis of numerical data (Aprilia et al., 2025). This approach was chosen to predict students' reading interest competencies based on learning engagement and academic performance.

The research sample consisted of 240 elementary school students in the Cirebon City area, with a composition of 52% males (n=128) and 48% females (n=112). The data collection techniques used include structured observation and questionnaires. Structured observation aims to obtain numerical data that can be analyzed statistically, while questionnaires are used to collect quantitative data through structured statements (Ardiansyah et al., 2023). Observations in this study were carried out by visiting the school directly, while the questionnaire filling strategy was carried out by all students in the class with a predetermined filling time and the questionnaire contained statements related to the needs of the students (Saputri & Fransisca, 2020).

The data analysis in this study uses the logistic regression method, which is a statistical technique that is commonly used to estimate parameters objectively and minimize bias so as to be able to build a representative model of the population even though the sample data contains uncertainties (Nurmalitasari & Purwanto, 2022). Logistic regression is divided into two main types: binary logistic regression, which is used when a dependent variable is dichotomous (e.g., Yes or No), and multinomial logistic regression, which is used when the response variable has more than two categories. Multinomial *Logistic regression,* used when the response variable (Y) has more than two categories or options (Sofiyat & Tjalla, 2023).

Meanwhile, the variables of learning engagement were measured using the Likert scale with four assessment categories, namely 4 (strongly agree), 3 (agree), 2 (disagree), and 1 (strongly disagree). The Likert scale is commonly used in educational research to quantitatively measure students' attitudes, perceptions, and engagement levels with a high level of reliability (Puspita sari et al., 2022). By using these structured and valid instruments, this study can obtain a comprehensive picture of the factors that affect students' academic performance in The development of instruments based on specific indicators allows for a more accurate and valid assessment of students' competencies of reading interest and academic performance (Almenara et al., 2021).

Table 1. Variable Description

Variabel	Kind	Measurement scale	Category
Writing Interest Competency	Quantitative	Nominal	0: No 1: Yes
Student Academic Achievement	Quantitative	Nominal	0: No 1: Yes
Learning Engagement	Quantitative	Nominal	Positive 4: Strongly agree 3: Agree 2: Disagree 1: Strongly disagree Negative 1: Strongly agree 2: Agree 3: Disagree 4: Strongly Disagree

Class	Quantitative	Nominal	IV, V, VI
Gender	Quantitative	Nominal	0: Male -male 1: Female
Age	Quantitative	Nominal	10, 11, 12 Years

Significant variable predictions affect the competency of writing interest, academic performance, and learning engagement.

This study involved as many as 240 upper-level elementary school students in the Cirebon area. Respondents consisted of different backgrounds of age, gender, and varying levels of learning involvement. The purpose of this description is to provide an overview of the characteristics of the respondents before further analysis of the relationship between the research variables. This data is the basis for developing statistical models and determining the significant influence between predictor variables and outcome variables. This analysis is expected to help identify important factors that can improve students' writing interest competencies, as well as provide insight for educators in designing more effective learning strategies that suit students' needs. In this study, two statistical software, namely SmartPLS and SPSS, were used, each of which has a specific and complementary role (Kusumah, 2023).

Before being used in the main analysis, all instruments were first tested for validity using data management by utilizing the SmartPLS application or Smart Partial Least Square, which is a statistical software that has the same purpose as testing the relationship between variables, both with latent variables and with indicator variables. The results that have been obtained, the three variables in this model, namely V1 (Writing Interest), V2 (Student Academic Performance), and V3 (Academic Learning Engagement) have shown that the convergent validity requirements are adequately met. SmartPLS is used to test measurement models and structural models with the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach. This approach is suitable when the research model involves latent constructs, has many indicators, and aims to predict and explore relationships between variables. SmartPLS is especially useful in abnormal data conditions and relatively small samples (Subhaktiyasa, 2024) .

Meanwhile, SPSS is used for preliminary analysis such as descriptive statistics, reliability tests, and logistic regression on manifest or observable variables. The use of SPSS helps to provide a basic understanding of the characteristics of respondents' data before entering the advanced structural analysis stage in The combination of these two tools provides a dual power in data analysis: SPSS strengthens a basic understanding of data patterns and characteristics, while SmartPLS allows researchers to test more complex conceptual models and identify causal relationships between latent constructs (Nallaluthan et al., 2024).

