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The mediating role of self-regulatory learning on the relationships between attitudinal variables and mathematics achievement

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ABSTRACT

This quantitative study investigated three attitudinal components of senior high school students (enjoyment in math [EM], usefulness of math [UM], and interest in math [IM]) and self-regulatory learning (SRL) and math achievement (MA). SRL served as a mediating variable between attitude and MA. The gaps in studies over the years propelled the researchers to generate six hypotheses on the impact of attitude on MA and the mediating role of SRL between attitude and achievement. Data was collected by using a questionnaire on the attitudinal components and a test on MA administered to 272 students. The SPSS Amos was used to run a series of analyses. Specifically, the use of the structural equation model helped to generate factor loadings and the discriminant validity of the constructs were obtained before subsequent analysis of the data revealed several findings. Findings indicated that EM and IM did not have a significant impact on students' MA although usefulness did. Nor did SRL have a direct influence on MA. However, all three attitudinal components (EM, UM, and IM) had a significant impact on SRL, yet SRL did not serve as an effective mediator between attitude and MA.

Keywords: attitude, enjoyment, usefulness, interest, self-regulatory learning, mathematics achievement, structural equation model, quantitative analysis

INTRODUCTION

Learning mathematics stands out as a part of elementary education through to the tertiary level. Although every level of education requires different applications of mathematics, students' approach to learning may also vary depending on several factors. The body of literature has undoubtedly recognized student attitude as a very influential factor in determining student mathematics achievement (MA) (Hemmings, 2010; Segarra & Julià, 2022). Some findings have made it clear that attitude determines academic performance, and that a positive attitude results in higher academic achievement and negative attitude results in lower academic achievement (Michelli, 2013; Mokgwathi et al., 2019). This has not always been the case, as studies by Zhang et al. (2020) as well as Chen et al. (2021) discovered that students may possess a positive attitude but may still perform poorly and likewise, they may have a negative attitude and still perform well academically. A study by Mokgwathi et al. (2019) indicated that learners who enjoyed learning mathematics and found it useful showed outstanding performance. They further opined teachers' job satisfaction as an external factor that determines students' performance, even though their study did not find that. Although attitude affects performance, external factors can also influence students' achievement. A negative attitude towards mathematics can sometimes lead to good performance if it is accompanied by a strong work ethic or a fear of failure. Students with a negative attitude may be motivated to work hard to avoid getting poor grades or feeling that they are not good at mathematics (Alderman, 2013). For example, students may have a negative attitude towards mathematics because they find it difficult and frustrating. However, if they are motivated to succeed, they may put a lot of effort into studying and practice, which can lead to good performance. The existence of attitude as not being a sole determinant of students' academic success reiterates the fact that self-motivated students may trigger certain features that tend to improve their performance. Hence, self-regulatory learning (SRL) is a core variable that needs to be investigated concerning MA of students.

As students' progress through learning, they tend to divert to several disciplines based on their interest and aspirations. MA is essential for success in a variety of disciplines, including the arts and the sciences. Many students, however, have challenges with mathematics, often as a result of negative attitudes and inefficient SRL practices (Dradkh, 2018). The issue lies within the interaction between attitude, SRL, and mathematical achievement. Students' motivation, interest, and tenacity can be hampered by negative attitudes toward mathematics, resulting in mediocre achievement levels. According to Chen et al. (2021), students who use effective SRL strategies can overcome negative attitudes and enhance their mathematical ability. Numerous studies have found correlation between attitude, SRL, and MA (Dradkh, 2018; Michelli, 2013; Zee & de Bree, 2017). Such studies have consistently shown that students with positive attitudes toward mathematics outperform those with reservations about it. Furthermore, research has shown that successful SRL practices can considerably improve academic achievement (Chen et al., 2021).

After completing a mathematical task, students may experience psychological reactions to the achievement. Students' attributions to their achievement or failure can lead to more complex emotions such as arrogance, rage, humiliation and remorse. The quality of attributions and emotions are significant outputs of self-regulation processes as students reflect on reasons for their performance (Pintrich, 2004; Weiner, 1986). As students actively apply SRL, it is reasonable to predict that their attitudes about the lesson or academic work will improve. There have been few studies on the relationship between attitude and SRL. In Arsal's (2009) study, a SRL module was used among fourth-grade mathematics and it was discovered that a SRL program improved the pupils' attitude toward mathematics. However, their achievement in mathematics is also an area of concern.

