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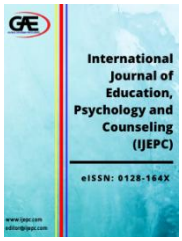

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GENDER DIFFERENCES IN MATHEMATICS ATTITUDES: SELF-CONFIDENCE, ENJOYMENT, AND PERCEIVED VALUE AMONG COMPUTER SCIENCE STUDENTS

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Abstract:

This study investigates gender differences in attitudes toward mathematics among first-year Computer Science (CS) students, focusing on three key dimensions: self-confidence, enjoyment, and value. Understanding students' affective orientations toward mathematics is crucial, as these attitudes can influence their engagement, persistence, and performance in mathematics-related courses. The study aims to determine whether male and female students differ significantly in their levels of self-confidence, the value they place on mathematics, and the degree of enjoyment they derive from the subject. A total of 114 first-year CS students participated in the study and completed a structured questionnaire designed to measure the three attitude dimensions. The instrument's reliability was confirmed through internal consistency analysis, while the Mann–Whitney U test was employed to assess gender differences in the responses. The findings revealed no statistically significant gender differences in self-confidence and enjoyment, suggesting that male and female students hold similar levels of belief in their mathematical abilities and experience comparable levels of positive affect toward the subject. However, the analysis identified a small but significant difference in perceived value, with female students reporting a stronger recognition of mathematics as valuable in their academic and professional pursuits than their male counterparts.

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These results suggest that while self-confidence and enjoyment in mathematics appear unaffected by gender among CS students, female students may place greater importance on the role of mathematics in their studies and future careers. The study contributes to the growing body of literature on gender and mathematics attitudes, highlighting the need for educators to acknowledge and leverage these perceptions to foster equitable and supportive learning environments.

Keywords:

Mathematics Attitudes, Gender Differences, Self-Confidence, Value, Enjoyment

Introduction

Attitudes toward mathematics commonly conceptualised as encompassing cognitive beliefs, affective responses, and motivational factors play a crucial role in shaping students' engagement, achievement, and long-term participation in science, technology, engineering, and mathematics (STEM) pathways. Negative attitudes, including low self-confidence, low relevance, and high mathematical anxiety, are consistently associated with lower academic achievement, avoidance of courses requiring high math skills, and reduced participation in STEM-related careers. Schools and higher education institutions need to implement effective strategies to cultivate a positive attitude towards the subject, engage students' interest, and continue supporting their mathematics success to address this issue.

Students' attitudes toward mathematics are also a key factor influencing their academic achievement. Numerous studies (Mazana et al., 2019; Mensah & Okyere, 2019; Michelli, 2013) have examined the relationship between students' attitudes toward learning mathematics and their academic achievement. These studies consistently indicate a positive relationship between mathematics attitude and academic performance. As gender is considered an essential factor determining mathematics achievement, much research has been conducted and reported significant gender differences in students' attitudes toward mathematics (Amalu, 2016; Boran, Aslaner & Cakan, 2013; Lee & Anderson, 2015).

Consistent studies show that students' attitudes towards mathematics, particularly self-confidence, perceived value, and enjoyment, influence their academic engagement, decision-making, and performance. Gender differences in these affective dimensions have been well documented. While prior research has consistently demonstrated that male and female students often perform at comparable levels in mathematics, their perceptions, beliefs, and affective responses toward mathematics differ markedly. For example, a study in the U.S reported that female students showed lower interest, enjoyment, and confidence in mathematics compared to their male peers (Campbell et al., 2025). International level analyses, including TIMSS-based meta-analyses, indicate that male students report higher self-confidence, deeper interest, and greater appreciation for mathematics in various countries (Ghasemi & Burley, 2019). Girls often report lower levels of self-confidence and higher levels of anxiety, even though their academic achievements are equivalent at the primary school level, thus highlighting a significant gap in self-confidence. (Rodríguez et al., 2020).

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Hence, this study examines gender differences in attitudes towards mathematics among Computer Science students, focusing on self-efficacy, enjoyment, and their value in mathematics. The aim is to determine whether there are significant differences between male and female students in these dimensions. Since mathematics is essential in the science and technology field, this study is expected to provide some significant benefits, as it offers educational insights on how gender can influence attitudes towards mathematics, thereby assisting educators and curriculum designers in developing more inclusive and effective teaching strategies.

