



## Rethinking the Relationship: Analyzing the Lack of Association Between Number Sense and Metacognitive Awareness in Madrasah Ibtidaiyah Students

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### ABSTRACT

This study aims to re-examine the relationship between metacognitive awareness and students' number sense in Madrasah Ibtidaiyah (MI) on Bangka Island, Indonesia. Although previous studies in general education contexts have shown that higher metacognitive awareness supports stronger number sense, empirical evidence in Islamic elementary schools remains limited, particularly where mathematics instruction tends to emphasize procedural rather than reflective learning. Addressing this gap provides insights into how MI pedagogical characteristics influence students' cognitive and metacognitive engagement in numeracy. This study employed a quantitative approach with a descriptive correlational design. Data were collected from 256 fifth-grade MI students using a number sense test and a teacher-reported metacognitive awareness questionnaire. The results showed that students' number sense performance was generally low. Statistical analysis indicated no significant relationship between metacognitive awareness and number sense achievement ( $p = 0.459$ ,  $R^2 = 0.002$ ), suggesting that metacognitive awareness may not directly contribute to number sense development in the MI context. This finding implies that students' metacognitive processes are not optimally activated during mathematics learning due to instructional practices that limit self-monitoring and strategic thinking. Therefore, mathematics instruction in madrasah settings should integrate explicit metacognitive strategy training, such as planning, self-questioning, and reflection, to strengthen both metacognitive awareness and number sense.

**Keywords:** Metacognitive awareness, Madrasah Ibtidaiyah, number sense.

### ABSTRAK

Penelitian ini bertujuan untuk meninjau kembali hubungan antara kesadaran metakognitif dan number sense siswa Madrasah Ibtidaiyah (MI) di Pulau Bangka, Indonesia. Meskipun penelitian sebelumnya dalam konteks pendidikan umum menunjukkan bahwa kesadaran metakognitif yang lebih tinggi mendukung kemampuan number sense yang lebih baik, bukti empiris dalam konteks sekolah dasar Islam masih terbatas, khususnya pada pembelajaran matematika yang cenderung menekankan aspek prosedural dibandingkan pembelajaran reflektif. Penelitian ini berupaya mengisi kesenjangan tersebut dengan memberikan pemahaman mengenai bagaimana karakteristik pedagogi MI memengaruhi keterlibatan kognitif dan metakognitif siswa dalam numerasi. Penelitian ini menggunakan pendekatan kuantitatif dengan desain korelasional deskriptif. Data dikumpulkan dari 256 siswa kelas V MI melalui tes number sense dan kuesioner kesadaran metakognitif yang diisi oleh guru. Hasil penelitian menunjukkan bahwa kemampuan number sense siswa secara umum tergolong rendah. Analisis statistik menunjukkan tidak terdapat hubungan yang signifikan antara kesadaran metakognitif dan capaian number sense ( $p = 0,459$ ;  $R^2 = 0,002$ ), yang mengindikasikan bahwa dalam konteks MI, kesadaran metakognitif belum berkontribusi secara langsung terhadap perkembangan number sense. Temuan ini mengisyaratkan bahwa proses metakognitif siswa belum teraktivasi secara optimal dalam pembelajaran

matematika akibat praktik pembelajaran yang kurang menekankan pemantauan diri dan berpikir strategis. Oleh karena itu, pembelajaran matematika di lingkungan madrasah perlu mengintegrasikan pelatihan strategi metakognitif secara eksplisit, seperti perencanaan, *self-questioning*, dan refleksi, guna memperkuat kesadaran metakognitif dan kemampuan *number sense* siswa.