In this study, specific attitudinal components are considered as well as the role of SRL between these attitudinal components and MA of students. The broad nature of attitude has been extensively investigated in relation to students' performance, but attitude has many components within it. SRL has also been separately investigated with achievement (Camahalan, 2006). This study examines enjoyment in math (EM), usefulness of math (UM), and interest in math (IM) as the attitudinal components that are linked with MA. Aside from the three constructs (EM, UM, and IM) examined about MA, the role of SRL as a mediating variable is also investigated. A framework is modelled and the mediating variable (SRL) is examined to better explain the impact of these attitudinal components (EM, UM, and IM) on students' MA.

Thus, the following research questions are raised:

1. What is the impact of student EM on MA?
2. What is the impact of the UM on students' MA?
3. What is the impact of students' IM on their MA?
4. What is the mediation role of SRL on EM and MA of students?
5. What is the mediation role of SRL on the UM and MA of students?
6. What is the mediation role of SRL on IM and MA of students?

LITERATURE REVIEW

Interest, Usefulness, and Enjoyment as Attitudinal Components

These three measures of attitudes are not mutually exclusive as they frequently relate to and impact one another. An individual who finds something interesting, for example, is more likely to see it as beneficial and pleasurable, resulting in increased involvement and a good attitude. Similarly, considering something beneficial can increase interest and enjoyment, driving people to learn more about it and use it. The concepts of enjoyment, usefulness, and interest are essential tools for understanding and measuring attitudes. We can get insight into individual's motives, beliefs, and perceptions by analyzing these variables, allowing us to make informed judgments and build successful interventions in a variety of fields.

Enjoyment in math

Csikszentmihalyi (1990) defines enjoyment as "the pleasure or satisfaction derived from engaging in a specific topic or activity." Students who appreciate a topic or activity have a greater likelihood of being naturally motivated to learn and persevere in the face of difficulties (Hidi & Renninger, 2006). Significant levels of enjoyment are linked to higher levels of desire, tenacity and the willingness to dedicate time and effort to an activity. A student who enjoys learning mathematics will surely have a great desire to learn math and will be willing to spend much time to learn the subject.

Usefulness of math

The perceived worth or relevance of a topic or activity to one's life or aspirations is referred to as usefulness (Schunk, 2012). Students are more likely to be motivated to learn and implement mathematics when they believe it to be valuable (Schunk et al., 2008). Learners may be motivated to seek out and use mathematical knowledge or resources, and they are encouraged to engage in activities that they believe will be beneficial or meaningful. Learners' ability to recognize the value of mathematics implies that they understand that math is worthwhile and relevant in their life and not just in school (Banson et al., 2022).

Interest in math

Curiosity, involvement and a desire to learn more about a particular topic or activity are all components of interest (Hidi & Renninger, 2006). Any person who is curious and always yearns to learn more mathematics has an interest in the subject. It is an important aspect in inspiring children to learn and can have a great impact on their achievement (Pintrich & De Groot, 1990). A high degree of interest is linked to enhanced focus, stronger information processing and the willingness to devote time and effort. Interest and enjoyment, as attitudinal constructs, are very close in meaning but they have clear-cut differences. One who has an IM does not only look at the desire or pleasure of math but also goes deeper in learning math over a long time and spends more hours learning the subject.

