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Gender Differences in Multidimensional Mathematics Attitudes Among Junior Secondary Students: A Cross-Sectional Survey in the Indonesian Context

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Abstract

Mathematics attitudes play a critical role in shaping students' engagement, achievement, and long-term participation in STEM-related pathways. This study aimed to examine gender differences across four dimensions of mathematics attitudes—self-perceptions, value of mathematics, enjoyment, and perceived mathematics achievement—among junior secondary students in Indonesia. A quantitative cross-sectional survey design was employed involving 60 seventh-grade students (30 male and 30 female) selected through convenience sampling. Data were collected using an adapted version of the Attitudes Toward Mathematics Scale for Indonesian Students (ATMSE), comprising 26 items measured on a four-point Likert scale. Descriptive statistics based on median values were used to analyze gender-based patterns across dimensions. The findings indicate that both male and female students exhibit moderate, but not strongly positive, attitudes toward mathematics. Self-perceptions and enjoyment were generally situational and cautious, while perceived achievement emerged as the weakest dimension, with consistently low-to-moderate median scores across genders. Gender differences were minimal and largely descriptive rather than substantial, suggesting convergent attitudinal tendencies within this context. The results highlight a potential discrepancy between students' classroom participation and the internalization of a confident mathematics identity. Strengthening students' academic self-concept, reinforcing authentic recognition of achievement, and connecting mathematical learning to meaningful future pathways are recommended as strategic directions for pedagogical intervention. Future research employing inferential and longitudinal designs is needed to examine how these attitudinal profiles evolve and influence sustained engagement in mathematics and STEM trajectories.

INTRODUCTION

Mathematics occupies a central position in contemporary education systems as a foundational discipline shaping academic trajectories and long-term participation in STEM-related careers. Beyond cognitive competence, students' success in mathematics is strongly influenced by affective dispositions, including confidence, enjoyment, anxiety, and perceived value (Wen & Dubé, 2022; Dowker & Sheridan, 2022). Empirical evidence demonstrates that mathematics attitudes are significantly associated with behavioral engagement and performance outcomes, suggesting that how students think and feel about mathematics directly influences how they act and achieve (Wang et al., 2022). Conceptually, mathematical attitude has increasingly been framed as a multidimensional construct encompassing cognitive beliefs, affective reactions, and behavioral

tendencies (Aquilina et al., 2025). Moreover, attitudes are contextually shaped and may vary across learning domains, including specific areas such as mathematical word problem solving (Wakhata et al., 2022), as well as across multicultural educational environments (Alemany-Arrebola et al., 2025).

A substantial body of international research highlights persistent gender-related differences in attitudes toward and achievement in mathematics. Although performance gaps are often small or inconsistent across contexts (Lu et al., 2023; Le et al., 2023), gender differences in mathematics self-concept, anxiety, and identity are more consistently documented (Andersen & Smith, 2024). Mathematics–gender stereotype endorsement has been shown to influence anxiety, self-concept, and performance differently for boys and girls (Rossi et al., 2022), and broader sociocultural conditions moderate the magnitude of these disparities (Balducci, 2023). Gendered representations in textbooks (Guichot-Reina & De la Torre-Sierra, 2023), classroom climate and perceived female representation (Andersen & Smith, 2024), and sociocultural determinants of course selection (Kirkham & Chapman, 2022) further shape students' mathematical engagement. Additionally, individual, interpersonal, and sociocultural contributors to mathematics anxiety have been identified as mechanisms underlying gendered patterns (Retanal & Maloney, 2026). These disparities have long-term implications, as mathematics identity and sustained engagement significantly influence entry into STEM pathways (Akin et al., 2024), while broader structural inequalities affect participation trajectories (Bottia et al., 2022).