**Kata Kunci:** *Kesadaran metakognitif, Madrasah Ibtidaiyah, number sense.*

## INTRODUCTION

Mathematics education in Madrasah Ibtidaiyah (MI) plays a crucial role in developing students' basic numerical understanding and problem-solving abilities. At this level, students are expected not only to master mathematical procedures but also to recognize numerical patterns and monitor their own thinking while solving problems. In this context, number sense refers to students' ability to comprehend, estimate, and manipulate numbers flexibly in everyday situations, while metacognitive awareness refers to their ability to plan, monitor, and evaluate their own thinking processes during mathematical tasks. These two aspects are considered essential for building foundational mathematical competence in primary education (Zhang et al., 2024).

Metacognition refers to an individual's awareness of their own thinking processes, encompassing the ability to plan, monitor, and evaluate strategies used in problem-solving. In educational research, metacognition can be assessed as either domain-general, reflecting overall thinking awareness across subjects, or domain-specific, focusing on strategies applied within a particular subject such as mathematics. The distinction between these two types is critical, as domain-general measures may not strongly correlate with specific mathematical skills like number sense, whereas domain-specific assessments are more likely to reveal meaningful associations. This measurement consideration helps explain why correlations between metacognitive awareness and number sense can vary across studies and contexts, including in Madrasah Ibtidaiyah settings (Desoete & De Craene, 2019; Güner & Erbay, 2021). This awareness enables students to be more flexible and adaptive in selecting the most effective approaches when dealing with complex mathematical problems (Toraman et al., 2020). Meanwhile, number sense refers to an intuitive ability that enables individuals to recognize, understand, compare, and use numbers accurately and efficiently (Fahlevi, 2022b; Reys, 1994). Students with well-developed number sense are generally more capable of performing calculations quickly and accurately, as well as understanding mathematical concepts more deeply, which ultimately contributes to improved academic achievement in mathematics (Woods et al., 2017; Yilmaz, 2017).

Several previous studies have indicated a positive and significant relationship between metacognitive awareness and number sense in supporting mathematical proficiency (Ilko, 2021; Yorulmaz et al., 2023). For instance Yorulmaz et al. (2023), emphasized that metacognition is positively correlated with number sense, and suggested that the results of this relationship be used to design instructional activities aimed at enhancing number sense, while Ilko (2021) highlighted that metacognition plays a crucial role from various perspectives in the development of students' number sense going beyond mere rote memorization to foster deeper understanding and flexible application of mathematical concepts. This relationship is not only mutually supportive but also fundamental, as

it enables students to regulate their learning processes and adapt to new mathematical challenges. High metacognitive awareness allows students to recognize when and how to apply appropriate numerical strategies, thereby enhancing their number sense optimally (Habib et al., 2024). Thus, the metacognitive aspect and number sense are regarded as two key components that mutually support each other in the process of effective and meaningful mathematics learning.

However, the majority of studies examining the relationship between metacognitive awareness and number sense have predominantly been conducted at the secondary education level or in general schools, while the educational context of Madrasah Ibtidaiyah, which is one of the primary education levels, particularly in Indonesia, has received relatively less attention (Zainuri et al., 2020). Madrasahs, however, possess distinct characteristics and learning cultures compared to general schools. MI operates under the Ministry of Religious Affairs, whereas elementary schools (SD) fall under the Ministry of Education and Culture. A significant difference lies in the curriculum content, where MI incorporates more intensive Islamic religious subjects such as Qur'an and Hadith, Fiqh, Aqidah Akhlak, and Islamic Cultural History, alongside the general subjects also taught in elementary schools. Institutionally, MI aims to develop students who are not only academically competent but also grounded in strong religious values in accordance with Islamic teachings. Nonetheless, both institutions adhere to national education standards and confer diplomas recognized as equivalent (Syar'i et al., 2020). These differences are suspected to influence how students develop metacognitive awareness and number sense abilities in mathematics learning.

Based on data from the 2022 Asesmen Nasional Berbasis Komputer (ANBK) and Asesmen Kompetensi Minimum (AKM), it was found that the numeracy competency achievements of elementary school students or their equivalents in Bangka Island remain below the national standard. The results also indicate relatively small differences in achievement between regencies and cities, thus highlighting systemic and contextual factors as primary considerations in understanding students' mathematics learning performance in the Bangka Belitung Islands province (Kemendikbudristek, 2022).

