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# Exploring secondary school students' attitudes towards mathematics through the lens of the ABC model

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## Abstract

**Purpose** – This quantitative, cross-sectional survey investigated the relationship between the affective, behavioural and cognitive components of students' mathematics attitudes and achievement. It also explored which component was the most and least dominant, the predictive power of each component on achievement and whether there was a difference in mathematics attitudes by gender.

**Design/methodology/approach** – A quantitative, cross-sectional survey design was employed with 193 Jamaican secondary school students (aged 13–16). Data were collected using the ABC-Model-of-attitude questionnaire alongside teacher-made mathematics examinations. Analyses included descriptive statistics, Spearman's correlation, simple linear regression and the Mann–Whitney U test.

**Findings** – Results revealed a significant, low, positive relationship between each of the components of attitude and mathematics achievement, as well as moderate, significant correlations between the affective component and both behavioural and cognitive components. The cognitive component emerged as the most dominant, while the behavioural component was the least. No significant gender differences were found across the three components.

**Practical implications** – These results underscore the importance of adopting a multidimensional view of mathematics attitudes and highlight the need for targeted, component-specific interventions to improve attitude and achievement.

**Originality/value** – This study makes a novel contribution by examining secondary students' mathematics attitudes through the multidimensional ABC (affective, behavioural, cognitive) model within a Caribbean context, where empirical evidence remains limited. Unlike studies that treat attitude as a unidimensional construct, this research disaggregates its components to reveal their distinct relationships and predictive roles in mathematics achievement. Importantly, it provides one of the first empirical applications of the ABC model among Jamaican secondary students, offering context-specific insights to inform targeted interventions, educational policy and future research on improving mathematics outcomes in the region.

**Keywords** Mathematics attitude, Mathematics achievement, Secondary school, ABC model

**Paper type** Research article

## Background

In Jamaica and the wider Caribbean, there have been longstanding concerns from educational stakeholders about mathematics achievement due to students' underperformance at all educational levels. As a result of this, there have been recent calls for initiatives to improve students' achievement (Gilkes, 2024; Small, 2024). However, to effectively develop targeted strategies to achieve this goal, a comprehensive understanding of the underlying factors contributing to this achievement is needed (George, 2023). Notwithstanding this imperative, there is still much uncertainty about the factors influencing students' performance in mathematics (Hidayatullah & Csíkos, 2024), although there is a well-established research base to build upon. In this regard, students' attitudes towards mathematics have long been recognised as critical, given their strong relationship with mathematics attainment (Bakker, Cai, & Zenger, 2021; Di Martino & Zan, 2015; Grootenboer & Marshman, 2016). Furthermore, previous studies have found it to be related to students' participation, conceptual development and engagement, which are all closely linked to achievement (Markovits & Forgasz, 2017; McLeod & McLeod, 2002; Syyeda, 2016).

Within the Caribbean context, there appears to be a general acceptance that students' attitude towards mathematics affects their achievement despite limited empirical evidence to substantiate this belief (Leacock, 2015). For example, the Jamaican National Mathematics

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Policy, in discussing the issue of poor mathematics performance, notes that "poor attitudes to the subject are also very evident among many students" (Ministry of Education, 2013, p. 5). Consequently, one main aim of mathematics teaching across all levels is the cultivation of positive attitudes towards mathematics and mathematical activities (Ministry of Education, 2013). Similarly, Leacock (2015), in discussing issues in mathematics education in the Eastern Caribbean, notes that "teachers and other concerned individuals in the Eastern Caribbean often attribute poor performance of the students to negative and undesirable attitudes to the subject" (p. 213). In both cases, empirical evidence relating achievement and mathematics attitude was not presented.

