

## UNLOCKING MATHEMATICS ENTHUSIASM: ANALYZING FOURTH-GRADE STUDENTS' LEARNING INTEREST

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### Abstract

Students' interest in learning mathematics at the elementary level is often reported as suboptimal. This study aims to describe the mathematics learning interest profile of fourth-grade students in Tasikmalaya City. Employing a quantitative approach with descriptive method, the research involved 118 students from SDN 1 Pengadilan and SDN Saripin, selected through purposive sampling. Data were collected using a mathematics learning interest questionnaire with four indicators: emotion, value, knowledge, and engagement, then analyzed using descriptive statistics. The findings revealed an average mathematics learning interest score of 65.39% (moderate category). Per-indicator analysis showed significant imbalances: the value indicator demonstrated the highest results, while the knowledge indicator showed the lowest performance. A notable finding is the learning paradox evidenced by a 14.15% gap between value and knowledge indicators, suggesting students recognize mathematics' importance yet struggle to master fundamental concepts. The study recommends transforming instructional approaches from procedural to meaningful conceptual understanding, creating positive learning environments to enhance emotional engagement, and implementing student-centered learning to increase active participation. These findings provide important insights for improving mathematics education quality at the elementary level.

**Keywords:** learning interest, mathematics education, elementary school, learning paradox, conceptual understanding

### INTRODUCTION

Mathematics is a fundamental subject at the elementary education level that plays a crucial role in developing students' logical, analytical, and systematic thinking skills, as well as equipping them with problem solving abilities applicable in everyday life (Renninger & Hidi, 2016). The effectiveness of mathematics learning is not only determined by the quality of teaching methods, but is also significantly influenced by students' learning interest, an internal factor that drives active participation, persistence, and curiosity in mastering mathematical concepts. Learning interest has been empirically proven as an important

determinant of student learning outcomes (Nurhasanah & Sobandi, 2016; Siagian, 2015), with students who exhibit high interest tending to show better academic achievement, including deeper conceptual understanding, willingness to explore multiple problem solving strategies, and resilience when facing difficulties (Astuti, 2015; Auliya & Marlina, 2021).

However, empirical evidence consistently indicates that many students experience difficulty achieving mastery in mathematics (Varaizai & Makondo, 2020). The stigma of mathematics as a subject that is difficult, frightening, and boring largely stems from the use of monotonous teaching methods (Cahyanti,

2024; Hayati et al., 2024; Yuniyanto et al., 2022), which in turn weakens student engagement and reinforces negative perceptions of the subject (Rahmawati & Lumaati Noor, 2022; Hadi et al., 2025). This phenomenon known as mathematics anxiety has become a significant concern in the field of mathematics education (Anita, 2014), as prolonged negative emotions hinder the development of mathematical abilities and diminish learning motivation (Pekrun, 2006). Moreover, as students progress to higher educational levels, insufficient mastery of foundational concepts creates a compounding effect that further reduces interest and engagement (Permata et al., 2021; Voinea & Purcaru, 2014).

From a theoretical standpoint, self-determination theory posits that students' intrinsic motivation develops when their basic psychological needs competence, autonomy, and social connectedness are fulfilled (Ryan & Deci, 2000a). Complementarily, expectancy value theory emphasizes that students' interest and motivation are shaped by the perceived value of a subject and their expectations of success (Eccles & Wigfield, 2002; Wigfield & Cambria, 2010). Together, these frameworks provide a robust theoretical foundation for analyzing variations in students' learning interest in mathematics.

Based on preliminary exploratory interviews conducted with eight fourth-grade teachers from two elementary schools in Tasikmalaya City in October 2025, many students were reported to show a lack of focus during mathematics learning. Although students physically appeared to be listening to the teacher's explanations, they were unable to provide appropriate responses when questioned, indicating minimal cognitive engagement in the learning process. Additionally, a

tendency was found for students to interact more with their peers than to pay attention to the material delivered by the teacher. Students' self confidence in solving mathematics problems was also still at a low level, which has the potential to become an obstacle to their active participation in learning activities.