The fact that numeracy learning outcomes in elementary schools, including MI are still suboptimal raises critical questions regarding the role of metacognitive awareness in the development of students' number sense. Does the metacognitive awareness, which is widely believed to strengthen numerical abilities, also apply to madrasah students? Conversely, are there other factors that play a more dominant role in influencing number sense abilities among MI students? Although various previous studies have confirmed a positive and significant relationship between metacognitive awareness and number sense abilities in mathematics learning (Ilko, 2021; Yorulmaz et al., 2023), these findings may not necessarily be generalizable to all educational contexts, particularly within the environment of MI in Indonesia.

Furthermore, preliminary indications from the field suggest that the correlation between these two variables is not always as strong or consistent as widely assumed in previous studies. Although these indications have yet to be systematically and thoroughly investigated in scientific literature, they provide an important opportunity to re-examine the theoretical assumptions

traditionally used to understand the relationship between metacognition and number sense. This forms the basis for the novelty and urgency of the present study. Therefore, the objective of this research is to critically and empirically examine whether the relationship, which has long been considered robust, also holds true within the context of madrasah education, an environment characterized by curricular approaches, teaching methods, and learning settings that differ from those of general elementary schools.

Mathematics education in MI requires further attention and in-depth study, particularly concerning the development of number sense and metacognitive awareness, which have been relatively underexplored. Some studies indicate that metacognition plays a significant role in enhancing mathematical problem-solving abilities, as evidenced by research conducted at the Madrasah Tsanawiyah (MTs) level, where the use of metacognition-based instruments, such as reflection cards, has successfully led to significant improvements in students' learning outcomes ([Inastuti et al., 2021](#)). However, similar research is scarcely found at the MI level, despite other studies at the senior high school level indicating that the majority of students are already at moderate to high metacognitive levels, such as aware use and strategic use, with a considerable number also reaching reflective use, which is an indicator of higher-order thinking ([Zakiah, 2020](#)). The scarcity of literature addressing strategies to strengthen metacognition and number sense in MI indicates a gap that needs to be bridged through further research and the development of instructional models that promote reflection, conceptual exploration, and mathematical decision-making from an early stage.

This situation serves as the primary foundation for this study to conduct a comprehensive re-analysis of the relationship between metacognitive awareness and number sense among MI students. This situation provides the rationale for conducting a comprehensive analysis of the relationship between metacognitive awareness and number sense among MI students. This study employs a quantitative approach with the aim of testing the hypothesis that metacognitive awareness serves as a significant predictor of number sense ability at the primary education level. The instruments used have been validated and tested for reliability, the number sense test demonstrated high reliability with a Cronbach's  $\alpha = 0.909$  and content validity confirmed through expert review, while the teacher-reported metacognitive awareness questionnaire showed  $\alpha = 0.79$  and construct validity verified through factor analysis, whereas the metacognitive awareness questionnaire was selected based on its development by subject-matter experts, ensuring adequate content and construct suitability for the MI student population.

Furthermore, the study examines additional variables, such as differences in gender and the location of regencies/cities, to provide a more comprehensive understanding of the phenomenon. By doing so, the research not only investigates the direct relationship between metacognitive awareness and number sense but also explores contextual factors that may influence mathematics learning outcomes in MI settings. Additionally, the research explores other variables such as differences based on gender and the location of regencies/cities to gain a broader understanding of the dimensions of this phenomenon.

