



The Synergy of Numerical Intelligence and Learning Interest in Determining the Mathematics Achievement of Students at SD Negeri 1 Passo

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ABSTRACT

The background of this study is the low learning outcomes of students influenced by internal factors such as numerical intelligence and learning interest. The purpose of this study is to examine the influence of numerical intelligence and learning interest on student learning outcomes. This research method employs a quantitative approach, utilizing correlation analysis to examine the relationship between variables. The sample size of this study consisted of 23 students. Data were collected using various instruments, including questionnaires, tests, observations, and surveys. The significance value of numerical intelligence and learning interest on learning outcomes is usually linearly distributed. The results of the analysis indicate that numerical intelligence and learning interest determine students' mathematics learning outcomes. The implication is that it is necessary to differentiate learning to improve students' numerical intelligence, and the learning process must use a concrete and visual approach.

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1. INTRODUCTION

Education is a conscious and continuous learning process that creates an environment enabling students to develop and realize their potential (Kemendikbud, 2020). The primary goal of education is to equip students with spiritual and religious strength, self-control, noble character, intelligence, morality, and the competencies needed in personal, social, and national life (Permendikbud, 2022). As such, education plays a vital role in a nation's progress by serving as a means to enhance human resources, which is increasingly significant in the era of global competition (NCTM, 2014).

According to Law No. 20 of 2003, education is a consciously designed effort to create a learning atmosphere where students actively develop their potential in spiritual, social, and intellectual domains. Despite this well-articulated vision, the quality of education in Indonesia, especially in mathematics, remains a concern (OECD, 2019, 2023). Mathematics is a foundational discipline taught from elementary school through higher education, as it fosters logical, analytical, and critical thinking (Stacey, 2006). Unfortunately, student achievement in mathematics consistently underperforms at various educational levels, highlighting the need for continuous improvement (OECD, 2023).

Ironically, mathematics is often perceived as a problematic and uninteresting subject by many students, leading to fear and avoidance behavior (Mariamah et al., 2021). This negative perception is driven by challenges in understanding mathematical concepts, which ultimately hinders students from achieving optimal learning outcomes (Saputri et al., 2024). If learning barriers such as these are not adequately addressed, students' reasoning abilities and overall achievement in mathematics will remain suboptimal.

One of the promising approaches to overcoming students' difficulties in learning mathematics is by enhancing both numeracy intelligence and interest in learning (Achdiyat & Utomo, 2017). Numerical intelligence specifically relates to a student's ability to understand and process numbers, recognize relationships, and solve mathematical problems (Anwar, 2023). According to Noemy et al., (2017), numerical intelligence facilitates the development of effective reasoning strategies, making it easier for students to process and solve mathematical problems and potentially strengthening their interest in the subject.

Learning interest, as discussed by Harefa (2023) it is a form of engagement manifested through persistent attention, curiosity, and active participation during learning. Recent research supports that students who show genuine interest in mathematics are more motivated to participate and tend to achieve better results. Interest not only increases the likelihood of sustained learning but also encourages enjoyment and satisfaction in the learning process.

Students who are genuinely interested in learning are often more active, frequently ask questions, and are more motivated to understand the material, which can significantly enhance their learning success. A person tends to remain focused on activities they enjoy, accompanied by a feeling of enjoyment while doing them. Interest is a stable tendency to pay attention to and remember a particular activity. Interest plays a crucial role in learning activities. Without interest, learning activities are often not carried out wholeheartedly or sincerely. Recent studies confirm that high interest in mathematics encourages students to engage more deeply, improves their persistence in facing challenges, and is positively correlated with their academic performance (Arni et al., 2024; Harefa, 2023; Retnawati & Wawan, 2022). Additionally, motivated students are more likely to exert effort and

demonstrate resilience when faced with challenging mathematical concepts. Thus, fostering learning interest not only supports the mastery of mathematics but also helps to build important social and emotional skills required in lifelong learning (Fitrianti & Nur, 2018).