Furthermore, insufficient understanding of mathematical concepts has become a contributing factor to students' low learning interest in mathematics. The higher the level of material students study, the greater the difficulties they face in comprehending it. This occurs because previously fundamental concepts have not been adequately mastered, thereby impeding students' ability to absorb advanced material. This condition frequently causes students to become indifferent and tend to be inattentive during the learning process.

Learning interest in mathematics plays a crucial role in determining how well students engage in the learning process. Students with high interest tend to exhibit positive attitudes such as great curiosity, persistence in learning, and a strong drive to genuinely understand concepts, so that learning goes beyond merely memorizing formulas to encompass understanding the meaning behind those concepts. Students with high interest are also more active in asking questions, willing to try various approaches in solving problems, and do not easily give up when facing difficulties.

While previous studies have investigated mathematics learning interest at the secondary school level (Yuniyanto et al., 2022; Auliya & Marlina, 2021) and examined general factors affecting mathematics achievement (Permata et al., 2021;

Varaizai & Makondo, 2020), empirical research specifically profiling the multidimensional structure of mathematics learning interest among fourth-grade elementary students in the Indonesian urban context remains limited. Most existing studies address learning interest as a single construct rather than disaggregating it across indicators such as emotion, value, knowledge, and engagement, thereby obscuring the internal imbalances that may exist within a student's interest profile. The present study addresses this gap by providing a comprehensive, indicator level analysis of mathematics learning interest among fourth-grade students in Tasikmalaya City. The novelty of this study lies in its identification of a "learning paradox", a systematic gap between students' high perceived value of mathematics and their low conceptual understanding which has not been previously documented at this educational level and context. These findings are expected to offer evidence based insights for educators and policymakers in designing targeted instructional interventions that address specific dimensions of learning interest rather than treating it as a homogeneous construct.

## **METHODS**

This study employed a quantitative approach with a descriptive method to describe the mathematics learning interest profile of fourth-grade students in Tasikmalaya City based on empirical data collected through questionnaires. According to (Creswell, 2014), quantitative research is oriented toward measuring variables and analyzing data numerically to answer research questions in a structured manner. In descriptive research, the aim is to portray

characteristics of the group or phenomenon being studied without manipulating variables (Creswell, 2014; Shields & Rangarajan, 2013).

The research sample comprised 118 students from two public elementary schools, namely SDN 1 Pengadilan (80 students) and SDN Saripin (38 students). The sampling technique employed was purposive sampling, a technique for determining samples with specific considerations. Sample selection criteria included: (1) fourth-grade students actively participating in mathematics learning, (2) schools with heterogeneous characteristics in terms of students' academic achievement, and (3) schools' willingness to participate in the research.

Mathematics learning interest is the tendency of students to pay attention, feel enjoyment, be motivated, and actively participate in mathematics learning without any external compulsion. The instrument used in this study was a mathematics learning interest questionnaire developed based on four main indicators: (1) emotion, measuring students' feelings toward mathematics; (2) value, measuring students' perceptions of mathematics' benefits and importance; (3) knowledge, measuring students' understanding of mathematical concepts; and (4) engagement, measuring students' active participation in mathematics learning. The questionnaire consisted of 20 statement items using a 4-point Likert scale: Strongly Agree (SA) = 4, Agree (A) = 3, Disagree (D) = 2, and Strongly Disagree (SD) = 1. The item distribution for each indicator was: emotion (5 items), value (5 items), knowledge (5 items), and engagement (5 items). The maximum score students could obtain was 80, while the minimum score was 20.

Data collection was conducted in October 2025. The data collection process began by requesting permission from school principals and fourth-grade teachers at both schools serving as research sites. Questionnaires were distributed to students during mathematics learning time, accompanied by researchers and classroom teachers to ensure students understood each statement item. Questionnaire completion time ranged from 20 to 30 minutes. The collected data were then checked for completeness before proceeding to the analysis stage. The obtained data were analyzed using descriptive statistics. Data analysis steps included: (1) tabulation of questionnaire results, (2) calculation of total scores for all students and each indicator, (3) percentage calculation using the formula:

$$\text{Percentage} = (\text{Obtained Score} / \text{Maximum Score}) \times 100\%$$

For the total score, the maximum score was 80 (20 items  $\times$  4 points). For each indicator, the maximum score was 20 (5 items  $\times$  4 points). Subsequently, the percentage calculation results were categorized based on the following criteria:

Table 1. Learning Interest Categorization Criteria

Score	Percentage Range (%)	Category
68 – 80	85-100	Very High
56 – 67	70-84	High
44 – 55	55-69	Moderate
32 – 43	40-54	Low
20 – 31	25-39	Very Low

The instrument validity was established through expert judgment by a mathematics education expert who evaluated the relevance, clarity, and appropriateness of each item against the four indicators of learning interest. The

reliability of the instrument was subsequently tested using Cronbach's Alpha coefficient, yielding a value of 0.816, which exceeds the minimum threshold of 0.70 and indicates that the instrument has high reliability and is consistent in measuring students' mathematics learning interest (Tavakol & Dennick, 2011).

## RESULT AND DISCUSSION

Based on the results of data collection through questionnaires completed by 118 fourth-grade students from SDN 1 Pengadlan and SDN Saripin, an overview of students' learning interest profile toward mathematics learning was obtained. Student learning interest data were categorized based on the percentage of scores obtained into five categories: very high, high, moderate, low, and very low. Descriptive statistics for the total score of students' learning interest are presented in Table 2.

Table 2. Descriptive Statistics of Total Mathematics Learning Interest Score

Statistics	Value
Sample Size (N)	118
Minimum Score	40
Maximum Score	67
Mean	52.31
Median	51.00
Mean Percentage	65.39%

Based on Table 2, it can be observed that the average mathematics learning interest score was 52.31 out of a maximum score of 80, or equivalent to 65.39%. This value indicates that overall, students' mathematics learning interest falls within the moderate category.

The analysis results showed that the distribution of mathematics learning interest categories varied among students. The majority of students (36.44%) had mathematics learning interest in the high

category, followed by the moderate category (32.20%) and low category (31.36%). No students had learning interest in the very high or very low categories. The complete distribution of student learning interest categories is presented in Table 3 and Figure 1.

Table 3. Distribution of Students' Mathematics Learning Interest Categories

Category	Number of Students	Percentage (%)
Very High	0	0.00
High	43	36.44
Moderate	38	32.20
Low	37	31.36
Very Low	0	0.00
Total	118	100.00

To provide a clearer picture of the distribution of students' mathematics learning interest categories, the data in Table 3 were visualized in the form of a bar chart in Figure 1 below.

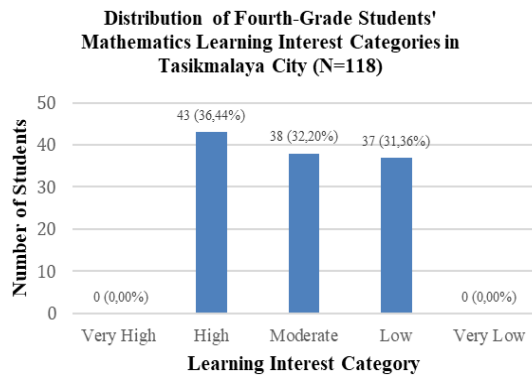


Figure 1. Distribution of Students' Mathematics Learning Interest Categories

Based on Table 3 and Figure 1, the distribution of mathematics learning interest categories was relatively balanced across the three dominant groups, with no students falling in the very high or very low categories. This near even spread suggests that mathematics instruction in both schools has yet to produce a consistently high level of student interest. Notably, nearly

one, third of students remained in the low category, indicating a substantial proportion at risk of disengagement that warrants targeted intervention from teachers.

The student learning interest profile was also analyzed based on four indicators: emotion, value, knowledge, and engagement. The analysis results for each indicator are presented in Table 4 and Figure 2.

Table 4. Distribution of Mathematics Learning Interest Indicators by Category

Indicator or Category	Category (number of students and percentage)				
	Very High	High	Moderate	Low	Very Low
Emotion	5 (4.24%)	20 (16.95%)	46 (38.98%)	44 (37.2%)	3 (2.54%)
Value	13 (11.02%)	56 (47.46%)	48 (40.6%)	1 (0.85%)	0 (0%)
Knowledge	4 (3.39%)	18 (15.25%)	27 (22.8%)	69 (58.4%)	0 (0%)
Engagement	6 (5.08%)	25 (21.1%)	49 (41.5%)	38 (32.2%)	0 (0%)

To provide a clearer picture of the distribution of mathematics learning interest indicators by category, the data in Table 4 were visualized in the form of a bar chart in Figure 2 below.