This study aims to validate the relationship between metacognitive awareness and number sense within the context of Madrasah Ibtidaiyah, which presents unique challenges compared to general primary schools. By addressing this gap, the research is expected to provide practical insights for improving mathematics learning tailored to the distinctive characteristics of madrasah students. This study is particularly important given the fundamental role of mathematics in preparing the younger generation to face the increasingly complex and dynamic challenges of the 21st century (Kissane, 2016). The findings may also inform curriculum design and teacher training that integrate metacognitive skill development with number sense instruction, contributing to more effective and context-appropriate mathematics education in MI settings.

## METHOD

This study employs a quantitative approach with a descriptive correlational design and a survey method. The descriptive correlational design was chosen because it enables the researcher to measure the degree of association between metacognitive awareness and number sense without manipulating any variables. Through this design, the study can describe existing levels of both variables while simultaneously examining how variations in students' metacognitive awareness relate to their number sense performance. This approach is selected because it allows for an objective analysis of the relationship between variables through numerical data.

The research population consists of all fifth-grade MI students on Bangka Island, with a sample of 256 students drawn from ten madrasahs selected through stratified random sampling. The strata were determined based on school status (public and private) and geographical region (urban and rural areas) to ensure proportional representation of students across different educational contexts. This stratification aimed to minimize sampling bias and reflect the diversity of the MI population on Bangka Island. The sample selection also considered school accreditation levels (A and B) to ensure representativeness of the population.

The two main variables investigated in this study are number sense achievement as the dependent variable and metacognitive awareness as the independent variable. Number sense is operationalized as students' ability to understand, interpret, and flexibly use numbers in various mathematical contexts. It is measured using a test consisting of 30 multiple-choice and short-answer items developed based on the three indicators proposed by Purnomo et al. (2014): (1) knowledge of and facility with numbers, (2) knowledge of and facility with operations, and (3) knowledge of and facility with numbers and operations in computational settings. Each item is scored on a scale from 0 (incorrect) to 2 (completely correct). The validity of the instrument was theoretically established through alignment with the indicators proposed by Purnomo et al. (2014), ensuring that the items represent key aspects of number sense. The reliability coefficient (Cronbach's  $\alpha$ ) was 0.909, indicating high internal consistency of the instrument.

Metacognitive awareness refers to students' awareness and regulation of their own cognitive processes during mathematical problem-solving. It was measured using the Teacher's Metacognitive Awareness Scale adapted from Sperling et al. (2002), consisting of 12 items representing two

dimensions: (1) primarily regulation of cognition and (2) better represents knowledge of cognition. Each item was rated on a three-point Likert scale (1 = rarely, 2 = sometimes, and 3 = often). The adaptation followed a linguistic adjustment procedure to ensure clarity and contextual relevance to the student population. The reliability coefficient (Cronbach's  $\alpha$ ) was 0.79, suggesting good internal consistency. The validity of this instrument is supported by its theoretical foundation and its extensive prior use in educational research.

Data were collected offline between May and August 2024. The number sense test was administered directly to students at their respective schools by the research team, ensuring standardized instructions and supervision during testing. The metacognitive awareness questionnaire was completed by classroom teachers within one week, based on systematic observation of students' behavior and problem-solving strategies in class. Both instruments were adapted from well-established measures in educational research.

Data were analyzed using SPSS version 25. Descriptive statistics were used to profile students, while t-tests and ANOVA were conducted to compare number sense achievement based on region and school characteristics. Prior to inferential analyses, assumptions of normality, linearity, and homogeneity of variances were checked to ensure appropriateness of the t-tests, ANOVA, Pearson correlation, and linear regression analyses. Pearson correlation and linear regression were used to examine the relationship and influence of metacognitive awareness on number sense.

## **RESULT AND DISCUSSION**

### **Results**

This study provides an overview of number sense achievement and metacognitive awareness among MI students on Bangka Island, based on data from 256 students across ten MIs. The participants were fifth-grade students, aged 10–12 years, with a balanced distribution of gender (approximately 51,95% male and 48,05% female). These schools were selected through stratification based on school status (public or private) and accreditation (A or B), and representation from the main administrative regions, namely Pangkalpinang City and the four regencies on Bangka Island. This stratified sampling strategy was designed to capture a comprehensive and varied picture of basic mathematics learning conditions at the MI level.