A supportive learning environment—both external and internal—plays a decisive role in students' enthusiasm and learning outcomes (Fitrianti & Nur, 2018; Wibowo et al., 2021). If the internal and external conditions are favorable, students become more focused, enthusiastic, and able to develop mathematical thinking skills such as critical, creative, thorough, and logical reasoning (Fitrianti & Nur, 2018; Gao & Fu, 2017; Sinaga, 2022). This will ultimately improve their achievement, especially in challenging topics such as equivalent fractions.

Based on these explanations, the research problem formulated in this study is: "Is there an influence of numerical intelligence and learning interest on students' learning outcomes in equivalent fractions in Grade IV at SDN 1 Passo?" The objective is to determine the Influence of numerical intelligence and learning interest on mathematics achievement, specifically for the topic of equivalent fractions in Grade IV at SDN 1 Passo. Therefore, this study is entitled "The Synergy of Numerical Intelligence and Learning Interest in Determining the Mathematics Achievement of Students at SDN 1 Passo".

2. METHODS

This study employs a quantitative approach, utilizing the correlation method, a commonly used technique to determine the degree of relationship between research variables (Creswell & Creswell, 2018; Sugiyono, 2013). In correlation studies, there are generally independent variables and dependent variables involved. Specifically, this method was chosen to examine the influence of numerical intelligence and learning interest on student learning outcomes, as correlation analysis is effective in identifying and measuring these relationships (Hanushek & Jackson, 2013).

The steps in conducting research include identifying the problem, formulating the problem and hypotheses, determining the research variables, and selecting the population and sample. Subsequently, research instruments are prepared and tested for validity and reliability, followed by data collection, processing, and analysis. This sequence aligns with methodological procedures for quantitative studies, aiming for scientific rigor and replicability (Sugiyono, 2013).

The population in this study consisted of fourth-grade students at SD Negeri 1 Passo, while the sample comprised 23 students from Class IV B at the same school. Sampling was carried out only in one class of the entire population. The sampling technique used was purposive sampling, which involves selecting a class from two available classes based on characteristics that best meet research requirements (Arikunto, 2019; Etikan et al., 2016).

The data collection technique in this study employed tests and surveys through questionnaire instruments, focusing on numerical intelligence and learning interest. The numerical intelligence questionnaire contains 24 statements covering four indicators: (1) mathematical calculation ability; (2) logical and systematic thinking; (3) problem-solving ability; and (4) recognition of patterns and numerical relationships. Meanwhile, the learning interest questionnaire comprises four indicators, namely: (1) pleasure; (2) attention level; (3) curiosity (interest); and (4) student involvement, elaborated into 24 items. Development of the instrument refers to established practices in quantitative educational research to ensure content validity (Creswell & Creswell, 2018; Suhudi et al., 2024).

Prior to their use in research, the instruments were tested on respondents outside the sample of 23 students to establish their validity and reliability. Instrument testing is necessary to ensure the quality of the data and to verify the suitability of the instrument for further analysis (Sugiyono, 2013).

Validity testing was conducted using statistical tests on responses after distributing the questionnaires. Each item score was compared with the r-table value, taking into account the number of respondents and a significance level of 5%. This procedure aims to select items that validly measure the intended constructs (Suhudi et al., 2024).

Data analysis techniques included normality tests, linearity tests, autocorrelation tests, and several linear regression analyses. This sequence ensures that prerequisite assumptions for regression are met, supporting accurate inference regarding the relationship between variables (Ghozali, 2018; Hanushek & Jackson, 2013).