Empirical research exploring mathematics attitudes within Caribbean populations is notably limited. Brown and Kanyongo (2010), for example, indicated that their study sought "to determine whether students' attitude towards mathematics and students' beliefs in their mathematical abilities are related to the differential in mathematics attainment" in a primary school sample from Trinidad and Tobago (p. 117). However, they did not directly measure attitudes towards mathematics. Instead, their study examined broader constructs such as perceptions of schooling, persistence in academic challenges, mathematics self-concept, general academic self-concept and educational values. Similarly, Wilkinson and Ogunkola's (2014) study, "*Students' Attitudinal Variables as Correlates of Achievement in Secondary School Mathematics in Barbados*", explored the relationship between students' perceptions of mathematics usefulness, parental involvement and mathematics teachers' influence on mathematics achievement. However, among these variables, only students' perceptions of the usefulness of mathematics can be directly linked to attitudes towards mathematics, thereby only partially capturing attitudinal factors. Binns-Thompson, Hornby, and Burghes (2021) investigated the impact of an intervention on Jamaican students' attainment and attitude. While the intervention improved students' achievement in mathematics, changes in attitude varied. The authors reported that some students reported increased confidence and motivation, while others remained anxious or disengaged. The study used surveys and self-report questionnaires to measure mathematics attitudes, which included components such as confidence in problem-solving, enjoyment of mathematics, perceived usefulness of the subject and levels of anxiety. The study highlights the need for sustained support to foster positive math attitudes, as some students continued to struggle with apprehension despite academic gains. Lewis (2023) explored psychological factors such as attitudes, interests and readiness influencing students' mathematics achievement in the Caribbean Secondary Education Certificate (CSEC) examination, which students typically sit at the end of high school. The study found that positive attitudes and interests were associated with higher academic achievement, while negative attitudes impeded progress. Collectively, these studies underscore the significance of students' attitudes towards mathematics as a contributing factor to academic achievement in Caribbean contexts. They also highlight the need for continued empirical exploration of this relationship, particularly considering the diverse constructs previously examined and the limited focus on attitudes as a multidimensional construct.

Given these limitations, the present study addresses a critical gap by examining students' attitudes towards mathematics through the lens of the multidimensional ABC (Affective, Behavioural, Cognitive) model. This approach allows for a more nuanced understanding of how different components of attitude relate to mathematics achievement among Jamaican secondary school students. In doing so, the research seeks to provide empirical insights that inform educational policy and practice. Against this background, the study seeks to answer the following research questions.

(1) What are the most and least dominant components of students' attitudes towards mathematics?

(2) What is the relationship between the affective, behavioural and cognitive components of attitude towards mathematics and mathematics achievement?

(3) To what extent does each component of the attitude towards mathematics construct predict mathematics achievement?

(4) Is there a statistically significant difference in the affective, behavioural and cognitive components of attitude towards mathematics by gender?

**Attitude towards mathematics**

Neale (1969) defines mathematics attitude as "a liking or disliking of mathematics, a tendency to engage in or avoid mathematical activities, a belief that one is good or bad at mathematics, and a belief that mathematics is useful or useless" (p. 632). This definition aligns with the widely accepted tripartite, or ABC model of attitude, which conceptualises the construct as comprising three interrelated dimensions: affective, behavioural and cognitive (Mazana, Suero Montero, & Olifage, 2019; Svenningsson, Höst, Hultén, & Hallström, 2022; Syyeda, 2016). This model has been extensively documented in empirical research (Eagly & Chaiken, 1998; Rosenberg & Hovland, 1960; Walker, Walker, & Widaman, 2020; Zan & Di Martino, 2007) and serves as the theoretical framework for the present study.

The affective dimension of the attitude construct refers to the emotional aspect, that is, how one feels, such as like/dislike or enjoyment or boredom about mathematics (Ayob & Yasin, 2017; Mensah, Okyere, & Kuranchie, 2013). Walker *et al.* (2020) add that this component could be "measured by collecting participants' reports of their feelings or moods about the target task, object, or situation" (p. 3). The affective component of attitude may impact the other two subconstructs, where positive emotions (enjoyment) or negative emotions (anxiety) can preserve or reduce cognitive resources and behaviour (Pekrun *et al*., 2017).