Despite extensive global scholarship, conceptual fragmentation remains a challenge in research on mathematical attitudes. Systematic reviews reveal inconsistencies in how attitudes are defined and operationalized, with studies often isolating affective, cognitive, or behavioral components without integrating them into a unified framework (Wen & Dubé, 2022). Furthermore, while cross-national research demonstrates variability in gender gaps (Lu et al., 2023), empirical investigations in Indonesia remain comparatively limited. Existing Indonesian studies have primarily focused on the adaptation and validation of mathematics attitude measures (Suherman & Vidákovich, 2022), the development of mathematics efficacy scales (Mubarrak et al., 2022), and the examination of gender differences in mathematics anxiety and achievement (Arifin & Kismiantini, 2023). However, comprehensive analyses integrating multidimensional mathematics attitudes and gender within Indonesia's sociocultural context are still scarce. This limitation limits a deeper understanding of how cognitive, affective, and behavioral dimensions interact to shape gendered mathematics engagement.

Grounded in a multidimensional cognitive–affective–behavioral framework of mathematics attitude (Aquilina et al., 2025; Lv et al., 2025), this study conceptualizes attitude as an integrated system of beliefs about competence and utility, emotional responses such as enjoyment or anxiety, and behavioral tendencies toward engagement. Prior empirical findings demonstrate that these dimensions are closely interconnected: cognitive self-concept and perceived value influence behavioral engagement (Wang et al., 2022), while anxiety and affective reactions are systematically related to performance differences across gender (Retanal & Maloney, 2026). Building on this evidence, the present research addresses both conceptual fragmentation and contextual limitations by systematically examining how these interrelated components operate within the Indonesian educational context, where multidimensional and gender-integrated analyses remain limited.

Furthermore, gender is treated not as a biological determinant but as a socially constructed phenomenon shaped by stereotype endorsement, classroom climate, and sociocultural expectations (Kirkham & Chapman, 2022). This perspective allows for a more nuanced interpretation of how cognitive beliefs, affective experiences, and participation patterns may

diverge between female and male students within specific sociocultural environments. By situating the analysis within broader discussions of gender equity and STEM participation, the study aims to (1) identify gender differences across cognitive, affective, and behavioral dimensions of mathematics attitudes, and (2) generate empirically grounded insights to inform early and context-sensitive interventions that may reduce the risk of widening disparities and support equitable entry into STEM trajectories (Edwards et al., 2023).

METHODS

This study employed a quantitative, cross-sectional survey design to examine gender differences in students' attitudes toward mathematics. Cross-sectional surveys are widely used to generate standardized and comparable data within natural educational settings, particularly when the objective is to identify patterns across defined student populations (Gumbi et al., 2024; Wang et al., 2023). The design was grounded in a positivist orientation, emphasizing objective measurement, structured instruments, and statistical comparison of group tendencies. Consistent with established procedures in survey research, the study progressed through sequential stages: formulation of research objectives, identification of the target population, determination of sample characteristics, adaptation of the measurement instrument, administration of the survey, and statistical analysis of the collected data.

The research was conducted at a private junior high school in Karawang, Indonesia, during the 2024/2025 academic year. The target population comprised all seventh-grade students enrolled in the institution (N = 128). A convenience sampling technique was used, including students who were accessible during the data collection period and consented to participate. Convenience sampling is frequently adopted in school-based research when access to participants is bounded by institutional and temporal constraints (Eniego et al., 2025; Nie et al., 2025). A total of 60 students participated, representing approximately 46.9% of the population. To enable balanced gender comparison, the final sample consisted of 30 male and 30 female students, thereby allowing symmetrical analysis of gender-based differences in mathematics attitudes.

Data were collected using an adapted version of the *Attitudes Toward Mathematics Scale for Indonesian Students (ATMSE)*, which has been previously validated for use in the Indonesian educational context. The instrument consisted of 26 items organized into four subscales reflecting a multidimensional understanding of mathematics attitudes: (1) Self-Perceptions (6 items), measuring beliefs about competence and confidence; (2) Value of Mathematics (6 items), assessing perceived usefulness and importance; (3) Enjoyment of Mathematics (8 items), capturing affective engagement; and (4) Perceived Mathematics Achievement (6 items), evaluating self-assessed performance. The multidimensional structure aligns with contemporary psychometric approaches to the measurement of mathematics attitudes, which emphasize validity and reliability across cognitive and affective domains (Özçakır & Özdemir, 2022; Kılıç & Bölükbaş, 2025; Szczygieł, 2023). Each item was rated on a four-point Likert scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). Likert-type scaling is widely recognized as an effective approach for capturing attitudinal variability while enabling structured quantitative comparison (Robinson, 2023). The absence of a neutral midpoint was intended to encourage directional responses and reduce central tendency bias. Prior to administration, the instrument was reviewed to ensure clarity of wording and contextual appropriateness for seventh-grade students.