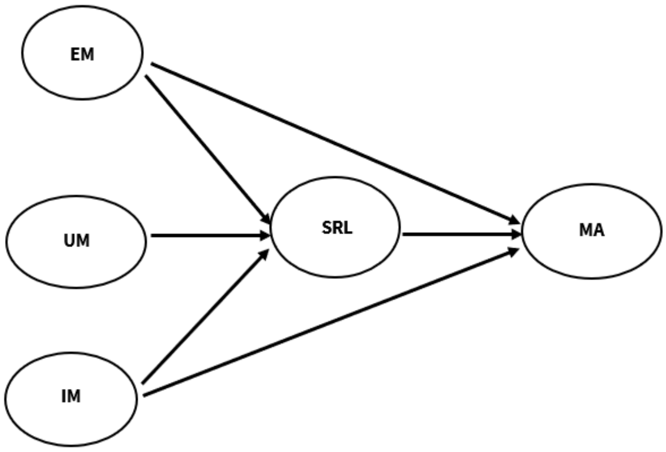

Figure 1. The hypothesized framework of all constructs (Source: Authors' own elaboration)

Self-Regulatory Learning

Zhu et al. (2020) explain that SRL encompasses students' ability to control their ideas, motivation and learning behaviours to achieve their learning objectives. It also defines how students use mental processes and cognitive techniques for learning that are motivated by their desire to learn. SRL further refers to the combination of cognitive and metacognitive skills that allow pupils to regulate and handle their learning (Zimmerman, 2000). Target planning, self-monitoring and self-evaluation, along with successful utilization of instructional strategies are examples of these skills (Winne & Perry, 2000). Students who have good self-regulatory skills are more likely to set realistic goals, track their progress and alter their techniques as needed. In addition, they are more likely to employ successful learning strategies such as active learning, reflection and time management (Zimmerman & Schunk, 2011).

Some students passionately pursue educational duties, while others shun them or work only hesitantly. Although some people seek and appreciate learning, others are terrified of it. The reasons for this difference in habits raise questions (Mazana et al., 2019). Educators and parents have been continuously troubled by the issue of learners' low academic achievement (Gladstone et al., 2018). Many people have had the frustrating experience of witnessing a youngster damage his or her chance of high performance just by failing to attempt. A student who performs poorly as a result of not studying, or not completing assignments, is usually regarded as one who does not have control over his or her own learning. Teachers are responsible for teaching pupils not only what to learn, but also how to learn. Promoting SRL practices promotes the long-term purpose of education, which is to educate students on the will to learn and at the same time, the ability to learn (Camahalan, 2006). As the ancient adage goes, "Teach a man to fish, and you have fed him for life." Students who engage in self-regulatory practices not only become capable of dealing with mathematical tasks in school but also with their lifelong goals and existence.

Empirical Gaps: Attitude Scales, Self-Regulatory Learning, and Math Achievement

Attitude and SRL have a bidirectional relationship. Students with a positive attitude are more likely to engage in SRL, and effective SRL practices can help students overcome negative attitudes and enhance their mathematical ability. Students who have a good attitude toward mathematics are more likely to be naturally motivated to learn it, which can lead to the development of SRL skills. Students who acquire excellent SRL skills, on the other hand, are more likely to succeed in mathematics, which can encourage a more positive attitude toward the subject.

Several studies have been conducted to evaluate the impact of attitude and SRL on mathematical achievement. Pintrich and De Groot (1990) discovered that attitude and SRL were both important determinants of MA. Another study, conducted by Richardson and Woolfolk Hoyle (2014), discovered that math anxiety was inversely connected to MA, whereas SRL was positively related to achievement. Boekaerts et al. (2003) discovered that SRL strategies had a moderate influence on MA in a meta-analysis. Furthermore, SRL strategies were most beneficial for learners who have low previous accomplishments in mathematics (Winne et al., 2002).

Indeed, much has been studied as far as the interaction between attitude, SRL, and MA are concerned. This study goes deeper into the mediating role of SRL on attitudinal components and MA. The few studies that have looked at attitudinal components focused on a direct relationship between the attitudinal components and MA or they look at an aspect of math. For instance, a study by Mogari (2003) looked at enjoyment, motivation, fear, and importance as attitudinal constructs for geometry achievement of students. A current study by Banson et al. (2022) looked at confidence, enjoyment, and usefulness of geometry about geometry achievement of pre-service mathematics teachers. Several studies have also indicated findings on a direct relationship between attitude and achievement (Bakar et al., 2010; Dowker et al., 2019). The hypothesis raised in our study is the impact of a mediating variable (SRL) between attitude (EM, UM, and IM) and MA. A new perspective on the mediation role in research on attitude and achievement has not been constantly investigated. Hence this study generates a framework (see **Figure 1**) on the mediating role of SRL on attitude (EM, UM, and IM) and students' MA.