The behavioural component of attitude encompasses the verbal or non-verbal responses or actions an individual displays when exposed to or engaging with mathematics (Mazana *et al*., 2019). More specifically, it includes behaviours such as completing homework on time, studying for quizzes, persisting in understanding mathematical concepts and engaging with mathematics tasks (Walker *et al*., 2020). It is partly determined by the cognitive and affective components (Ayob & Yasin, 2017; Mensah *et al*., 2013; Svenningsson *et al*., 2022), again highlighting the interrelatedness of the construct. However, some scholars argue that the inclusion of behaviour introduces a risk of circular reasoning, where behaviour is used to infer attitude, which is then used to explain behaviour (Zan & Di Martino, 2020). To address this concern, Daskalogianni and Simpson (2000) proposed excluding the behavioural component from the framework. Despite this critique, the majority of researchers, including Zan and Di Martino (2020), continue to support its inclusion.

The cognitive component includes an individual's beliefs about mathematics, including their perceived competence and the value they attribute to the subject in their present and future lives (Mensah *et al*., 2013; Syyeda, 2016). Students who view themselves as capable generally tend to engage more positively and regularly with mathematics content. Conversely, those with low confidence may experience anxiety or avoidance. Research highlights the crucial role of these beliefs in shaping students' attitudes and overall success in mathematics (Goldin *et al*., 2016).

Although the three components comprising the mathematics attitude construct are distinct, they are also interrelated (Mazana *et al*., 2019; Svenningsson *et al*., 2022; Syyeda, 2016). However, research exploring the relationships between the individual components and key educational outcomes, such as academic achievement, remains limited. Also, there is a need for multidimensional investigations across variables such as age, gender and diverse student populations (Walker *et al*., 2020). Recent studies have, therefore, called for further research that addresses these gaps (Walker *et al*., 2020; Wen & Dubé, 2022). The present study seeks to contribute to this body of knowledge by examining different aspects of mathematics achievement and the three dimensions of students' attitudes towards mathematics. In doing so, it addresses not only the local and regional research gaps

outlined earlier in the paper, but also international concerns. Furthermore, this study is distinct in its focus on a Caribbean student population, which has not been extensively examined in empirical research on attitudes towards mathematics.

**Relationship between students' mathematics attitude and achievement**

The extensive research base on attitudes towards mathematics has generally found a significant positive relationship between students' attitudes and their mathematics achievement (Hemmings & Kay, 2010; Hidayatullah & Csíkos, 2024; Hwang & Son, 2021; Ma & Kishor, 1997; Mata, Monteiro, & Peixoto, 2012; Mazana *et al.*, 2019; Nicolaidou & Philippou, 2003). It must be noted, however, that each study used different conceptualisations and measures for attitude towards mathematics, so intra-study analysis is limited. Ma and Kishor (1997) noted, based on their meta-analysis involving 113 empirical studies, that although the relationship between the variables was statistically significant overall, it was not strong for educational practice. For example, Mata *et al.* (2012), in a study involving 1719 Portuguese students from fifth to twelfth grade, found a weak, positive correlation ($r = 0.212$) between attitude and mathematics achievement. To measure attitude towards mathematics, they used a "five-item index relating to how students feel in math class and when performing math school tasks" (p. 4). Mensah *et al.*'s (2013) research used the Attitude Towards Mathematics Inventory, an instrument developed by Tapia and Marsh (2004), to explore the mathematics attitudes of 100 high school students. They reported a significant, positive correlation ($r = 0.419$, $p < 0.05$) between students' attitudes towards mathematics and their mathematics achievement. Similar to Mensah and his associates, Ajisuksmo and Saputri (2017) used Tapia and Marsh's inventory. They conducted research involving 103 high schoolers from Indonesia and found a significant, positive relationship ($r = 0.505$; $p < 0.001$) between the attitude and achievement variables. Contrary to the studies mentioned above, Idris, Khazila, Agustina, and Lisa (2021) found that students' attitudes towards mathematics and their mathematics achievement were weak but significantly negatively correlated ($\rho = -0.089$, $p = 0.05$). Also, Lim and Chapman (2015) found non-significant correlations between mathematics achievement and selected attitudinal components after accounting for mathematics self-confidence and ease.