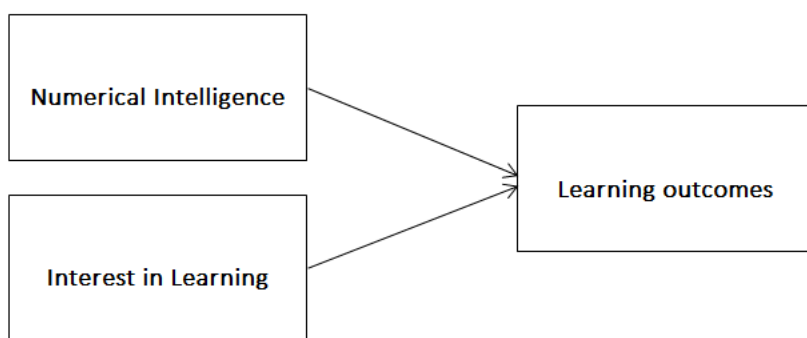


Figure 1. Conceptual Framework

3. RESULTS AND DISCUSSION

3.1. Results

This study used a quantitative approach with a correlation method. This method was chosen because the study aimed to analyze the relationship between numerical intelligence and learning interest in mathematics learning outcomes in the topic of equivalent fractions. Therefore, this study did not compare two groups, but instead used only one class as the research subject: class IV B at SD Negeri 1 Passo.

3.1.1 Descriptive Analysis

a. Validity Test

According to Azwar (2018), validity refers to the degree to which a test or scale accurately performs its function as a measuring tool.

Table 1. Question Validity Test Results

Indicator	Information
S1	Valid
S2	Valid
S3	Valid
S4	Valid
S5	Valid

Based on the results of the validity test conducted using SPSS 23, all questions listed in the table were declared valid. Therefore, all questions can be used to measure student abilities accurately.

b. Reliability Test

The reliability of an instrument is crucial to ensure that the items consistently measure the desired abilities. According to Sukendro (2019), reliability supports validity because valid statements are generally reliable, although reliable statements are not necessarily valid.

Table 2. Reliability Test Results

Numerical Intelligence		Interest in Learning	
Cronbach's Alpha	N of Items	Cronbach's Alpha	N of Items
.758	4	.668	4

Based on the reliability test results for the valid elements, the Cronbach's alpha values were 0.758 for the Numerical Intelligence Questionnaire and 0.668 for the Learning Interest Questionnaire. These values are greater than 0.60, indicating reliability. These values meet the reliability criteria because the Cronbach's alpha values are 0.758 and 0.668, both of which exceed the recommended threshold of 0.60.

c. Learning Outcome Data

After administering the treatment, a learning outcome test was conducted by distributing questions on equivalent fractions to a sample group of 23 students.

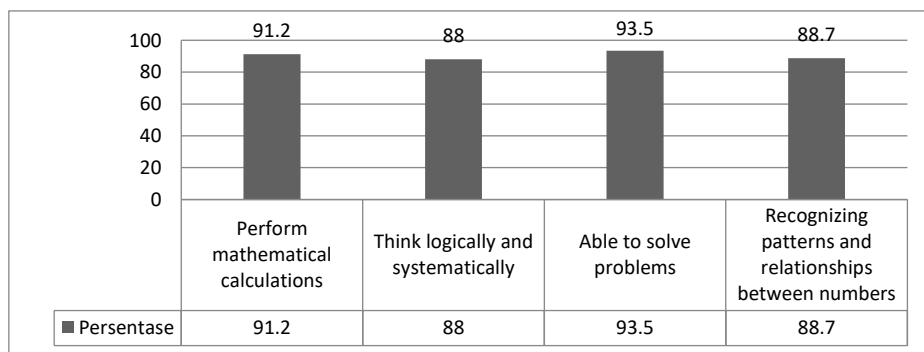
Table 3. Student Learning Outcomes Data

Acquisition	Learning outcomes
Minimum	79
Maximum	100
Average	92,4

d. Questionnaire Data

Questionnaire data is data collected through a survey, where respondents provide answers to a series of questions. The purpose of a questionnaire is to obtain direct information from respondents regarding a variable being studied.