### **Number Sense Achievement Remains Low**

Overall, the number sense achievement of MI students on Bangka Island remains relatively low. The average score across the 30-item number sense test was 25.61 out of a maximum possible score of 60, indicating that most students answered fewer than half of the questions correctly. The distribution of scores showed that only a small number of students approached the maximum score, highlighting variability in student performance. The scoring scale ranged from 0 (incorrect) to 2 (completely correct) for each item.

Several factors may contribute to this low achievement, including limited exposure to reflective or problem-based instructional strategies and insufficient opportunities for students to

develop conceptual understanding and flexible numerical thinking. Notably, the test items assessed not only calculation skills but also conceptual understanding of numbers, estimation ability, and flexibility in numerical reasoning.

**Table 1.** Regional Distribution of Average Number Sense Scores

| No | City/Regency   | Number of Students | Average Number Sense Achievement |
|----|----------------|--------------------|----------------------------------|
| 1  | Pangkalpinang  | 58                 | 27.3                             |
| 2  | Bangka         | 49                 | 27.0                             |
| 3  | Bangka Tengah  | 59                 | 24.58                            |
| 4  | Bangka Barat   | 47                 | 22.7                             |
| 5  | Bangka Selatan | 43                 | 26.43                            |

**Table 1** presents the regional distribution of average number sense scores among MI students. When analyzed by region, the highest number sense achievement was observed in Pangkalpinang City, with an average score of 27.3, while the lowest was in Bangka Barat, with an average score of 22.7. These differences were statistically supported by an ANOVA test, which yielded a significance value of 0.016 ( $p < 0.05$ ), indicating that the variations in number sense achievement across regions are significant.

The observed pattern suggests that students in urban areas, such as Pangkalpinang City, generally perform better in number sense than those in more rural regions. This difference may be influenced by several contextual factors, including greater access to educational facilities, availability of more qualified and experienced teachers, and a more conducive learning environment in urban centers. Conversely, rural areas may face constraints in educational resources and opportunities for enriched mathematical experiences, which could limit the development of students' number sense.

In terms of school-level performance, the highest number sense achievement was attained by a public MI in Pangkalpinang, with an average score of 29.36, while the lowest was recorded by a public MI in West Bangka, with a score of 21.31. This substantial disparity indicates notable variations in quality among educational institutions, even those under the same governing ministry. The inferential statistical analysis using ANOVA produced a significance value of 0.003, further confirming that there are significant differences in number sense test performance based on the school attended.

### Number Sense Questions Remain Difficult for Students

An analysis of the test items revealed that only two out of thirty questions were classified as easy, based on students' success rates. Seven items were categorized as moderate in difficulty, while as many as 21 items fell into the difficult category. Notably, there was one item that none of the students answered correctly. This suggests that many students are still unfamiliar with problems requiring the use of estimation, understanding of ratios, number rounding, as well as the ability to compare quantities or construct alternative computational strategies (see **Table 2**).

**Table 2.** Number Sense Test Item Analysis

| Item Number and Question Description | Percentage of Correct Responses | Remarks |
|--------------------------------------|---------------------------------|---------|
|--------------------------------------|---------------------------------|---------|