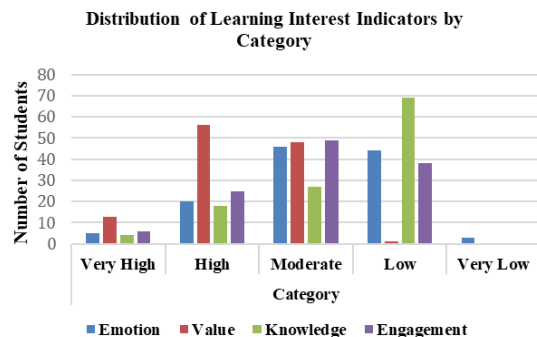


Figure 2. Distribution of Learning Interest Indicators by Category

Among the four indicators, the most striking contrast was between the value

and knowledge indicators. Students demonstrated the strongest performance on the value indicator, reflecting broad awareness of mathematics' importance in their lives, yet paradoxically showed the weakest performance on the knowledge indicator, where the majority struggled with conceptual mastery. The emotion indicator revealed a predominantly ambivalent to negative affective orientation toward mathematics, while the engagement indicator showed a moderately balanced distribution, though a considerable portion of students remained passively engaged. Together, these patterns suggest that students' cognitive recognition of mathematics' value has not translated into either strong conceptual understanding or positive emotional experience, a critical imbalance that merits attention in instructional design.

### **Overall Mathematics Learning Interest Profile**

The research findings revealed that the mathematics learning interest profile of fourth-grade students in Tasikmalaya City exhibited heterogeneous distribution, with the dominant category at the high level (36.44%), followed by moderate (32.20%) and low (31.36%) categories. The relatively balanced percentages among the three categories (with differences of only approximately 5%) indicated that students' mathematics learning interest varied considerably and had not yet shown consistent tendencies. This near equal distribution is particularly noteworthy because it suggests that no single dominant pattern of learning interest has emerged across both schools, implying that the current mathematics instructional practices have produced highly varied affective outcomes among students. From the

perspective of the four-phase model of interest development (Hidi & Renninger, 2006), this distribution indicates that students are at different phases of interest development, some have progressed toward well developed individual interest (high category), while a substantial proportion remain at the triggered or maintained situational interest phase (moderate category), and nearly one-third have yet to develop even situational interest (low category). This variation likely reflects differences in students' prior learning experiences, classroom climate, and the degree to which mathematics instruction has succeeded in creating personally meaningful and emotionally engaging learning experiences. These findings demonstrated significant disparities in mathematics learning interest among students, which were likely influenced by various internal and external factors as identified in research on elementary school students' mathematics learning difficulties (Permata et al., 2021).

The average mathematics learning interest score of 65.39% indicated that overall learning interest fell within the moderate category. Although in the moderate category, this condition suggested the need for more systematic and structured interventions to enhance students' mathematics learning interest. The nearly even distribution among high, moderate, and low categories showed that mathematics instruction in both sample schools generated diverse learning interest responses from students. The presence of 31.36% of students with low learning interest became a serious concern because this group potentially experienced difficulty in achieving basic mathematics competencies and required special intervention to increase their learning interest. This significant

variation in learning interest aligned with the four-phase model of interest development (Hidi & Renninger, 2006), which explains that interest develops through phases from triggered situational interest to well-developed individual interest, and not all students are at the same phase in their interest development.

### **Analysis Based on Learning Interest Indicators**

Analysis based on learning interest indicators revealed significant imbalances among the four indicators. The finding that the value indicator had the highest percentage (58.48% of students in high and very high categories) indicated that students possessed good cognitive awareness of the importance of mathematics for their lives, both in academic contexts and practical applications. This high value perception constituted very valuable basic capital in efforts to enhance overall mathematics learning interest, as awareness of a subject's importance could become a source of learning motivation for students. This finding was consistent with research on achievement values showing that value perception toward mathematics is an important predictor of student engagement and achievement (Wigfield & Cambria, 2010). In line with expectancy-value theory (Eccles & Wigfield, 2002), students' high task value perception has not been matched by sufficient expectation of success, as weak conceptual mastery, reflected in the knowledge indicator (58.64%) undermines their confidence in achieving mathematics tasks.