Analysis of Convergent Reliability and Validity of Instruments of Student Interest, Performance, and Academic Engagement

Analysis of the reliability and validity of structural model testing, an important initial stage in the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach is to evaluate the measurement model. This evaluation is carried out to ensure that the indicators used have adequate capabilities in representing the latent constructs being measured. In this study, the evaluation of the measurement model was carried out through SmartPLS software, focusing on convergent validity testing (Hair et al., 2021).

Convergent validity was evaluated based on three main criteria, namely outer loading, Composite Reliability (CR), and Average Variance Extracted (AVE). The indicator is said to meet the convergence validity if it has an outer loading value of ≥ 0.50. However, values

between 0.40 to 0.70 can still be considered for use if the CR and AVE values of the construct remain within the accepted limits (Hair et al., 2021). On the other hand, indicators with an outer loading value below 0.40 should be eliminated because they show a very weak contribution to the constructed being measured (Nallaluthan et al., 2024). In the results of the analysis shown in the following table, a number of indicators were found that had an outer loading value below 0.5. These findings are the basis for assessing the strength of each indicator and determining whether it is worth maintaining or should be removed from the model.

Table 2. Validity and Reliability Test Result

Variabel	Dimension	Item	Outer-loading	CR	AVE	R^2	Decision
Writing Interest Competency	Uses of EYD	P1	0,390	0,681	0,357	0,764	Invalid
		P2	0,636				Valid
		P3	0,668				Valid
		P4	0,630				Valid
	Diction Accuracy (Word Selection)	P5	0,348	0,628	0,506	0,752	Invalid
		P6	0,949				Valid
	Content and topic alignment	P7	0,434	0,663	0,526	0,316	Invalid
		P8	0,930				Valid
	Sentence Effectiveness	P9	0,731	0,744	0,592	0,590	Valid
		P10	0,806				Invalid
Student Academic Performance	Fluency (kelancaran)	P11	0,411	0,719	0,339	0,729	Invalid
		P12	0,709				Valid
		P13	0,630				Valid
		P14	0,727				Valid
	Flexibility (flexibility)	P15	0,418	0,677	0,355	0,514	Invalid
		P16	0,775				Valid
		P17	0,541				Valid
		P18	0,594				Valid
	Originality (keaslian)	P19	0,469	0,579	0,303	0,421	Invalid
		P20	0,553				Valid
		P21	0,115				Valid
		P22	0,820				Valid
Learning Engagement	Sense of Related	P23	0,901	0,667	0,391	0,881	Valid
		P24	0,874				Valid
		P25	0,066				Invalid
		P26	0,016				Invalid
	Sense of Autonomy	P27	0,785	0,696	0,483	0,697	Valid
		P28	0,889				Valid
		P29	0,210				Invalid
	Sense of Competence	P30	0,790	0,641	0,468	0,715	Valid
		P31	0,014				Invalid
		P32	0,884				Valid

Based on the results of the instrument analysis, it was found that some indicators had an outer loading value below 0.4 which indicates the low validity of the indicator in explaining the construct. Therefore, these indicators need to be eliminated or revised. Meanwhile, the majority of other indicators show an outer loading value of > 0.5 and a Composite Reliability

(CR) value above 0.7, which indicates that the construct has good internal consistency (Hair et al., 2021). However, there are some dimensions with an Average Variance Extracted (AVE) value below 0.5, which means that the convergent validity is still not optimal and needs to be strengthened.

Overall, this instrument is considered quite feasible for follow-up research with the note that invalid indicators must be corrected. Dimensions such as Sense of Relatedness show significant contributions to constructs, while Originality and Sense of Competence dimensions still need development. This improvement is in line with the latest recommendations in the implementation of Partial Least Squares Structural Equation Modeling (PLS-SEM), which emphasizes the importance of indicator validity and construct reliability to obtain strong and valid analysis results.

RESULTS AND DISCUSSION

Based on the results of this study, SPSS is also used to conduct binary and multinominal logistic regression analysis to see the relationship between independent and dependent variables that are categorical (Scott et al., 2013). This method allows the identification of predictive factors that affect the likelihood of an event occurring. The use of SPSS in this study provides analytical flexibility and supports robust and objective data-driven decision-making.

To find out the extent of students' writing abilities and their perception of the psychological aspects that affect the writing process, measurements are carried out using several instruments. The average results of each statement are presented in the following table.