Literature Review

Self-Confidence towards Mathematics

Mathematical confidence is affected by intrinsic factors such as self-efficacy, motivation and self-concept, as well as extrinsic elements such as classroom environment, teacher support, peer interaction and parental involvement (Bendol & Dalayap, 2021). Setiawan et al. (2022) found a positive relationship between self-confidence and students' mathematical understanding. Students with high confidence can make decisions and generate ideas when solving problems. In contrast, students with low confidence tend to struggle with concepts, rely on memorization and hesitate to make decisions during problem-solving. According to Riboroso et al. (2018), low self-confidence in many students contributes to increased mathematics anxiety.

Enjoyment towards Mathematics

Enjoyment represents a critical positive affective dimension of learning mathematics. However, many students lack enjoyment in engaging with the subject. According to Hastuti (2020), students' enjoyment is enhanced when teachers design activities that make learning mathematics engaging and pleasurable. Indicators of enjoyment consist of learning mathematics, participating in mathematical discussions, perceiving new problems as challenges, and experiencing happiness in mathematics classes (Dewanti et al., 2020). Additionally, a study by Tukiman et al. (2024) found that using interactive learning methods, such as educational games, effectively increases students' enjoyment and engagement in mathematics.

Value toward Mathematics

Beliefs and values in learning mathematics involve individuals' feelings, thoughts, and perceptions toward the subject. These factors significantly influence their approach to mathematical tasks, their confidence in mathematics, and the extent to which they perceive mathematics as necessary (Sediarin et al., 2023). Schukajlow and Rellensmann (2022) note that students who value mathematics are more engaged and confident in their mathematical abilities. Moreover, Edu et al. (2025) outlined five key themes in studying students' perceptions of the value of mathematics, such as the importance of mathematics in daily life, perspectives on mathematics, its educational value, challenges and misconceptions, and its modern relevance.

Gender Differences in Self-Confidence, Value and Enjoyment towards Mathematics

Gender differences in students' attitudes toward mathematics have been widely examined, particularly regarding self-confidence, perceived value, and enjoyment. Extensive research has examined gender differences in math anxiety and self-concept, consistently finding that girls

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often report greater anxiety and lower confidence in their mathematical abilities (Casey et al., 1997; Fredricks & Eccles, 2002; McGraw et al., 2006). Mejía-Rodríguez et al. (2021) also found lower self-concepts in girls, even when their actual performance is considered. A study in Malaysia found that female secondary students reported significantly greater enjoyment, perceived usefulness, and intention to use gamified mathematics learning approaches than male students, suggesting that interactive instructional strategies may positively influence girls' engagement more than boys' (Zainuddin et al., 2025). However, Gaspard et al. (2015) research has shown that girls perceive mathematics as less personally meaningful and less relevant to their everyday lives and future careers than boys.

Hypotheses of the Present Study

The researcher developed three null hypotheses for this study based on the three dimensions of mathematics attitude (Self-Confidence, Enjoyment, and Value). The summary of the hypothesis statement is as follows:

H_{0_1} : There is no difference in the distribution of self-confidence scores between male and female students towards mathematics.

H_{0_2} There is no difference in the distribution of enjoyment scores between male and female students towards mathematics.

H_{0_3} : There is no difference in the distribution of perceived value scores between male and female students towards mathematics

Methodology

Sample and Procedure

The population comprised university students enrolled in pre-calculus courses of the Computer Science (CS) program. A non-probabilistic convenience sampling was applied by distributing a survey via Google Forms, which was shared through the instant messaging application (WhatsApp) to facilitate wider access to participants. This study involved 114 students in their first year of university, representing individuals at the initial stage of their higher education journey.

Instruments

To examine gender differences among Computer Science students, the study questionnaire was adapted and modified from the items of Majeed et al. (2013) Attitude Toward Mathematics Inventory (ATMI). The first section collects demographic information from respondents, including gender, and their Mathematics results in the SPM examination. The second section consists of 16 items rated on a 5-point Likert scale, ranging from strongly disagree to strongly agree. This section measures respondents' level of agreement in three dimensions of attitude towards mathematics: 7 items focused on Self-confidence, 5 items on Value, and 4 items on Enjoyment.

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Statistical Analysis

The IBM SPSS-26 programs were used for data analysis. First, the reliability, validity, and fit of the measurement model were tested. Next, the normality test was used to determine whether a dataset is approximately normally distributed. The Mann–Whitney U test was used to test the research hypotheses.

Analysis and Findings

Descriptive Statistics

Table 1 shows the gender distribution of CS students enrolled in the Pre-Calculus course. The sample comprised 114 students, of whom 50 (43.48%) were male and 65 (56.52%) were female.