However, this high value perception was not accompanied by adequate conceptual understanding, as evident from the low knowledge indicator where 58.47% of students were in the low

category. This finding revealed a critical learning paradox: students recognized the importance of mathematics yet were unable to master fundamental concepts. The gap between awareness of mathematics' importance and actual ability in mastering concepts aligned with research findings identifying that difficulty in understanding mathematical concepts is one of the internal factors (Permata et al., 2021), where learning difficulties ultimately impact student achievement. This condition was most likely caused by instructional approaches that still overemphasized procedural aspects (memorizing formulas and solution procedures) rather than deep conceptual understanding (Yuwana et al., 2023). Research on mathematical knowledge shows that procedural and conceptual knowledge have reciprocal relationships that mutually reinforce each other (Rittle-Johnson et al., 2015). When instruction focuses only on procedures without conceptual understanding, students may be able to solve routine problems but experience difficulty in situations requiring application or knowledge transfer (Suraji et al., 2018).

The low knowledge indicator also suggested that mathematics instruction in both sample schools had not fully succeeded in building strong conceptual understanding. Students might be able to memorize formulas and procedures but did not understand the meaning behind those concepts, thus experiencing difficulty when confronted with problems requiring conceptual understanding or application in different contexts. This was reinforced by preliminary research findings showing that insufficient understanding of mathematical concepts was a contributing factor to students' low mathematics learning interest, where the higher the level of material studied, the

greater the difficulty faced because previous basic concepts had not been mastered well. To address this problem, transformation of instructional approaches from procedural to meaningful conceptual understanding was necessary.

The 14.15% gap between the value indicator (72.80% average percentage) and knowledge indicator (58.64% average percentage) constituted the most notable finding in this study. This paradox revealed dissonance between students' cognitive awareness of mathematics' importance and their actual ability in mastering mathematical concepts. This phenomenon could be explained through several possibilities. First, students' difficulty in understanding mathematical concepts could be caused by material presentation that was too complex or not well-structured, thus exceeding students' comprehension capacity at their developmental stage. Second, low conceptual understanding could decrease students' self-confidence in their mathematical abilities, which in turn could affect learning interest despite their awareness of mathematics' importance. From a motivational perspective, this gap could be explained through self-determination theory, which emphasizes that intrinsic motivation only develops when students feel competent (Ryan & Deci, 2000a). Without strong feelings of competence, even students who recognize mathematics' importance will struggle to develop sustained interest.

This gap also indicated the possibility of a phenomenon where students felt they understood mathematics (because they recognized its importance) when in fact their conceptual understanding remained very weak. This phenomenon could occur in mathematics instruction that

overemphasized formula memorization and procedures without deep understanding of underlying concepts. To address this gap, instructional approaches were needed that focused not only on procedural knowledge transfer but also built strong conceptual understanding through meaningful and contextual learning experiences.

### **Emotional Dimension in Mathematics Learning**

The emotional dimension in mathematics learning plays a very important and complex role (Hannula, 2012). The control-value theory of achievement emotions (Pekrun, 2006) explains that students' emotions in learning are influenced by their perceptions of control (whether they feel capable) and value (whether they consider it important). Negative emotions such as anxiety, boredom, or frustration can inhibit cognitive processes, decrease motivation, and ultimately affect mathematics learning achievement. Research findings showed that 39.83% of students exhibited negative emotions toward mathematics, which aligned with the math anxiety phenomenon documented in various educational contexts (Anita, 2014).

For the emotion indicator, the category distribution tended to be uneven, with 38.98% of students in the moderate category and 37.29% in the low category, showing that most students had ambivalent or even negative feelings toward mathematics. This finding was concerning because 39.83% of students (consisting of 37.29% in the low category and 2.54% in the very low category) exhibited negative emotions that could hinder the learning process. This pattern reflects what Hannula (2012) describes as the multidimensional nature of

mathematics-related affect, wherein students' emotional responses involve layered interactions between cognitive appraisals, social experiences, and prior learning histories, suggesting that the negative emotions observed in this study were likely shaped by repeated experiences of difficulty and low confidence in mathematics. Prolonged negative emotions not only affected students' motivation and engagement in learning but could also form long-term negative attitudes toward mathematics that were difficult to change later.