Figure 1 depicts several relationships between the attitudinal components and MA. SRL is also positioned to mediate between attitude and MA. This helps to generate six hypotheses.

Table 1. Demographic information

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	161	59.2
Female	111	40.8
Total	272	100
Age		
Less than 16	4	1.5
Between 16 and 20	257	94.5
Above 20	11	4.0
Total	272	100

Hypothesis

The following hypotheses were developed:

H_1. EM has an impact on MA of students.

H_2. UM has an impact on MA of students.

H_3. IM has an impact on the MA of students.

H_4. SRL serves as a mediator between the EM and students' MA.

H_5. SRL serves as a mediator between the UM and the MA of students.

H_6. SRL serves as a mediator between IM and students' MA.

METHODS

This study employed a quantitative approach to investigate the self-regulatory mediating role between attitude and MA of students. The study randomly sampled 350 senior high school students who agreed to participate voluntarily. The instruments for the study were a questionnaire and an MA test. The questionnaire had 40 items from constructs:

(a) EM,

(b) UM, and

(c) IM (all three making up attitude) and the fourth was on SRL.

The MA test also had 40 objective questions. The instruments were designed by the researchers and all ambiguities were clarified for simplicity and understanding by the students.

Statistical techniques were employed to calculate the number of underlying factors and factor loadings and also to guide in selecting the valid items for statistical analysis and decisions (Hox, 1995). After the participants responded to all the items, the Mahalanobis test (by the use of SPSS) helped to detect outliers and later the sample was reduced to 272. The SPSS (version 23 and Amos) analyzed the data for exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), respectively. This helped to generate a framework for the analysis using the structural equation model. The observed variables that loaded on the components were chosen based on the factor loadings of the observed variables from the EFA, and all additional analyses were carried out with the aforementioned indicators for all four constructs (EM, UM, IM, SRL, and MA).

The demographic data on the respondents are shown in **Table 1**.

RESULTS

Exploratory Factor Analysis

Table 2 displays the findings of the EFA. The Kaiser-Meyer Olkin (KMO) test is used in EFA to determine sample adequacy. The normal KMO test result is between 0 and 1. If the KMO is zero, factor analysis is improper because the total of correlations for different regions of the sample is greater than the sum of all correlations. The KMO for this study was .893, which is larger than the permissible value of 0.6 (Sawari et al., 2020). At the 0.05 level, Bartlett's test was significant. **Table 2** also displays the loaded factors in the rotated component matrix. It aided in fitting each observed variable to a single construct by suppressing loadings smaller than 0.5. EM items were loaded on component 1, and self-regulatory items were loaded on component 2. The UM items for students was put on component 3, while IM items were loaded on component 4. In addition, **Table 2** further shows a total variance explanation of 65.442%.

Confirmatory Factor Analysis

The findings of the CFA are shown in **Table 3**. The model fit indices were used to assess the fitness of the conceptual model with data received from respondents. The model fit indices were as follows: CMIN/df was 1.445, which satisfied the criteria of being near to 1, with a maximum threshold of 3. The comparative fit index (CFI) and Turker-Lewis index (TLI) were 0.977 and 0.968, respectively, above the 0.95 criterion. The root mean square residual (RMR) and root mean square error of approximation (RMSEA)

Table 2. EFA (Field Survey, 2023)

	Component			
	1	2	3	4
EM22 I enjoy talking to others about math.	.687			
EM24 Math is enjoyable to me.	.759			
EM28 I enjoy learning math on my own.	.757			
EM29 I find delight in solving more examples after class.	.550			
EM30 I enjoy being introduced to new tasks in math.	.695			
SRL37 I mostly join a study group to review class notes.		.734		
SRL38 I try solving questions on topics treated from recommended books.		.570		
SRL39 I mostly engage in self-assessment after my study period.		.786		
SRL40 I often glance through my notes before the next class.		.731		
UM13 Math is relevant in my life.			.758	
UM14 I will have major use of math in my future job.			.740	
UM19 I consider that math is very important no matter the course you want to study.			.752	
IM8 I would like to solve math every day.				.715
IM9 I prefer learning math to other subjects.				.790
IM10 I always want to discuss math with my colleagues.				.801
Total variance explained				65.442%
KMO measure of sampling adequacy				.893
Bartlett's test of sphericity		Approximate Chi-square		1,683.298
		df		105
		Significance		.000
Determinant				.002[a]