Data collection was conducted in October 2024 at the conclusion of a regular instructional session. Students were informed of the study's academic purpose and assured that participation would not affect their grades or academic standing. The survey was administered in paper-based

format and completed within approximately 15 minutes. Participation was voluntary, and responses were anonymous to minimize social desirability bias. All distributed questionnaires were returned, yielding a 100% response rate. Completed surveys were coded and categorized by gender for subsequent analysis.

Given that Likert-scale responses generate ordinal data, descriptive statistics emphasizing robust measures of central tendency were employed. The median was used as the primary summary statistic for each subscale and the overall attitude score to ensure appropriate representation of ordinal responses. Median comparisons were conducted across the four attitude dimensions to examine gender-based differences while avoiding distortions associated with parametric assumptions for ordinal-scale data. Statistical processing was conducted using dedicated software to ensure accuracy in tabulation and comparison. This analytical strategy enabled a structured examination of gender patterns across cognitive (self-perceptions and perceived achievement), affective (enjoyment), and value-related components of mathematics attitudes, thereby aligning methodological rigor with the study's research objectives.

RESULT

The findings are organized into four dimensions of students' attitudes toward mathematics: (1) Self-Perceptions, (2) Value of Mathematics, (3) Enjoyment of Mathematics, and (4) Perceived Mathematics Achievement. Each dimension is presented descriptively using frequency distributions and median values to examine gender-based patterns. Because responses were measured on a four-point Likert scale, medians were used to summarize central tendencies. The analysis focuses on identifying directional tendencies and comparing patterns between male and female students.

Self-Perceptions

Self-perceptions refer to students' beliefs about their competence, understanding, and confidence in mathematics.

Table 1. Items and Median Values of the Self-Perceptions Aspect

No.	Item	Male (n=30) SD	D	A	SA	Female (n=30) SD	D	A	SA	Median Male	Median Female
1	I am really good at math	2	13	10	5	1	15	14	0	2	2
2	I understand math	1	9	16	4	0	9	20	1	3	3
3	I can solve difficult math problems	8	12	7	3	12	14	4	0	2	2
4	Math is very hard for me	4	13	9	4	0	10	15	5	2	3
5	Math is confusing to me	4	12	11	3	0	13	13	4	2	3
6	I can tell if my answers in math make sense	0	2	15	13	1	5	18	6	3	3

Table 1 shows that both male and female students exhibit moderate levels of self-perception regarding their mathematical abilities, as reflected in median values predominantly ranging from 2 to 3. On positively framed competence statements—such as "I am really good at math" and "I understand math"—both groups show comparable medians (2–3), indicating cautious agreement about their understanding of mathematical content but an absence of strong self-assuredness. When

addressing more demanding cognitive tasks, particularly the ability to solve difficult mathematical problems (Item 3), both genders report a median of 2, suggesting uncertainty and limited confidence in managing complex or higher-order mathematical challenges. Notably, on negatively worded items—"Math is very hard for me" and "Math is confusing to me"—female students display slightly higher median values (3), reflecting stronger agreement with statements describing mathematics as challenging. This pattern may indicate heightened academic self-awareness or sensitivity to perceived difficulty rather than objectively lower competence. Meanwhile, both male and female students report a median of 3 on the metacognitive item assessing their ability to judge whether their answers make sense, suggesting relatively stable confidence in evaluating their own work. Taken together, the self-perception dimension portrays a profile of moderate but not robust mathematical confidence across genders, with minor variations that do not translate into substantial differences in overall central tendency.

Value of Mathematics

This dimension captures students' perceptions of the usefulness, importance, and relevance of mathematics.