Table 3. Result of Average Students on Each Instrument

Statement	*Size M ±SD*
Use of EYD (Enhanced Spelling)	
I often forget to capitalize at the beginning of a sentence.	0,00 ± 2,50
I write words according to the spelling rules and don't make spelling mistakes.	1.00 ± 3.88
I often misspell words because I don't pay attention to the spelling.	1.00 ± 4.98
Effective Sentences	
I write sentences clearly and not long-winded so that they are easy for readers to understand.	1.00 ± 3.49
I often write sentences that are too long and difficult to understand.	1.00 ± 4.55
Fluency Aspect	
I often run out of ideas while working on assignments.	0.00 ± 4.93
I can explain ideas smoothly and structured.	1.00 ± 4.98
I had a hard time communicating ideas clearly.	1.00 ± 5.01
Flexibility Aspect	
I find it difficult to accept new ideas that are different from my habits.	1.00 ± 4.95
I like to try different approaches to solving problems.	1.00 ± 4.16
I only use one method when facing problems.	1.00 ± 4.77
Aspects of Originality	
I often copy other people's ideas more often than I make my own.	1.00 ± 3.81
I rarely have a truly original idea.	1.00 ± 4.91
A Sense of Connection	
I love being at school with friends.	4.00 ± 1,154
I feel comfortable talking to the teacher if there are any difficulties.	3.00 ± 9.98

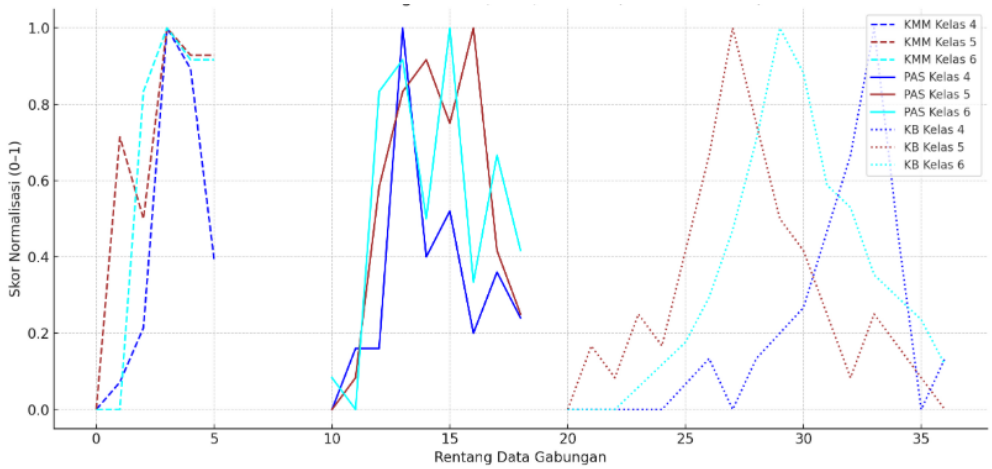
***Sense of Autonomy* (Sense of Autonomy)**	
I have the freedom to set my own study time.	3.00 ± 1.017
I feel more motivated when I can set my own learning strategies.	3.00 ± 9.93
Sense of Competence	
I feel that I can complete my academic assignments well.	3.00 ± 9.28
I stayed motivated despite the difficulties in studying.	3.00 ± 1,063

Based on the results in Table 3, it is known that technical aspects of writing such as the use of Enhanced Spelling (EYD), effective sentences, and fluency have a low average score, ranging from 0.00 to 1.00. This shows that students' ability to apply Indonesian rules in writing is still not optimal. Writing skills not only require mastery of grammar, but also the ability to string together words that are arranged to form a paragraph (Idammatussilmi & Latifah, 2021). Meanwhile, the originality aspect showed the highest score (4.00), which indicates that students have the potential to think creatively in developing their writing ideas. In addition, psychological aspects such as sense of autonomy, competence, and relatedness showed a fairly good average score (3.00–4.00). This is in line with the Self-Determination theory of (Deci & Ryan, 2000), which states that these three psychological needs are the basis for generating strong internal motivation in the learning process.

In conclusion, even if students show a positive level of creativity and psychological state, they still need intensive guidance in the technical aspects of writing to achieve complete and effective writing skills. The potential for originality and internal motivation possessed by students is an important capital in the process of developing writing skills. Therefore, a learning approach is needed that not only emphasizes linguistic aspects, but is also able to maintain and direct student motivation optimally.

The following graph is presented to illustrate the distribution of the number of students from each class (grades 4, 5, and 6) based on each of the variables studied, namely writing competence, writing interest, student academic achievement, and involvement in the learning process. This visualization aims to show the tendency of differences and similarities in achievement between classes towards the four variables in a more concrete way.