Table 1: Gender Distribution of Respondents

Gender	Number of students	%
Male	50	43.86
Female	64	56.14
Total	**114**	**100.00**

Reliability Analysis

The reliability of the questionnaire was evaluated by assessing the internal consistency of the items corresponding to each factor using Cronbach's alpha. This coefficient indicates internal consistency, reflecting the extent to which a set of items is interrelated and functions cohesively as a group. Furthermore, Cronbach's alpha can be conceptualized as a function of the number of items included in the scale and the average inter-item correlation.

Table 2 reports the Cronbach's alpha coefficients, providing evidence for the reliability of the questionnaire. The Self-confidence factor, which included seven items, showed excellent internal consistency with a Cronbach's α of 0.904. The Enjoyment factor had four items and showed good reliability with a Cronbach's α of 0.836. The Value factor comprised five items and showed high reliability with a Cronbach's α of 0.890. All values surpassed the recommended threshold of 0.70 (Nunnally & Bernstein, 1994). This means that the scales were consistent and reliable for further analysis.

Table 2: Reliability Analysis for Study Constructs

Factor	Item	Cronbach's alpha
Self-confidence	Mathematics does not scare me at all I have a lot of self-confidence when it comes to mathematics I can solve mathematics problems within the given time. I am able to solve mathematics problems without too much difficulty I have confidence to take the mathematics tests and exams. I have the confidence to ask mathematics questions in class. I believe I am good at solving mathematics problems	0.904
Enjoyment	I have usually enjoyed studying mathematics at university. I am happier in a mathematics class than in any other class.	0.836

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	I really like mathematics. I am comfortable answering questions in mathematics class.	
Value	Mathematics is a very worthwhile and necessary subject. I want to develop my mathematical skills Mathematics is one of the most important subjects to study. I need mathematics for my future job. Mathematics helps develop the mind and teaches a person to think.	0.890

Normality Test

The normality of the dependent variables (self-confidence, enjoyment, and value) was evaluated separately for male and female students using the Shapiro-Wilk test (Table 3). The results showed that all variables significantly deviated from a normal distribution for both genders ($p < .001$).

Table 3: Tests of Normality for Dependent Variables by Gender

Variable	Gender	Shapiro–Wilk *W*	*df*	*p*
Self-confidence	Male	0.830	50	<.001
	Female	0.841	64	<.001
Enjoyment	Male	0.818	50	<.001
	Female	0.852	64	<.001
Value	Male	0.762	50	<.001
	Female	0.713	64	<.001

Given the violation of the normality assumption and the ordinal nature of the Likert scale data, the Mann-Whitney U test was used to examine gender differences for each dependent variable.

Mann–Whitney U Test

Table 4: Mann–Whitney U Test for Gender Differences in Self-confidence

Gender	*n*	Median	IQR	Mean Rank	*U*	*Z*	*p*	*r*
Male	50	3.00	1	62.67	1341.50	−1.643	.100	.15
Female	64	3.00	0	53.46				

Note. IQR = interquartile range. r is calculated as Z / √N. Higher mean rank indicates higher scores. $p < .05$ is statistically significant. Effect sizes are interpreted as small (.10), medium (.30), large (.50) (Cohen, 1988).

A Mann–Whitney U test (Table 4) indicated that there was no significant difference in self-confidence scores between male students ($n = 50$, *Median* = 3.00) and female students ($n = 64$, *Median* = 3.00), $U = 1341.50$, $Z = -1.64$, $p = .100$, $r = .15$. This suggests that gender does not significantly influence students' self-confidence in mathematics.

Table 5: Mann–Whitney U Test for Gender Differences in Enjoyment

Gender	*n*	Median	IQR	Mean Rank	*U*	*Z*	*p*	*r*
Male	50	4.00	1	57.57	1596.50	−0.022	.983	<.01
Female	64	4.00	1	57.45				

Note. IQR = interquartile range. r is calculated as Z / √N. Higher mean rank indicates higher scores. $p < .05$ is statistically significant. Effect sizes are interpreted as small (.10), medium (.30), large (.50) (Cohen, 1988).

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A Mann–Whitney U test (Table 5) showed no significant difference in enjoyment scores between male students (n = 50, *Median* = 4.00) and female students (n = 64, *Median* = 4.00), U = 1596.50, Z = −0.02, p = .983, r < .01. These results indicate that both genders reported similar levels of enjoyment in mathematics.