Table 2. Items and Median Values of the Mathematics Aspect

No.	Item	Male SD	D	A	SA	Female SD	D	A	SA	Median Male	Median Female
1	I feel confident in solving math problems	5	10	9	6	2	17	10	1	2	2
2	I am good at math	6	10	13	1	3	19	8	0	2	2
3	I understand teacher explanations easily	0	13	11	6	2	11	14	3	3	3
4	Mathematics is interesting	6	4	10	10	6	7	10	7	3	3
5	I would like to use math in my future job	2	13	10	5	3	13	9	5	2	2
6	I spend lots of time practicing math	6	15	5	4	4	10	8	8	2	3

The Value of Mathematics dimension reflects broadly consistent perceptions between male and female students, with median scores indicating similar evaluative tendencies. Both groups report a median of 3 on the statement "Mathematics is interesting," suggesting a shared acknowledgment that the subject possesses intellectual appeal and classroom relevance. This agreement indicates that mathematics is not perceived as inherently disengaging by either gender. However, when the focus shifts to long-term orientation—specifically the intention to use mathematics in future careers—the median decreases to 2 for both groups, signaling a limited connection between current mathematical learning and future professional aspirations. This pattern suggests that although students may appreciate mathematics in the classroom, they do not strongly internalize its instrumental value for career development. A slight gender difference emerges in practice-related behavior: female students report a median of 3, compared to 2 for male students, indicating somewhat stronger commitment to sustained engagement and practice. Nevertheless, these differences remain modest. Overall, the findings suggest that students recognize the immediate value and interest of mathematics but do not firmly associate it with long-term

academic or occupational trajectories, and gender-based distinctions within this dimension are minimal.

Enjoyment of Mathematics

This aspect examines affective responses, including interest, comfort, and perceived ease.

Table 3. Items and Median Values of the Enjoyment of Mathematics Aspect

No.	Item	Male SD	D	A	SA	Female SD	D	A	SA	Median Male	Median Female
1	I do math homework with joy	4	12	9	5	3	17	9	1	2	2
2	I would choose math electives	12	11	6	1	10	13	6	1	2	2
3	Math class material is interesting	3	8	15	4	1	11	13	5	3	3
4	Math is one of the most boring subjects	6	14	2	8	2	13	15	0	2	2
5	I like mathematics	6	7	11	6	3	13	12	2	3	2
6	Studying math is boring	7	14	6	3	5	15	10	0	2	2
7	I feel comfortable doing math problems	1	10	14	5	3	10	10	7	3	3
8	Doing math is easy for me	7	11	8	4	8	18	4	0	2	2

The Enjoyment of Mathematics dimension indicates moderate levels of affective engagement among both male and female students, with only slight variations between the groups. Median values of 3 on items such as "The subject taught in mathematics classes is very interesting" and "I feel comfortable doing math problems" suggest that students generally experience a positive emotional response in the classroom. These findings imply that mathematics is not perceived as overwhelmingly unpleasant and that students feel reasonably at ease when engaging with routine mathematical tasks. However, this affective positivity does not extend strongly to voluntary engagement. The item concerning elective course preference yields a median of 2 for both genders, indicating limited intrinsic motivation to pursue mathematics beyond compulsory requirements. Although female students show marginally stronger agreement on statements related to classroom interest, and male students display slightly higher endorsement on the statement "I like mathematics," these differences remain minor and do not alter the overall pattern of central tendency. Collectively, the results suggest that enjoyment of mathematics is largely situational—emerging within structured classroom experiences—rather than deeply internalized as a stable personal interest. Both male and female students demonstrate moderate, but not high, affective commitment to the subject.

Perceived Mathematics Achievement

This dimension measures students' self-evaluations of success and perceived recognition from peers and teachers.