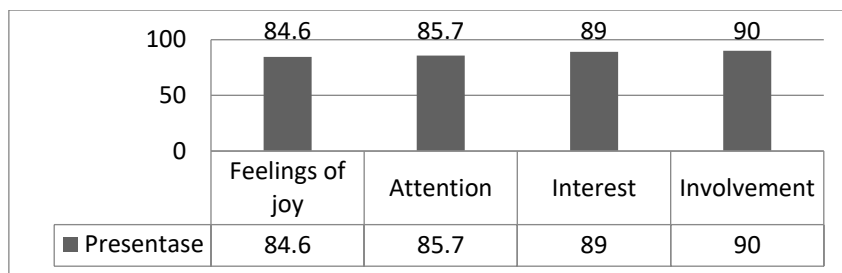
Figure 2. Numerical Intelligence Questionnaire Chart



Based on the graphic image above, seen from the results of student responses in the class obtained from the numerical intelligence questionnaire, it can be seen that the percentage of the logical and systematic thinking indicator is 88% with a high category, the indicator of

recognizing patterns and relationships between numbers is 88.7% with a high category, the indicator of performing mathematical calculations is 91.2% with a very high category and the indicator of being able to solve problems is 93.5% with a very high category.

Figure 3. Learning Interest Questionnaire Graph



Based on the graphic image above, seen from the results of student responses in the class obtained from the provision of a learning interest questionnaire, it can be seen that the percentage of the feeling of pleasure indicator is 84.6% with a high category, the attention indicator is 85.7% with a high category, the interest indicator is 89% with a very high category and the student involvement indicator is 90% with a very high category.

3.1.2 Data Analysis

a. Normality Test

To determine whether data is normally distributed, the Shapiro-Wilk test can be used. If the significance value (asymptotic significance) of a variable is greater than 0.05, then the variable is considered to be normally distributed.

Table 4. Output of Normality Test Results

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
Learning Outcomes	,179	23	,053	,918	23	,060
Numerical Intelligence	,142	23	,200*	,946	23	,240
Learning Interest	,127	23	,200*	,943	23	,210

From the table above, we can see that numerical intelligence, learning interest, and learning outcomes are normally distributed, as the significance values of all variables are greater than 0.05. The graph of the normality test results is as follows:

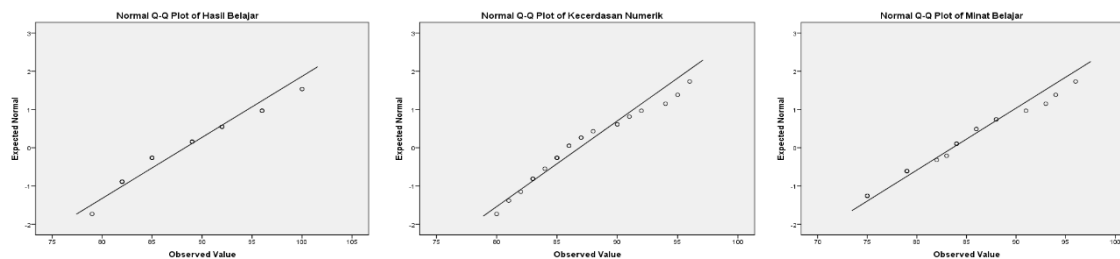


Figure 4. The graph of the normality test results

b. Linearity Test

Linear regression is based on the assumption that the variables being analyzed have a linear relationship with each other. ANOVA can be used to verify this linear relationship.

Table 5. Output of Linearity Test Results for X₁ and Y

			Sum of Squares	Df	Mean Square	F	Sig.
Learning Outcomes * Numerical Intelligence	Between Groups	(Combined)	691,203	14	49,372	2,301	,119
		Linearity	443,229	1	443,229	20,655	,002
		Deviation from Linearity	247,973	13	19,075	,889	,592
	Within Groups		171,667	8	21,458		
Total			862,870	22			