|  |   |  |                    |
|--|---|--|--------------------|
| 8. Berapakah jumlah bintang pada gambar berikut?   |  | 97.66% (250 out of 256 students) correctly answered this question. | Easy Category      |
| 9. Manakah pecahan yang paling besar? Lingkari jawabanmu!  | A. $4568/4569$<br>B. $4569/4570$<br>C. $499/500$<br>D. $500/501$                  | 75.00% (192 out of 256 students) correctly answered this question. | Easy Category      |
| 13. Tanpa menghitung, lingkari manakah operasi yang menunjukkan hasil yang lebih besar.                            | A. $95 \times 4$<br>B. $94 + 96 + 98 + 100$                                       | 59.38% (152 out of 256 students) correctly answered this question. | Medium Category    |
| 23. Lingkari pernyataan yang tepat untuk $4/5 \times 3/2$  | A. Lebih dari $4/5$<br>B. Sama dengan $4/5$<br>C. Kurang dari $4/5$               | 44.14% (113 out of 256 students) correctly answered this question. | Medium Category    |
| 14. Berapa nilai pecahan yang direpresentasikan dari gambar yang berwarna (diarsir) berikut.                       |  | 0.78% (2 out of 256 students) correctly answered this question.    | Difficult Category |
| 5. Jika $36 \times 24 = 864$ , gunakan untuk menuliskan jawaban dari pertanyaan berikut.<br>$864 \div 360 = \dots$ |   | 0.00% (0 out of 256 students) correctly answered this question.    | Difficult Category |

### Overview of Teachers' Responses to the Metacognitive Awareness Scale Questionnaire

In addition to the number sense test, another instrument used in this study was the Metacognitive Awareness Scale Teacher Form, administered in the form of a questionnaire. This instrument was originally developed by [Sperling et al. \(2002\)](#). The teacher version of the metacognitive awareness scale consists of 12 items. The questionnaire was adapted by modifying the original student-focused items to suit teacher respondents. A three-point Likert scale was used (Always, Sometimes, Never), allowing respondents to choose the option that best represented their behavior. The scoring was assigned as follows: 1 = Never, 2 = Sometimes, and 3 = Always. The description of each item along with the average scores obtained from teacher responses is presented in [Table 3](#) as follows:

**Table 3.** Item Descriptions and Mean Scores of the Metacognitive Awareness Scale

| No | Item Description  | Average |
|----|---|---------|
| 1  | He/she knows whether he/she has understood something or not.                                    | 2.36    |
| 2  | He/she can learn independently when needed.   | 2.41    |
| 3  | He/she tries to use learning methods that have previously proven effective for him/her.         | 2.27    |
| 4  | He/she is aware of the material being studied in class.   | 2.48    |
| 5  | He/she learns more easily if prior knowledge about the topic has been acquired.                 | 2.51    |
| 6  | He/she creates drawings or diagrams to better understand the material.                          | 1.81    |
| 7  | He/she evaluates him/herself to determine whether the topic has been understood after studying. | 2.00    |
| 8  | He/she chooses the best solution by considering various ways to solve a problem.                | 2.23    |
| 9  | He/she tends to identify needs before starting to learn.  | 1.94    |
| 10 | He/she engages in self-introspection when learning something new.                               | 2.20    |
| 11 | He/she listens carefully to important information.  | 2.43    |
| 12 | He/she understands topics that interest him/her more easily.                                    | 2.70    |

Out of the 12 items in the Metacognitive Awareness Scale Teacher Form, the highest average response score was found in item 12, reaching 2.70, while the lowest average response score was

observed in item 6, with a value of only 1.81. The standard deviation of the twelve average response scores presented in [Table 3](#) is 0.26.

### **The Relationship Between Metacognitive Awareness and Number Sense**

Regarding the metacognitive aspect, teachers' perceptions indicate that MI students on Bangka Island exhibit a moderate level of metacognitive awareness. Students are considered capable of understanding lessons they enjoy, but they are not yet accustomed to planning their learning processes, evaluating their own thinking, or seeking alternative strategies when facing difficulties. Reflective learning strategies, such as creating visual notes, asking questions when unclear, or summarizing their understanding, have not yet become habitual.