Table 6: Mann–Whitney U Test for Gender Differences in Value

Gender	*n*	Median	IQR	Mean Rank	*U*	*Z*	*p*	*r*
Male	50	4.00	1	51.10	1280.00	−2.072	.038*	.19
Female	64	4.00	1	62.50				

Note. IQR = interquartile range. r is calculated as Z / √N. Higher mean rank indicates higher scores. p < .05 is statistically significant. Effect sizes are interpreted as small (.10), medium (.30), large (.50) (Cohen, 1988).

A Mann–Whitney U test (Table 6) revealed a significant difference in perceived value of mathematics between male students (n = 50, *Median* = 4.00) and female students (n = 64, *Median* = 4.00), U = 1280.00, Z = −2.07, p = .038, r = .19. Female students reported higher perceptions of value in mathematics compared to male students.

The analysis indicated that gender did not significantly influence students' self-confidence and enjoyment in mathematics, as median scores were comparable between male and female students. Nevertheless, a small but statistically significant difference emerged in the value dimension, with female students perceiving mathematics as more valuable than their male counterparts. Despite the modest effect size, this result suggests that female students in this sample may attribute slightly greater importance to mathematics in their daily lives, prospective careers, and cognitive development. Female students may perceive mathematics as more valuable because it serves as an important foundation for achieving success, strengthening self-confidence, and professional credibility in a field where they remain underrepresented.

Confirmation of Hypothesis

Based on the Mann–Whitney U results, the null hypothesis of no difference in self-confidence between male and female students (H_{0_1}) was retained (p = .100), as was the null hypothesis for enjoyment (H_{0_2}; p = .983), indicating no significant gender differences for these constructs. However, the null hypothesis for perceived value (H_{0_3}) was rejected (p = .038), with female students reporting significantly higher value scores than male students. Table 7 provides a summary of the overall results of this research study.

Table 7: Summarize Hypothesis Result.

	Hypotheses	Decision
H_{0_1}	There is no difference in the distribution of self-confidence scores between male and female students towards mathematics.	Accepted
H_{0_2}	There is no difference in the distribution of enjoyment scores between male and female students towards mathematics.	Accepted
H_{0_3}	There is no difference in the distribution of perceived value scores between male and female students towards mathematics.	Rejected

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Conclusion

The present study explored gender differences in mathematics attitudes among computer science students, focusing on the dimensions of self-confidence, value, and enjoyment. The findings revealed that gender did not significantly influence self-confidence and enjoyment in mathematics, as both male and female students demonstrated comparable levels in these domains. However, a small but statistically significant difference was found in the perceived value of mathematics, with female students assigning greater importance to the subject than their male peers.

The absence of gender differences in self-confidence is an encouraging outcome, as prior studies frequently identified confidence as an area where male students outperformed females. However, our study aligns with previous studies by Kaur (2017), who found no significant gender difference in mathematics self-confidence among students, suggesting that confidence levels in quantitative domains are comparable across male and female learners. Similarly, Huang's (2013) analysis on primary and secondary school students showed no statistically significant gender differences in self-confidence in mathematics among students who demonstrate comparable levels of self-belief in their mathematical abilities.

Previous studies have reported that male students enjoy mathematics more than females (Prendergast & O'Donoghue, 2014). However, our finding that male and female students report similar levels of enjoyment in learning mathematics aligns with previous motivational research, which indicates that while gender differences in self-concept or confidence may exist, particularly in earlier educational stages differences in interest or intrinsic enjoyment often narrow or vanish at the university level (Eccles et al., 1993; Kurtz-Costes et al., 2008; Else-Quest et al., 2010).

Our findings align with recent research indicating some differences in gender among Asian and White adolescents' math value beliefs (Starr et al., 2025). Although many extensive studies report similar or higher math values among males in some contexts (Frenzel et al., 2007; Watt, 2004; Watt et al., 2012; Ghasemi et al.,2019), recent work shows that gender differences are highly dependent and can vanish or reverse in particular subgroups or after targeted interventions. Our result of a higher perceived value among female students is consistent with literature that finds occasional female advantage or parity when curricular or intervention factors favour female valuation of mathematics (Rozek et al., 2017; Fernandez, 2024). The higher value placed by females could be related to their awareness of mathematics's role in supporting their future academic and career opportunities.

The findings of this study carry important implications for educational practice and policy. Understanding that students may value, enjoy, or feel confident in mathematics differently allows for more targeted teaching approaches that address their needs. By integrating real-life applications, career connections, and problem-based learning into mathematics education, institutions can help students recognize the broader significance of the subject. The importance of creating a learning environment that equally supports all students, promoting inclusive teaching strategies that encourage persistence in mathematics-related fields, and contributing to the development of STEM-related careers needs to be emphasized.

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