Table 6. Output of Linearity Test Results for X₂ and Y

			Sum of Squares	df	Mean Square	F	Sig.
Learning Outcomes * Learning Interest	Between Groups	(Combined)	588,570	10	58,857	2,575	,062
		Linearity	419,259	1	419,259	18,342	,001
		Deviation from Linearity	169,311	9	18,812	,823	,608
	Within Groups		274,300	12	22,858		
Total			862,870	22			

Based on the table above, the linear value of numerical intelligence and learning interest on learning outcomes is less than 0.05. Therefore, H₀ is rejected, which means that numerical intelligence and learning interest have a linear relationship with learning outcomes.

c. Autocorrelation Test

The purpose of the autocorrelation test is to test whether there is a correlation between the nuisance error in period t and the nuisance error in period t-1 (previously) in the linear regression model. This autocorrelation phenomenon is detected using the Durbin-Watson (DW) test.

Table 7. Autocorrelation Test Result Output

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,844 ^a	,713	,684	3,519	2,158

From the table above, the model summary data yields a Durbin-Watson (DW) value of 2.158. This value will then be compared with the table value using a significance level of 5% (0.05), an n of 23 samples, and a k value of 2 (k = 2), resulting in a dU value from the Durbin-Watson table of 1.5435.

If formulated based on decision-making, i.e., $dU < d < 4-dU$, it becomes $1.5435 < 2.158 < 2.4565$. Based on the results of this decision-making formulation, it can be concluded that there are no signs of autocorrelation in the independent variables in this study.

d. Multiple Linear Regression Analysis

Multiple linear regression analysis was employed to investigate the impact of numerical intelligence and learning interest on the dependent variable, specifically learning outcomes.

Table 8. Multiple Linear Regression Results Output

		ANOVA ^a				
	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	409,227	2	204,613	9,021	,002 ^b
	Residual	453,643	20	22,682		
	Total	862,870	22			

From the table above, the F-value of 9.021 indicates a statistically significant model overall, and the p-value of 0.002 is statistically significant at the 0.05 (5%) level of significance. Because the significance value of $0.002 < 0.05$, H_0 is rejected, which means that numerical intelligence and learning interest influence student learning outcomes.

3.2 Discussion

Based on the data analysis results, it was found that numerical intelligence and learning interest have a significant influence on student achievement, particularly in mathematics subjects at SD Negeri 1 Passo. According to research conducted by Ridwan et al. (2023), the analysis of their study's results concluded that numerical ability had a 5.5% influence on mathematics learning outcomes for students, while the remaining 94.5% was influenced by other variables not included in the study. This research is also relevant to that conducted by Hanifah & Masruroh (2022), which showed a significant influence between student learning interest and student learning outcomes, as evidenced by the results of $F\text{-count} > F\text{-table}$ ($28.15 > 4.49$) at the 5% level, where H_a was accepted and H_0 was rejected.

Previously, mathematics learning outcomes in grade IV of SD Negeri 1 Passo, based on observations, indicated that the average score obtained by students fell into the low category. This was suspected to be due to students' lack of numerical ability and interest in learning mathematics, especially fractions. This is in line with research by Kheirkhah et al. (2023), which states that each person's intelligence can be improved through specific methods such as training and brain stimulation activities.

Thus, students were allowed to explore their initial understanding of fractions and build their interest in learning. Furthermore, discussions were held to determine the extent to which students understood the importance of fraction concepts in everyday life. Next, questionnaires were administered on numerical intelligence and learning interest, which aimed to determine a person's ability to think and calculate using numbers and students' interest in learning mathematics.

Then, material related to basic fraction operations, such as fraction elements and the fractional form of a picture, is presented. This session employs various instructional methods, including concrete illustrations and step-by-step practice problems, to refine students' numerical skills.

Additionally, students are encouraged to work in groups to enhance interaction and motivation. This is followed by a discussion of multiplying and dividing equivalent fractions. At this stage, students are given more complex exercises to test their understanding of the concepts they have learned. Students are given challenges in the form of problems that

require them to use creative thinking strategies to solve them. Class discussions are held to help students understand various methods for solving fraction problems. Students are also given applications of the concept of equivalent fractions in various everyday life contexts.