With a significance value of 0.459 (greater than 0.05), the statistical test results indicate that metacognitive awareness does not have a significant correlation with number sense achievement. Students with high metacognitive awareness (as perceived by teachers) do not necessarily demonstrate higher number sense achievement, and vice versa. This could suggest that the metacognitive indicators measured through teacher perception may not accurately represent the students' actual conditions. Alternatively, it may imply that students' metacognitive awareness has not yet been directly integrated into their mathematics learning process, thus its impact on cognitive achievement has not yet manifested significantly.

### **Discuss**

The results of this study indicate that the number sense achievement of MI students on Bangka Island remains at a low level. The highest individual student score was 32 out of a maximum total score of 60, while the average score was only 42.7% (25.61 out of 60). This means that no student demonstrated a high level of mastery in number sense skills. Most students were only able to complete a small portion of the test items, particularly those related to estimation, number comparison, and flexible calculation strategies.

These findings confirm that number sense skills have not yet become an integral part of the mathematics learning process in MIs. Although the overall level is not categorized as low, the distribution of achievement indicates that most students remain at moderate to low levels, with no students reaching a high achievement level. This result is consistent with several previous studies, particularly those conducted on early primary school students, which also revealed weak understanding of deep numerical concepts ([Ronau, 2020](#); [Yang & Sianturi, 2021](#)) or research on junior high school student ([Fahlevi et al., 2016](#)). However, unlike some studies that concluded all students are at low levels ([Safitri et al., 2017](#)), the number sense achievement of MI students in this study shows some variation, albeit still below ideal standards.

### **Factors Contributing to Low Number Sense Achievement**

Understanding the underlying factors that contribute to students' low number sense achievement is essential for interpreting the observed lack of association between number sense and metacognitive awareness. While the main focus of this study is to examine the relationship between these two variables, exploring contextual and instructional influences provides critical insight into why students may struggle to demonstrate both numerical flexibility and reflective problem-solving skills. Without this context, the findings could be misinterpreted as merely a measurement artifact rather than a reflection of real educational conditions.

Investigating contributing factors such as teaching practices, curriculum structure, and instructional resources allows the study to situate its quantitative findings within the broader learning environment of Madrasah Ibtidaiyah students. By highlighting these contextual elements, this section not only justifies the observed low number sense scores but also helps to explain why metacognitive awareness might not be strongly associated with number sense in this setting. In other words, understanding these underlying conditions strengthens the interpretation of the main research findings and supports practical recommendations for improving mathematics education at the MI level.

The low achievement in number sense cannot be separated from various interrelated factors. First, the human resource conditions at MI on Bangka Island remain varied, particularly regarding teachers' pedagogical competence. Many teachers are not yet accustomed to implementing contextual approaches or encouraging students to think reflectively when solving mathematics problems (Amalia et al., 2024; Kolar & Hodnik, 2021). Conversely, most teachers still rely on procedure- and algorithm-based teaching methods, emphasizing mechanical steps (Barokah & Mahmudah, 2025) rather than understanding the meaning of numbers or developing numerical flexibility.

Second, MI students in this study appear more comfortable using rule and operation-based (conventional) methods when solving problems. For example, in estimation tasks, most students preferred to calculate manually rather than estimate the result. This indicates that number sense skills, such as estimating, comparing, or recognizing patterns, have not been systematically cultivated in the classroom (Corso et al., 2024).

This pattern is likely influenced by the textbooks used in schools. As noted in several studies, mathematics textbooks play a significant role in shaping students' learning approaches. If textbooks emphasize conventional calculation problems and do not present a variety of questions that require numerical reasoning, this will directly limit the development of students' number sense. Teachers who rely entirely on textbooks in their instruction tend to replicate this pattern without meaningful modification (Petersson et al., 2023; Sayers et al., 2021).

Third, the curriculum used in madrasahs does not explicitly emphasize the development of all components of number sense. In contrast, some other education systems, such as in Turkey, have integrated all aspects of number sense, that estimation, numerical flexibility, understanding of fractions, and others into the curriculum objectives, which are then explicitly translated into the learning process. In Indonesia, the number sense content within the Elementary School/Madrasah

Ibtidaiyah Mathematics Curriculum remains implicit and fragmented across various topics, without clear strategic guidance for developing comprehensive numerical understanding. Furthermore, the lack of professional training for teachers and the inclusion of technology to enhance number sense instruction also contributes to these findings (Fahlevi, 2022a).