Figure 1. Result of Combined graph of KMM, PAS, and KB (Normalized)



The results of the graph show a gradual increase from grade 4 to grade 6 in aspects of writing interest, academic achievement, and thinking ability. Grade 6 students show more stable and higher performance, which reflects improved cognitive development and learning experience. Meanwhile, grade 4 showed inconsistent variation, indicating the need for a

more adaptive approach to learning. Overall, this trend confirms that environmental support and effective social interaction play an important role in the development of students' learning abilities. These findings reinforce the view that constructive and contextual learning strategies are essential in supporting the development of students' competencies in various aspects.

Table 4. Result of Influence of Predictors on The Model

Model Installation Information				
Variabel	**Model**	**Likehood Ratio Tests**		
		Chi-Square	**Df**	**Itself.**
Writing Interest Competency	Model Dasar (Intercept only)			
	Final Model	31.764	20	.046
Learning Engagement	Model Dasar (Intercept only)			
	Final Model	174.912	68	<.001

These results show that the addition of the variables Age, Class, and Gender makes the model significantly better at predicting the competency categories of writing interest and learning engagement. The final model proved to be superior to the basic model that used only interceptions, suggesting that the existence of these predictive variables did indeed make an important contribution to the model's ability to make predictions. Overall, these three variables collectively influenced both aspects studied, and this confirms that student demographic factors have a relevant role in understanding the variation in the competency of writing interests and learning engagement of elementary school students.

Table 5. Result of Significant Tests on Predictors

Likelihood ratio Test				
Writing Interest Competency				
Effect	**-2 Log of the possibilities of reduced models**	**Chi-Square**	**Df**	**Alone.**
Intercept	205.760a	0	0	.
age	208.391	2.632	5	0.757
JK	210.198	4.438	5	0.488
Class	227.545	21.786	10	0.016
Learning Engagement				
Effect	**-2 Log of the possibilities of reduced models**	**Chi-Square**	**Df**	**Alone.**
Intercept	363.324a	0	0	.
age	376.19	12.863	17	0.745
Class	508.64	145.31	34	<.001
JK	381.22	17.9	17	0.395

Based on the results of the analysis using chi-square statistics and the Likelihood Ratio test, it is known that the final model has better predictive capabilities than the basic model that does not include predictive variables. This shows that the addition of predictor variables does indeed contribute to improving the quality of the model. In particular, only the Class

variable was shown to have a significant influence on predicting the competency of students' writing interest and learning engagement. Meanwhile, the Age and Gender variables did not show a statistically significant influence on these two aspects. These findings suggest that students' grade levels have a more dominant role in distinguishing their writing skills and interests, as well as their level of involvement in the learning process, compared to age or gender factors. In other words, the higher the grade level, the more pronounced there are likely to be differences in student learning competence and engagement.

Table 6. Result of Parameter Estimates

KBa	B	Itself.	Exp(B)	95% Confidence Interval for Exp(B)	
				Lower Bound	Upper Bound
Intercept	-22.448	.051			
age	1.824	.056	6.195	.954	40.247
[Class=4]	4.719	.045	112.059	1.103	11381.762
[Class=5]	2.036	.257	7.658	.227	258.785
[Class=6]	0c	.	.	.	.
[JK = 0]	-.144	.888	.866	.117	6.436
[JK=1]	0c	.	.	.	.

Based on the results of the Parameter Estimates analysis, it is known that grade 4 students have a much higher chance of being in certain categories of learning engagement compared to students in other categories. This suggests that grade levels play an important role in differentiating student engagement levels. On the other hand, the age variable showed a tendency to have an effect on the category of learning engagement, but was not statistically strong enough to be statistically significant. In addition, the discovery of very high odds ratios in some estimates suggests potential instability in the model, which may be caused by an imbalance in the amount of data in each category of engagement or overfitting risk.

Table 7. Result of Students' Academic Performance (Fluency Aspect)

Variabel	Coeficien (B)
Konstan	-0.975
Students (1) – Grade 5	1.319
Students (2) – Grade 6	0.306
Model Coefficient Omnibus Test	
Test Statistics	**Value**
Chi-square	19.748
Df (Independent degree)	2
Itself.	< 0.001

The results showed that adding a student's class variable significantly improved the model's ability to predict the statement "I often run out of ideas while working on an assignment". The results of the study show that 5th grade students have the strongest influence on this statement. This means that they tend to have a much greater chance of having trouble with ideas than 4th graders. Meanwhile, 6th graders also showed increased chances compared to 4th graders, although the effect was not as large as 5th graders. Overall, this model is statistically significant.