While previous studies that treat the multidimensional construct of mathematics attitude as unidimensional, reporting a single composite score, offer valuable insights, this approach is limited in that it provides only a partial portrait of mathematics attitude that may obfuscate "a more insightful and sophisticated picture of math attitude related to math achievement" (Walker *et al.*, 2020, p. 10). Examining the individual subcomponents, affective, behavioural and cognitive, can, therefore, yield more precise information to inform differentiated strategies that address specific areas of concern.

Few studies have explored the relationship between the various components of mathematics attitude and mathematics achievement. Comparing results is challenging due to the different attitudinal components and measures used (Leder, 1985). Nonetheless, these studies consistently report a weak yet significant positive correlation between attitude components and achievement (Hwang & Son, 2021; Mazana *et al.*, 2019; Walker *et al.*, 2020). Wen and Dubé (2022), who undertook a meta-analysis with over 100 studies, reported a wider range of positive correlations for affective ($r = 0.39$ to $0.66$), cognitive ($r = 0.11$ to $0.34$), and behavioural ($r = 0.21$ to $0.34$) dimensions. Considering these results, the researchers propose that each aspect of students' attitudes towards mathematics will exhibit a positive correlation with mathematics achievement within the Jamaican sample. By investigating these components separately, this study aims to offer insights into how each dimension contributes to achievement.

**Predicting mathematics achievement based on attitude**

There is a scarcity of literature related to the extent to which the components of mathematics attitude predict students' mathematics achievement. Notwithstanding this, Mazana *et al.*

(2019) conducted a logistic regression analysis incorporating five attitudinal variables: confidence, enjoyment, usefulness, anxiety and motivation, as predictors of mathematics achievement. Their findings indicated that enjoyment and overall attitude made significant contributions to distinguishing between students who passed and those who failed, though the predictive relationship remained weak.

Several studies have found that mathematics attitudes account for less than 20% of the variance in mathematics achievement (Hemmings & Kay, 2010; Yücel & Koç, 2011). However, other studies report considerably higher variance estimates. For instance, Simegn and Asfaw (2018) found that, among Ethiopian secondary students, attitudes explained 42.8% of the variance in achievement for Grade 10 students and 55.4% for Grade 12 students, with enjoyment, motivation and confidence emerging as the most influential predictors. These discrepancies suggest that the predictive power of mathematics attitudes may vary depending on contextual factors, including educational environments, cultural influences and measurement approaches.

**Dominant attitudes component**

Findings on the most dominant component of students' attitudes towards mathematics vary across studies, likely due to differences in instruments and contexts. Mazana *et al.* (2019) found that the behavioural component of attitude towards mathematics (M = 4.10) scored the highest mean, while the affective and cognitive components had equal means (M = 3.69). Using a different instrument, the TIMSS questionnaire, Hwang and Son (2021) found the affective component to be most dominant, with a mean score of 10.07, whereas the behavioural and cognitive components scored below 10. In contrast, Walker *et al.* (2020) identified the cognitive component as the most dominant (M = 3.34) and the affective component as the least (M = 2.60). These variations underscore the influence of measurement tools and contextual factors on students' reported attitudes towards mathematics.

**Mathematics attitudes by gender**

Despite extensive research on the relationship between attitudes and mathematics achievement, relatively few studies have examined how the individual components of the attitudinal construct vary by gender. As a result, findings related to the overall construct of mathematics attitudes are more frequently reported in the literature.

Bashir, Akram, and Bashir (2023) is one of the few studies that disaggregated attitudinal components by gender. They found no significant gender differences in the affective dimension concerning enjoyment and motivation for mathematics. However, their findings indicated that female students exhibited significantly higher levels of fear and anxiety related to mathematics. Regarding cognitive components, including confidence, self-concept and perceived value and utility of mathematics, male students demonstrated significantly higher scores.