Note. Extraction method: Principal component analysis; rotation method: Varimax with Kaiser normalization; & [a]rotation converged in 5 iterations

Table 3. CFA (Field Survey, 2023)

Model fit indices: CMIN = 122.811; df = 85; CMIN/df = 1.445 ; CFI = .977 ; TLI = .968; RMR = .038 ; RMSEA = .041; & PClose = .839	**SFL**
EM: CA = 0.833; CR = 0.832; & AVE = 0.500	
EM22: I enjoy talking to others about math.	.708
EM24: Math is enjoyable to me.	.785
EM28: I enjoy learning math on my own.	.644
EM29: I find delight in solving more examples after class.	.710
EM30: I enjoy being introduced to new tasks in math.	.677
SRL: CA = 0.779; CR = 0.800; & AVE = 0.501	
SRL37: I mostly join a study group to review class notes.	.618
SRL38: I try solving questions on topics treated from recommended books.	.762
SRL39: I mostly engage in self-assessment after my study period.	.724
SRL40: I often glance through my notes before the next class.	.718
UM: CA = 0.747; CR = 0.751; & AVE = 0.503	
UM13: Math is relevant in my life.	.662
UM14: I will have major use of math in my future job.	.709
UM19: I consider that math is very important no matter the course you want to study.	.753
IM: CA = 0.790; CR = 0.796; & AVE = 0.565	
IM8: I would like to solve math every day.	.724
IM9: I prefer learning math to other subjects.	.805
IM10: I always want to discuss math with my colleagues.	.724

Note. SFL: Standardized factor loading

values were 0.038 and 0.041, respectively. This is less than or equal to the criterion of 0.08. PClose should be 0.05 or greater, however it was 0.839 in this model. In summary, all the indicators indicate that the conceptual model's suitability for the investigation was adequate.

Cronbach's alpha (CA) coefficient for internal consistency was calculated for each construct. The coefficients for EM, SRL, UM, and IM were, 0.833, 0.779, 0.747, and 0.790, respectively. The reliability study for all four constructs exceeded the 0.7 criterion indicated by (Nunnally, 1978).

For each construct, average variance extracted (AVE) and construct reliability (CR) were calculated. The AVE and CR minimum thresholds were 0.5 and 0.6, respectively (Fornell & Larker, 1981). EM had an AVE of 0.500 and a CR of 0.832, whereas SRL had an AVE of 0.501 and a CR of 0.800. UM had an AVE of 0.751 and a CR of 0.822. The AVE and CR for IM were 0.565 and 0.796, respectively. According to Valentini and Damasio (2016), the quality of a measure is determined by the average variance recovered and construct dependability. These values indicate that the quality of the construct measurements in this study was good.

The cumulative effects of each indicator on the constructs are referred to as standardized factor loading. **Table 2** shows that EM24 had the greatest impact on EM, followed by EM29, EM22, EM30, and EM28. SRL38 had the greatest influence on SRL, followed by SRL39, SRL40, and SRL37. In addition, UM19 had the greatest impact on UM, followed by UM14 and UM13. IM9 had the greatest overall impact on IM, followed by IM8 and IM10.