### The Relationship Between Number Sense and Metacognitive Awareness

Based on [Table 4](#) below, with a significance value of 0.459 (greater than 0.05) and an  $R^2$  value of 0.002, indicating that the influence of the metacognitive scale variable on number sense achievement is only 0.2%, it is concluded that there is no significant correlation between the average number sense test scores and teachers' responses to the metacognitive awareness scale in this study. One important finding of this research is the absence of a significant relationship between number sense achievement and students' metacognitive awareness levels. Although many theoretical frameworks and references suggest that metacognitive awareness, such as the ability to plan, monitor, and evaluate learning strategies, should support cognitive performance like number sense, the empirical results of this study do not show such a relationship. This finding supports a few other studies reporting no significant correlation between metacognition and mathematics achievement ([Baer & Odic, 2020](#)).

**Table 4.** Simple Regression Analysis Between Number Sense and Metacognitive Scale

| Model | Unstandardized Coefficients |            | Beta  | t     | Sig.  | $R^2$ | F     |
|-------|-----------------------------|------------|-------|-------|-------|-------|-------|
|       | B                           | Std. Error |       |       |       |       |       |
| 1     | (Constant) 23.853           | 2.440      |       | 9.776 | 0.000 | 0.002 | 0.550 |
|       | JumlahSM 0.065              | 0.087      | 0.046 | 0.742 | 0.459 |       |       |

a. Dependent Variable: SkorNS

This may occur because number sense is believed to be more influenced by concrete experiences, direct interaction with numbers, and a learning environment that encourages mathematical exploration and discussion, rather than by general reflection or learning planning. On the other hand, this finding differs from some studies indicating that increased metacognitive awareness positively impacts students' numerical achievement. This discrepancy may be due to the nature of students' metacognition still being general and not domain-specific to numeracy. In other words, although students possess learning awareness, they may not yet be able to apply it directly within the context of mathematical thinking. This is also reflected in the simple linear regression test results, which show that the metacognitive scale is not a significant predictor of students' number sense achievement.

Following these findings, the researcher proceeded to compile individual number sense achievement reports for each student in every MI, accompanied by contextual recommendations tailored to each school. Three main strategies are recommended to improve number sense achievement: (1) Implementation of Number Talks: Facilitate open classroom discussions about numbers, where students are encouraged to share their thinking processes, compare strategies, and collaboratively build an understanding of numerical concepts. (2) Strengthening Basic Math Facts: Instill conceptual understanding of basic number facts rather than mere memorization, enabling

students to be more flexible in solving problems. (3) Practice Problems Supporting Number Sense Skills: Teachers are advised to design or select problems that not only emphasize computational results but also assess numerical reasoning, estimation, and alternative strategies.

## CONCLUSIONS

This study indicates that the number sense achievement of MI students on Bangka Island remains relatively low, with most students struggling with problems that require estimation, flexible thinking, and conceptual understanding of numbers. Although students were perceived by teachers to have a moderate level of metacognitive awareness, statistical analysis revealed no significant relationship between metacognitive awareness and number sense ability. This finding challenges the theoretical assumption that closely links these two concepts, particularly within the context of Madrasah Ibtidaiyah education, which has its own unique curricular and pedagogical characteristics. Factors such as teacher background, procedural teaching approaches, limited professional training, and the role of the out-of-class learning environment are important variables contributing to students' weak numerical achievement. Therefore, the development of number sense in MI students should focus on learning strategies based on numerical exploration, reflective discussion, and contextual mathematical experiences from an early stage, without relying exclusively on general metacognitive indicators.

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