Findings related to the overall construct of mathematics attitudes have been mixed. While most studies have reported no significant gender differences in attitudes towards mathematics (Anokye-Poku & Ampadu, 2020; Dowker & Sheridan, 2022; Else-Quest, Mineo, & Higgins, 2013; Sarouphim & Chartouny, 2017; Simegn & Asfaw, 2018; Yücel & Koç, 2011), some studies have identified a significant gender difference in favour of males (Recber, Isiksal, & Koç, 2018). These inconsistencies suggest that gender-related variations in mathematics attitudes may be context-dependent and influenced by cultural, educational and methodological factors.

**Methods**

*The sample*

This quantitative study employed a cross-sectional survey research design and was conducted in a coeducational, rural secondary school located in southern Jamaica, which is the largest

country in the Anglophone Caribbean. The school served mainly students from low to middle-socioeconomic backgrounds. The research site has a population of approximately 560 students with classes structured from grades 7–13 (aged 12–18 years). However, the population for this research consisted of 220 students enrolled in grades 8–10.

Data were collected from 193 students (124 males and 69 females, aged 13–16) across Grade 8 ($N = 53$), Grade 9 ($N = 78$) and Grade 10 ($N = 62$). The researchers used non-probability, convenience (volunteer) sampling for selecting the sample. Teddlie and Yu (2007) state that a non-probability "convenience sampling involves drawing samples that are both easily accessible and willing to participate in a study" (p. 78). For this research, students volunteered to participate after having received written parental informed consent. A study on attitude towards mathematics and mathematics achievement could involve any grade level. However, the researchers surmised that in grades 8–10, it is expected that the students would have some established mathematics attitude and pattern of mathematics achievement at that educational level. The researchers acknowledge that the use of convenience sampling is a research limitation since the students who volunteered to participate in the research may have particular characteristics of a given type.

Notwithstanding this shortcoming, this research is important as it adds key elements to the research base on the important topic of mathematics attitude. The researchers obtained institutional ethical approval to undertake this research. They also obtained written parental informed consent and student assent for each respondent.

*Data collection*

*Attitude towards mathematics questionnaire.* This research utilised the ABC model for attitude towards mathematics questionnaire proposed by Walker *et al.* (2020) (see Section B of Table 1) to collect data related to students' attitudes towards mathematics. Walker and her associates developed this scale to address concerns about the length and cultural specificity of previously established instruments, such as the Attitudes Toward Mathematics Inventory (ATMI) (Tapia & Marsh, 2004). In this regard, they highlighted that the ATMI was considered lengthy (40 items) and typically validated only within single cultural contexts, either Western or non-Western. Walker *et al.* (2020), therefore, aimed to develop a shorter, culturally robust measure. This resulted in an 11-item questionnaire that measured, using a four-point Likert scale (Strongly Agree-4, Agree, Disagree, Strongly Disagree-1), the affective (four items), behavioural (four items) and cognitive (three items) dimensions of mathematics attitudes. The resulting scale exhibited strong psychometric properties, with Cronbach's alpha coefficients ranging from 0.74 to 0.91 across its three subscales (affective, behavioural and cognitive), factor loadings that spanned from 0.49 to 0.90 and robust convergent and discriminant validity.

For the current study, Walker *et al.*'s (2020) ABC scale was adopted primarily due to its demonstrated reliability, validity and multidimensional conceptualisation of mathematics attitudes. In addition, this model aligns well with the theoretical framework guiding this research, acknowledging that attitudes towards mathematics consist of interrelated affective, behavioural and cognitive components. Considering its brevity, cultural versatility and alignment with contemporary theories, Walker's ABC questionnaire provided an effective, efficient and theoretically robust instrument suitable for the current Jamaican educational context.

For this research, a demographic section (see Section A of Table 1) was included in the questionnaire to gather information on participants' grade level, age, gender and class placement. Collecting these demographic data allowed the researchers to contextualise students' responses, interpret findings more meaningfully within the Jamaican educational setting, and explore potential variations in attitudes towards mathematics across different student groups. The addition of this section would not affect the psychometric properties of the scale. Additionally, the entire questionnaire, including demographic questions, was reviewed and validated by experts in measurement, testing, evaluation and psychology. This expert