Table 4. Discriminant validity (Field Survey, 2023)

Variables	M	EM	SRL	UM	IM
EM	2.597	**<u>0.707</u>**			
SRL	2.753	.626*	**<u>0.708</u>**		
UM	2.762	.627*	.589*	**<u>0.709</u>**	
IM	2.582	.693*	.562*	.522*	**<u>0.752</u>**
MA	2.115	.292*	.347*	.456*	.275*

Note. *~p-value significant at 1% (0.01) & √AVE are **bold** and <u>underlined</u>

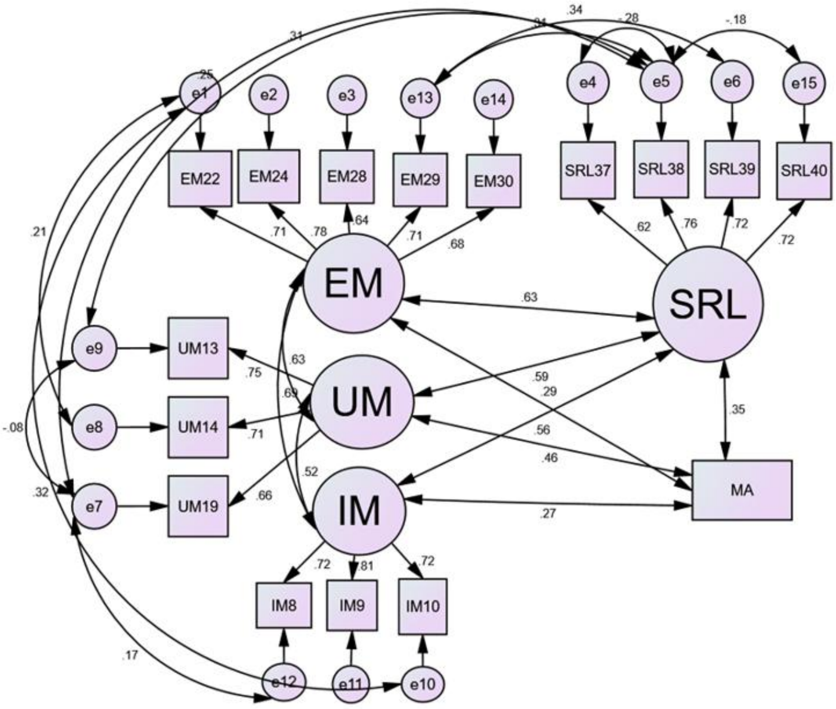

Figure 2. Diagrammatic presentation of CFA (Source: Field Survey, 2023)

Discriminant Validity

The descriptive statistics, that is means on the responses to items on the variables, EM, SRL, UM, IM, and MA (see **Table 4**) were calculated. The means for EM, SRL, UM, IM, and MA were, respectively 2.597, 2.753, 2.762, 2.582, and 2.115. The correlation between each of the components was performed to verify discriminant validity. EM was 0.626, 0.627, 0.693, and 0.292, respectively, with SRL, UM, IM, and MA. Furthermore, the connection between SRL and UM, IM, and MA was 0.589, 0.562, and 0.347, respectively. The correlation coefficient between UM and IM, MA was 0.522, 0.456. Finally, the correlation coefficient between IM and MA was 0.275. All these correlations were significant at 1% level of significance. Since the square root of AVE for each construct is larger than the correlations between the constructs, the construct in the model has discriminant validity.

Path Estimates

Direct effect

To assess the direct link between the components, the model was recreated to show the conceptual framework (see **Figure 1**, **Figure 2**, and **Figure 3**). The model indices were tested to determine the new model's fitness. The CMIN/df ratio was 1.413, while the CFI and TLI were .977 and .968, respectively. The RMR and RMSEA values were .038 and .041, respectively. The PClose was .839. This indicates that the model passed the fitness test. There was no significant impact of EM on MA. However, there was an inverse correlation of EM on MA. Also, the impact of IM and SRL on MA was not significant. There was a significant impact of UM on MA. Additionally, EM, UM, and IM have a significant impact on SRL.

Table 5 summarizes the relationship's coefficients.

The model used for testing the direct relationships between the constructs in Amos is shown in **Figure 3**.

Indirect effects

Sobel's test was used to determine the indirect impacts of EM, UM, and IM on MA via SRL. The findings demonstrated that both impacts were not significant. This result was achieved by comparing Sobel's test z-score to the crucial value from a 95% confidence interval. If Z > 1.96, the mediation effects are considerable; otherwise, the mediation effects are insignificant. 0.646 and -0.4602 have z-scores less than 1.96. Thus, there was no mediating effect of SRL on EM, UM, IM, and MA (see **Table 6**).