Table 8. Result of Students' academic performance (Flexibility Aspect)

Variabel	Category	Significance (p-value)
Model	Statement "I have trouble accepting new ideas that are different from my habits"	0.025
Students (Class)	Grade 5	0.005
JK	Male / Female	> 0.05
Age	10-12 years	> 0.05

Based on the results of the logistic regression analysis of the statement *"I find it difficult to accept new ideas that are different from my habits"*, it was found that the model was statistically significant. This shows that there are certain variables that affect the tendency of students to have difficulty accepting new ideas. The most significant variable is the student's score, especially grade 5, because the significance score is below 0.005 (Rizkia Nurul Wafa & Ibnu Muthi, 2024). This means that 5th graders have a higher tendency to have difficulty accepting new ideas than students from other classes. These findings suggest that grade level can affect students' openness to new ideas. Meanwhile, the gender and age variables did not show a significant influence, so it cannot be concluded that the two variables affect the ability of students to accept new ideas. Most likely, 5th graders are in a stage of cognitive and emotional development where they are more comfortable with the mindset and habits they have been familiar with before, thus tending to show resistance to new ideas that are different from their habits.

DISCUSSION

The findings of this study show that classes play a significant role in influencing the competence of writing interests, students' academic performance, and learning engagement. This supports the hypothesis that contextual factors such as grade level can be important predictors of elementary school students' learning outcomes. In the binary logistic regression analysis used, classes were shown to have statistical significance, while other variables such as age and gender did not show any significant influence. These results are in line with Piaget's theory of cognitive development, which states that children in the concrete operational stage (elementary school age) experience thinking development that is strongly influenced by their learning environment, including the structure of the classroom (Nainggolan & Daeli, 2021). In addition, Bronfenbrenner's ecological theory also emphasizes that microcontexts such as classrooms have a direct influence on children's behavior and development (Dharma, 2023).

Higher grades tend to provide access to more complex learning strategies, higher academic expectations, as well as exposure to more challenging writing tasks. This explains why classes are a significant variable in the model. On the other hand, age and gender may not be significant because age development at the elementary level is quite homogeneous (average age 9–12 years), and gender differences at this stage have not led to extreme variations in interests or academic performance, as also shown by (Putra et al., 2024) In his research, there was no significant difference based on gender.

However, there are some methodological limitations in this study. First, the design used is *cross-sectional*, so it is not possible to trace changes or developments in learning engagement and writing interest longitudinally. Second, data was collected through questionnaires with a self-report format, which were prone to social bias and dishonest

answers from students. Third, the sample used was limited to one or more elementary schools, which reduced the rate of generalization of results to a wider population.

In terms of theoretical implications, these results support the importance of viewing the classroom as a pedagogical unit that requires different attention in curriculum development. While implicitly practical, teachers and curriculum developers need to design instructional strategies that are tailored to the grade level, specifically to increase the learning engagement and writing interest of grade V students. For example, the integration of interactive media such as Wordwall has been shown to increase the motivation of grade V students (Amrillah & Sundi, 2024), which can be used as a means to develop writing competence through fun and collaborative activities. With this approach, the next research is expected to expand the understanding of how the classroom context is not only a statistical variable, but also includes teacher variables, teaching methods, and family support as a mediator between the classroom and academic performance and student involvement.

CONCLUSION

Based on the results of logistic regression analysis conducted on data of 240 elementary school students in grades 4 to 6, it was found that class variables were the only predictors that consistently had a significant effect on *Writing Interest Competency* (KMM), *Learning Engagement*, and aspects of students' academic performance. Meanwhile, the age and sex variables did not show a significant influence on all the models tested, so they could not be used as a strong indicator in predicting these dependent variables. This shows that student involvement and interest in writing can be an important link that determines academic success.

With this research, it can motivate educators to be able to use contextual and interesting methods, especially for high-level classes. In this case, educators play a strategic role in developing students' interest in writing and learning engagement. Approaches such as *project-based learning* or interest-based learning can be an effective alternative to increase the relevance of the material to students' experiences, thereby encouraging their active participation and enthusiasm in writing activities. So that for further research, the involvement of educators in the teaching and learning process can be carried out in developing students interest in writing to support academic performance.

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