**Table 1.** The research instrument (adapted from Walker *et al.*, 2020)

Section A

*Name:* _____
*Age:* __ 12 __13 __14 __15 __16 __17
*Gender:* _____Male _____Female ____Other
*Grade:* 8 _____9 10

Section B

| Components | Items | Strongly Disagree | Disagree | Agree | Strongly Agree |
|---|---|---|---|---|---|
| Affective | 1. I enjoy reading about mathematics | | | | |
| | 2. I look forward to my mathematics lessons | | | | |
| | 3. I do mathematics because I enjoy it | | | | |
| | 4. I am interested in the things I learn in mathematics | | | | |
| Behavioural | 5. I finish my mathematics homework on time | | | | |
| | 6. I work hard on my homework | | | | |
| | 7. I study hard for mathematics quizzes | | | | |
| | 8. I keep studying until I understand the mathematics material | | | | |
| Cognitive | 9. If I put in enough effort, I can succeed in mathematics | | | | |
| | 10. If I do well in mathematics, it is completely up to me | | | | |
| | 11. If I wanted to, I could do well in mathematics | | | | |

**Source(s):** Authors' own work

review helped to ensure that all items were appropriate, clear and relevant, especially considering that attitudes towards mathematics represent psychological constructs requiring careful contextual alignment for accurate assessment.

Students completed the questionnaire using a paper-based format at a scheduled time during regular school hours, under the supervision of a designated teacher, to ensure consistency in administration and clarity of instructions.

*Mathematics achievement.* Mathematics achievement was measured using end-of-term mathematics examinations administered in December 2023 for Grades 8, 9 and 10 at the end of the first academic term. These examinations were developed by the mathematics teachers responsible for each grade and comprised both objective (e.g. multiple-choice) and constructed-response items, reflecting the mathematics content covered during the school term. While teacher-made tests are widely used and considered a practical approach to assessing mathematics achievement in educational research (Anderson-Waugh & George, 2024; Wellberg, 2023), there are associated limitations. For example, teacher-made assessments often focus overly on procedural or lower-order skills to the exclusion of higher-order competencies such as problem-solving, reasoning and conceptual understanding (Nortvedt & Buchholtz, 2018). Additionally, teacher-made tests may lack standardisation, which suggests that their results may not extend beyond the research context. This limits their wider applicability in empirical research (Cai *et al.*, 2020).

To enhance the reliability and content validity of these teacher-made examinations, the classroom teachers used a table of specifications to guide test development. This approach

helped ensure alignment between instructional content and assessment items. Additionally, the head of the mathematics department and a mathematics coach assigned to the school by the Ministry of Education, Skills, Youth and Information reviewed the tests and provided feedback on ways to improve them. Their suggestions were incorporated into the final version of the mathematics examinations. The tests were administered face-to-face, under controlled examination conditions, where different subject teachers were assigned to invigilate. Teachers responsible for each class subsequently marked students' papers using a clearly defined marking guide to ensure consistency in scoring.

*Data analysis*

The research data were analysed using the Statistical Program for Social Sciences (SPSS), version 28, to provide answers to the research questions. Preliminary analyses were conducted on the mathematics attitudes and achievement data to determine whether parametric or non-parametric tests should be used. The histograms, which are visual representations of each variable, and the Shapiro–Wilk test were used to assess normality, a key assumption of parametric tests. These assessments indicated that none of the variables were normally distributed and, as such, non-parametric tests were used for the data analyses.

To find the most and least dominant components of students' attitudes towards mathematics (Research Question 1), descriptive statistics (mean and standard deviation) were calculated for each component. For Research Question 2, which examined the relationship between each component of mathematics attitude and mathematics achievement, a Spearman's rho correlation coefficient test was employed. To address Research Question 3 which focussed on the predictive value of each attitudinal component on mathematics achievement, a simple linear regression analysis was conducted for each component individually. Finally, to ascertain whether there was a gender difference in the students' attitudes towards mathematics (Research Question 4), the researchers conducted a Mann–Whitney U test.

## Results

*RQ1.* What are the most and least dominant components of students' attitudes towards mathematics?

Table 2 presents the mean and standard deviation related to each of the three components of students' attitudes towards mathematics, as well as a disaggregated view of individual items.