Next, students are given assignments in the form of case studies and problem-solving related to fractions. Through these activities, students are expected to be able to connect mathematical concepts with real-world experiences, thereby increasing their interest in learning the subject. Finally, a written test is administered, covering a range of difficulty levels, from basic questions to those requiring more complex problem-solving. The results of this test are then analyzed to determine the relationship between numerical intelligence, learning interest, and student learning outcomes in understanding the concept of equivalent fractions.

Based on the calculation of the multiple regression hypothesis test, the significance value is $0.002 < 0.05$, so the null hypothesis H_0 is rejected and the alternative hypothesis H_a is accepted. Therefore, it can be concluded that numerical intelligence and learning interest Influence student learning outcomes in fraction material at SD Negeri 1 Passo.

This research is further supported by Pratiwi & Alyani (2022) Research has found that numerical intelligence positively contributes to math problem-solving skills, particularly in materials that require an understanding of fraction concepts. Similarly, research by Indrawati (2015) It was found that students with high levels of numerical intelligence demonstrated better academic performance in mathematics.

Research by Sulfiani et al. (2024) concluded that student learning interest is closely related to academic success in mathematics. Another study by Maskur et al. (2020) explained that students who enjoy mathematics have better learning outcomes than those who are not interested.

This study has several limitations that should be taken into consideration. First, the study was conducted in only one class, so the results cannot be broadly generalized to the entire population of elementary school students. Second, the instrument used to measure numerical intelligence and learning interest was a questionnaire, which could potentially introduce subjective bias from respondents. Third, the study only examined two independent variables—numerical intelligence and learning interest—without considering other variables that could potentially Influence learning outcomes, such as learning styles, intrinsic motivation, family environment, or teacher teaching methods.

Based on these limitations, it is hoped that further research can use more samples, conduct observations or interviews to obtain a more objective picture of the variables of numerical intelligence and learning interest, add other variables in the research model, namely learning motivation, self-confidence, or parental support to obtain a more comprehensive understanding of the factors that Influence students' mathematics learning outcomes, and examine learning interventions to see the direct impact on improving numerical intelligence and learning outcomes.

4. CONCLUSION

Based on the results discussed, it is evident that numerical intelligence and learning interest determine student learning success at SD Negeri 1 Passo. This is supported by the statistical test results presented, which rejected the null hypothesis and accepted the alternative hypothesis. Therefore, numerical intelligence and learning interest play a crucial role in student progress and development, particularly in mathematics.

For teachers, it is expected to continually develop numerical intelligence skills by providing practice questions that range from easy to more complex, in addition to improving problem-solving and logical thinking skills, and utilizing learning media that capture students' attention. Also, develop students' interest in learning, so that this interest can later produce good results. Increasing student interest in learning can be achieved by enhancing students' sense of engagement in their learning activities. Then, teachers must also be able to attract students' attention to the subject. In this case, attracting students' attention can be achieved by providing different variations, such as varying language styles and methods used in delivering the material, so that it does not seem monotonous and boring.

Schools are expected to develop numeracy support programs, such as extracurricular math activities, weekly quizzes, or creative numeracy competitions, to enhance students' numeracy skills. Furthermore, they should provide training to teachers in differentiated learning approaches and strategies for increasing student interest in learning, as well as providing learning facilities that support students' numeracy development.

For further researchers, it is advisable to expand the scope by involving more than one school or class to increase the generalizability of the results and to incorporate additional variables such as learning motivation, learning style, or parental support.

5. AUTHORS' NOTE

This research was conducted as part of an effort to understand the internal factors that influence elementary school students' mathematics learning outcomes, particularly regarding equivalent fractions, which are often challenging. Numerical intelligence and learning interest were chosen as the focus of the research because both are considered important in students' cognitive and motivational processes during mathematics learning.

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