Meanwhile, the engagement indicator showed a fairly balanced pattern, with 41.53% of students in the moderate category, although there were still 32.20% of students with low engagement requiring special attention. Low engagement indicated that students tended to be passive in learning, participated less actively in class discussions, and showed no initiative in exploring mathematical concepts deeply. This condition could become a serious obstacle in achieving learning objectives that required students to become active and independent learners. This pattern of low engagement is consistent with findings from previous research indicating that passive learning behaviors in mathematics are closely linked to negative prior experiences and low self-efficacy, both of which are prevalent when instructional approaches fail to actively involve students in the learning process (Yuniyanto et al., 2022).

### **Interrelationships Among Learning Interest Indicators**

Analysis of interrelationships among indicators revealed that the four learning interest indicators (emotion, value, knowledge, and engagement) interacted with and influenced each other in

forming students' mathematics learning interest profile. This research finding showed that learning interest is a multidimensional construct that cannot be understood from only one aspect (Hidi & Renninger, 2006). The high value indicator showed that students had perceptions that mathematics was important and beneficial. However, value perception alone was insufficient to produce optimal learning interest if not supported by strong conceptual understanding (reflected in the knowledge indicator), positive emotions, and active engagement.

The gap between value and knowledge indicators could be explained through the perspective that learning motivation develops when students' basic psychological needs are fulfilled, including the need to feel competent in learning (Ryan & Deci, 2000b). In the context of this research, students might have awareness of mathematics' importance but lacked strong feelings of competence due to difficulty in understanding concepts. Without feelings of competence, students' learning motivation would be weak and learning interest would not develop optimally (Ryan & Deci, 2000b). Therefore, to enhance mathematics learning interest, pedagogical interventions must be designed to build students' sense of competence through successful experiences in understanding and solving mathematics problems.

The connection between emotion and engagement indicators was also very close. Students with negative emotions toward mathematics tended to avoid active engagement in learning because activities that generated negative emotions tended to be avoided (Pekrun, 2006). Conversely, students with positive emotions tended to be more actively

engaged in learning because they enjoyed the learning process and sought deeper learning experiences. This reciprocal relationship could create positive or negative cycles in mathematics learning (Pekrun, 2006). In a positive cycle, positive emotions increased engagement, which further increased understanding and sense of competence, which in turn further reinforced positive emotions. Conversely, in a negative cycle, negative emotions decreased engagement, resulting in weak understanding and low sense of competence, which further reinforced negative emotions. Therefore, interventions to enhance mathematics learning interest must break negative cycles and build positive cycles through creating positive, meaningful learning experiences that provide students with a sense of success

## CONCLUSION

This study reveals that the mathematics learning interest profile of fourth-grade students in Tasikmalaya City falls predominantly in the moderate category (65.39% mean score), with a relatively balanced distribution across high (36.44%), moderate (32.20%), and low (31.36%) categories. A notable finding is the learning paradox evidenced by a 14.15% gap between the value indicator (72.80%) and the knowledge indicator (58.64%), indicating that students recognize the importance of mathematics yet struggle to master its fundamental concepts. These findings suggest that mathematics instruction has yet to bridge students' awareness of mathematics' value with meaningful conceptual understanding. It is therefore recommended that teachers shift from procedural to conceptual instructional approaches, create positive emotional learning environments, and implement

student-centered strategies to foster active engagement across all dimensions of learning interest.

Despite these findings, this study is not without limitations. The sample was drawn from two public elementary schools in Tasikmalaya City through purposive sampling, which means the findings may not fully represent broader populations with different school characteristics, geographic settings, or socioeconomic backgrounds. Furthermore, as the study focused solely on fourth-grade students, the findings may not reflect the mathematics learning interest profile of students at other grade levels. Future research would benefit from expanding the sample across multiple grade levels and diverse school types to produce a more comprehensive understanding of mathematics learning interest among elementary school students.

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