Table 2 reveals that the cognitive component ($M = 3.40$, $SD = 0.512$) is the dominant aspect of students' attitude towards mathematics with a mean well over 3, which suggests that most of the students in the sample appeared to believe in personal agency and effort, and success in mathematics is determined by one's effort, control and willingness to achieve. It also showed the highest item means (M = 3.33 to 3.50), with the highest-rated item being "If I put in enough effort, I can succeed in mathematics" (M = 3.50). The cognitive component had the lowest standard deviation among the three components, indicating that students shared similar views regarding their confidence and beliefs about their ability to succeed in mathematics. This homogeneity suggests a strong consensus among the students on their self-perceived ability to do well in mathematics if they put in enough effort. The behavioural component with the smallest mean (M = 2.91, SD = 0.750) was the least dominant. Additionally, the behavioural items recorded the lowest means (M = 2.82 to 3.03), indicating weaker consistency in actions such as completing homework on time or studying hard.

*RQ2.* What is the relationship between the components of the attitude towards mathematics and mathematics achievement?

**Table 2.** Descriptive statistics of the components of attitude towards mathematics

| Components | | M | SD |
|---|---|---|---|
| Affective | I enjoy reading about mathematics | 3.00 | 0.884 |
| | I look forward to my mathematics lessons | 3.33 | 0.738 |
| | I do mathematics because I enjoy it | 3.06 | 0.955 |
| | I am interested in the things I learn in mathematics | 3.31 | 0.775 |
| *Overall* | | *3.17* | *0.659* |
| Behavioural | I finish my mathematics homework on time | 2.82 | 0.959 |
| | I work hard on my homework | 2.89 | 0.991 |
| | I study hard for mathematics quizzes | 2.89 | 0.945 |
| | I keep studying until I understand the mathematics material | 3.03 | 0.954 |
| *Overall* | | *2.91* | *0.750* |
| Cognitive | If I put in enough effort, I can succeed in mathematics | 3.50 | 0.630 |
| | If I do well in mathematics, it is completely up to me | 3.38 | 0.691 |
| | If I wanted to, I could do well in mathematics | 3.33 | 0.723 |
| *Overall* | | *3.40* | *0.512* |

**Source(s):** Authors' own work

A Spearman's rho correlation coefficient test was conducted to ascertain the relationship between the components of mathematics attitude and mathematics achievement. The data analysis revealed a significant and positive association between each component of students' attitudes towards mathematics and their mathematical achievement. For the affective component, the correlation between the two variables was rs (191) = 0.142, $p = 0.049$, while for the behavioural component, it was rs (191) = 0.320, $p < 0.01$. For the cognitive component, it was rs (191) = 0.157, $p = 0.029$). The affective and behavioural components demonstrated the weakest and strongest correlation, respectively.

*RQ3.* To what extent does attitude towards mathematics predict mathematics achievement?

The data analysis indicated a significant regression between attitude towards mathematics and mathematics achievement, with F (1, 191) = 14.898, $p < 0.001$. This result suggests that students' attitudes, as a combination of the affective, behavioural and cognitive elements, significantly predict their achievement in mathematics. The model's $R^2$ was 0.072, indicating that 7.2% of the variance in mathematics achievement is explained by the students' attitude (affective, behavioural and cognitive components). This result means that while students' attitudes towards mathematics play a role in their performance, other factors are likely contributing as well.

When the individual predictors were examined, only the affective and the behavioural components were found to be significant predictors of mathematics achievement in the model ($t = 2.151$, $p = 0.033$) and ($t = 4.575$, $p < 0.001$), respectively. For the affective component, it explains 2.4% of the variance in mathematics achievement, while 9.9% of the variance in mathematics achievement is explained by the students' behavioural component. This result suggests that students' emotions, such as enjoyment and interest, as well as actions, such as completing homework, studying and putting in the effort, are key in predicting their mathematics performance.

*RQ4.* Is there a gender difference in the students' attitudes towards mathematics?