Table 4. Items and Median Values of the Perceived Mathematics Achievement Aspect

No.	Item	Male SD	D	A	SA	Female SD	D	A	SA	Median Male	Median Female
1	My friends think I am successful in math	8	8	12	2	5	13	12	0	2	2
2	I see myself as successful in math	10	9	10	1	11	16	2	1	2	2
3	I think I am a good math student	6	15	8	1	14	11	3	2	2	2
4	I am sure I will succeed in math class	5	11	11	3	3	15	11	1	2	2
5	My friends see me as successful in math	8	11	8	3	10	13	7	0	2	2
6	My teachers see me as successful in math	5	11	12	2	5	17	7	1	2	2

Table 4 shows consistently low to moderate levels of perceived mathematics achievement among both male and female students, as reflected in a uniform median of 2 across all items. This pattern indicates that students generally lean toward mild disagreement or only cautious agreement when evaluating their success in mathematics. Statements addressing self-recognition as a successful mathematics student, as well as perceptions of peer and teacher acknowledgment, do not elicit strong affirmative responses from either group. Instead, the distribution of responses suggests restrained self-evaluation rather than overt academic confidence. Importantly, gender differences within this dimension are minimal, with both male and female students demonstrating similar medians and response tendencies. Perceived achievement, therefore, appears to be a shared concern rather than a distinctly gendered disparity. The overall pattern points to a potential disconnect between students' participation in mathematics classrooms and their internalized academic identity, in which learners neither fully endorse nor entirely reject their competence, but remain in a zone of cautious self-assessment.

When examining patterns across all four dimensions collectively, a coherent profile emerges. Students display moderate self-perceptions (median 2–3), recognize the value of mathematics (median 2–3), and report situational enjoyment within classroom contexts (median 2–3), yet express comparatively lower perceived achievement (median 2). Gender differences remain descriptive and limited rather than substantial. Female students show slightly stronger indications of diligence and classroom-related interest, whereas male students demonstrate marginally stronger endorsement of liking mathematics in isolated statements; however, these differences do not meaningfully alter the central tendency patterns. Overall, both male and female students maintain cautious, though not strongly positive, attitudes toward mathematics. Among the four dimensions, perceived achievement emerges as the most critical area of concern, as confidence in recognized success remains relatively subdued for both groups, potentially influencing long-term mathematical engagement and identity formation.

DISCUSSION

The present study examined gender differences across four dimensions of students' attitudes toward mathematics: self-perceptions, value of mathematics, enjoyment, and perceived achievement. The findings indicate that both male and female students demonstrate moderate, though not strongly positive, attitudes, with only minor differences between the gender groups. This pattern is consistent with research suggesting that gender differences in mathematics-related affect are often smaller and more context-dependent than commonly assumed (McLure et al., 2022). Rather than revealing polarized attitudes, the results point to broadly convergent attitudinal tendencies across genders, particularly in early secondary education.

Regarding self-perceptions, students from both groups expressed cautious confidence in their mathematical abilities. Although many students believed they understood mathematics, their confidence declined when faced with more demanding tasks, such as solving difficult problems. This distinction aligns with evidence showing that mathematics self-concept and self-efficacy are closely linked to performance on higher-order tasks and problem-solving competence (Julius, 2022; Agustina et al., 2024). Prior studies further indicate that mathematics self-efficacy develops through mastery experiences and classroom practices that support autonomy and feedback (Awofala, 2023; Zhu & Kaiser, 2022), yet students' confidence often remains moderate rather than strong (Street et al., 2024; Bendol & Dalayap Jr., 2025). Interestingly, female students in this study showed slightly stronger agreement with negatively framed items describing mathematics as difficult or confusing, though this did not substantially lower their overall medians. Research suggests that such patterns may reflect differences in self-evaluative tendencies rather than actual competence disparities (Rahe & Quaiser-Pohl, 2023). Importantly, both genders reported relatively stable confidence in evaluating whether their answers made sense, indicating functional metacognitive awareness. This finding is consistent with evidence that metacognitive awareness mediates the relationship between attitudes and reasoning performance in mathematics (Telaumbanua et al., 2024; Tak et al., 2025).