A Mann–Whitney U test was conducted to evaluate the differences in the students' attitudes towards mathematics based on their gender. The test revealed that there is no significant difference in students' attitudes towards mathematics for males (Md = 96.30, $N = 124$) and females (Md = 98.25, $N = 69$), U = 4191.500, z = −0.233, $p = 0.816$, and r = 0.02.

## Discussion and conclusion

This study investigated Jamaican secondary school students' attitudes towards mathematics through the multidimensional lens of the ABC (affective, behavioural, cognitive) factor model of attitude, examining the dominance of each component, their interrelationships, predictive value for mathematics achievement and gender differences. Consistent with prior research (e.g. Walker *et al.*, 2020), the cognitive component emerged as the most dominant, suggesting that students largely believe in the importance of mathematics and in their ability to succeed through effort. In contrast, the behavioural component was the least dominant, indicating that students' positive beliefs and emotions do not consistently translate into sustained academic behaviours. Walker *et al.* (2020), who used the same attitudinal scale as the current research but a different measure of mathematics achievement, also found that the cognitive component was dominant. In contrast, other studies (e.g. Hwang & Son, 2021; Mazana *et al.*, 2019) have varied in which component was most salient, likely due to differing educational contexts and measurement tools.

As it relates to the relationship between the attitudinal and achievement variables, the current study, as hypothesised based on previous research (e.g. Mata *et al.*, 2012; Lewis, 2023; Mensah *et al.*, 2013; Nicolaidou & Philippou, 2003; Walker *et al.*, 2020), found a positive, weak, statistically significant association. Though weak in strength, these associations are still relevant in educational settings where even modest gains in attitude can contribute to improved performance.

Furthermore, similar to the majority of existing studies, the present research found no significant differences in the mathematics attitudes of males and females for each of the three components. The findings also offer valuable insights for future research and practice. For example, the very small role that mathematics attitude appeared to play in this sample's mathematics achievement indicates that other, more significant factors are linked to mathematics achievement. The result that a positive but weak relationship was found between mathematics attitudes and achievement also points to this likelihood and suggests the need to investigate other contributing variables, such as instructional practices, socioeconomic status, assessment design and classroom climate (Dowker & Sheridan, 2022; George, 2023; Hidayatullah & Csíkos, 2024). This small variance may be unique to this sample, which included one secondary school. However, future research could involve more high schools and students across different grade levels to explore other factors that are known to be related to mathematics achievement. This research direction would address the limitation of the current study, which involved one educational institution. Additionally, a mixed methods approach could help capture the depth and complexity of students' attitudes and experiences, especially regarding why positive beliefs and emotions do not always translate into positive academic behaviours, even though a quantitative study is entirely helpful in exploring the variables in the research.

The results have practical implications for educational stakeholders such as teachers and teacher educators. Despite the modest correlations, prior research (Lipnevich, Preckel, & Krumm, 2016) suggests that mathematics attitudes are malleable. Interventions targeting the least dominant but significant components, particularly behavioural attitudes, could yield improvements in achievement. Teachers could focus on explicitly teaching metacognitive strategies, time management and self-regulation (Zimmerman, 2002), thus helping students translate positive beliefs into consistent and effective learning habits. Given the weak behavioural-cognitive link, efforts should also be made to align students' beliefs with actionable practices. Teacher education programmes and professional development workshops should incorporate training on recognising and addressing the multidimensionality of attitudes.

Furthermore, in resource-constrained settings such as Jamaica, these targeted strategies can be prioritised to maximise impact with limited means (Wiegel, 2019). Finally, the study makes a significant contribution to the literature by adopting a multidimensional lens to explore the link between attitudes and achievement, a methodological approach that remains relatively uncommon. Most critically, as far as the authors are aware, this is the first known study to explore secondary school students' attitudes towards mathematics in the Caribbean using the ABC model. As such, it provides a much-needed regional perspective, helping to create a more

comprehensive, culturally nuanced understanding of students' mathematical attitudes and their implications for achievement. This foundational insight can inform both policy and practice across the Caribbean and may serve as a springboard for future research and intervention in mathematics education in the region.

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