In terms of perceived value, students from both genders recognized mathematics as interesting and important but did not strongly associate it with future career aspirations. This divergence between classroom appreciation and long-term orientation resonates with expectancy-value perspectives, which suggest that students' perceived utility value influences sustained engagement and participation in STEM (Mayerhofer et al., 2024). While students may acknowledge mathematics as academically meaningful, limited career-related motivation may reduce their long-term persistence. The slight gender difference observed in practice-related engagement, with female students reporting somewhat greater diligence, aligns with findings indicating that beliefs and motivation are shaped by classroom contexts and instructional practices (Pedersen & Haavold, 2023). Overall, however, value-related perceptions appear largely comparable across genders.

Regarding enjoyment, the results suggest that students experience mathematics positively within structured classroom settings but do not display strong intrinsic motivation to extend engagement beyond compulsory requirements. Both groups reported interest in classroom material and comfort with problem-solving, yet elective course preference remained low. This pattern supports the distinction between situational interest—triggered by classroom context—and more enduring individual interest (Brakhage et al., 2023). Research on intrinsic motivation in mathematics similarly shows that classroom interventions can temporarily enhance enjoyment, but sustained motivation requires deeper integration of identity (Amjad et al., 2023). The small gender variations observed in classroom interest are consistent with prior studies indicating that emotional

climate and instructional design influence affective engagement more strongly than gender alone (McLure et al., 2022).

Perhaps the most notable finding concerns perceived mathematics achievement. Across items, both male and female students reported uniformly low to moderate medians, indicating restrained self-assessment of success and limited perception of peer or teacher recognition. This cautious appraisal aligns with research demonstrating that perceived achievement and mathematics self-concept are strong predictors of actual performance and persistence (Ding et al., 2024; Awado et al., 2024). When students do not internalize recognition of success, their academic identity may remain underdeveloped, potentially constraining long-term engagement in mathematics-related pathways. The absence of pronounced gender disparity in this dimension further suggests that the primary concern may not be gender inequality per se, but rather the overall level of restrained academic confidence among students.

Taken together, the findings indicate that gender differences in mathematics attitudes within this sample are relatively limited, with both groups exhibiting moderate engagement and cautious self-belief. The most critical issue emerging from the analysis is the generally low level of perceived achievement, which may hinder the consolidation of a confident mathematics identity. Strengthening students' academic self-concept, fostering authentic recognition of competence, and connecting mathematical learning to meaningful future trajectories may therefore represent key directions for instructional intervention. Future research employing inferential and longitudinal approaches would help clarify whether these moderate attitudinal profiles persist over time and how they relate to sustained participation in advanced mathematics and STEM pathways.

CONCLUSIONS

This study aimed to examine gender differences across four dimensions of students' attitudes toward mathematics—self-perceptions, value of mathematics, enjoyment, and perceived achievement—within a junior secondary school context. The findings indicate that both male and female students demonstrate moderately positive but cautious attitudes toward mathematics, with only minor gender variations. Overall, attitudinal patterns appear more convergent than polarized, suggesting that gender differences in this context are limited in magnitude and largely descriptive rather than substantial. Across dimensions, students reported moderate self-perceptions and situational enjoyment, as well as recognition of the importance and interest of mathematics. However, these positive orientations were not accompanied by strong career-related intentions or deeply internalized intrinsic motivation. The most critical finding concerns perceived mathematics achievement, where both male and female students reported consistently low to moderate confidence in their success and in recognition from peers and teachers. This restrained self-assessment suggests a potential gap between classroom engagement and the development of a confident academic identity in mathematics. The absence of pronounced gender disparities indicates that the primary challenge may not lie in gender inequality per se, but in strengthening students' overall academic self-concept and sense of achievement. Interventions aimed at reinforcing authentic feedback, promoting mastery-oriented instructional practices, and explicitly connecting mathematical learning to meaningful future pathways may help enhance students' confidence and identity formation. Future research should incorporate inferential statistical testing and longitudinal designs to determine whether these moderate attitudinal patterns persist over time and how they influence sustained engagement in advanced mathematics and STEM-related trajectories. Expanding the sample across diverse school contexts would also enhance the

generalizability of findings and contribute to a more comprehensive understanding of gender and mathematics attitudes in secondary education.

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