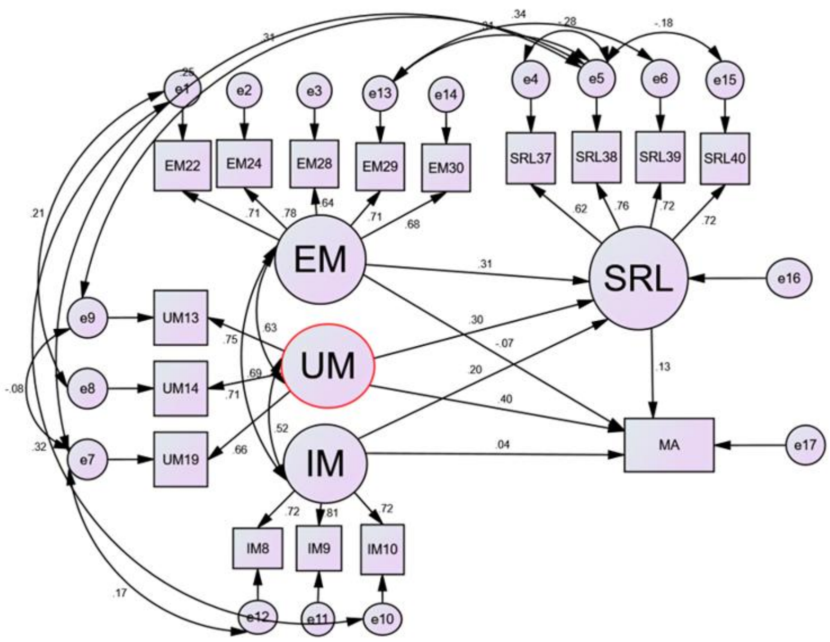

Figure 3. Structural paths (Source: Field Survey, 2023)

Table 5. Direct effects (Field Survey, 2023)

Path	Standard estimate	CR
EM → MA	-.071	-.628
UM→ MA	.402	3.901**
IM→ MA	.039	.393
SRL →MA	.133	1.505
EM → SRL	.305	2.917**
UM→ SRL	.295	3.248**
IM→ SRL	.196	2.169*

Note. Model fit indices: CMIN = 122.811; df = 85; CMIN/df = 1.445; CFI = .977; TLI = .968; RMR = .038; RMSEA = .041; PClose = .839; **~p-value significant at 1% (0.01); & *~p-value significant at 5% (0.05)

Table 6. Indirect effects (Field Survey, 2023)

Paths	A		B		$a \times b$	SE_{ab}	$Z = \frac{a \times b}{SE_{ab}}$
	Estimated	SE	Estimated	SE			
EM → SRL → MA	.305	.094	.133	.095	0.040565	0.358574	0.646
UM → SRL → MA	.295	.079	.133	.095	0.039235	0.346381	-0.4602
IM → SRL → MA	.196	.083	.133	.095	0.026068	0.26068	-0.4602

Note. $SE_{ab} = \sqrt{(SE_a)^2 \times b^2 + (SE_b)^2 \times a^2}$

DISCUSSION

Several findings were identified from the analysis of the links among the variables studied. For direct effects, it was found that EM had no significant impact on MA though there was an inverse relationship between them. Also, IM and SRL did not have a significant impact on MA. Among the four variables (EM, UM, IM and SRL) that were linked directly with MA, it was only IM that had a significant impact on MA. Some of these constructs in relation to MA have been investigated by other studies and made contrasting indications as compared to this study. For instance, a study by Camahalan (2006) which looked at the impact of SRL on MA of selected students from Asian school found that SRL had a significant effect on students' MA. The gap in the study by Camahalan (2006) was that the author looked at SRL and students' achievement though it was reckoned that students' SRL can be influenced to have a positive impact on their MA as supported by Bandura and Schunk (1981).

For studies that looked at attitudinal components and MA, Pinxten (2014) found that enjoyment had a significant link with MA. Students who displayed great levels of IM had higher performance in math (Singh et al., 2002), which has a positive impact. Our study findings were in contrast to the findings from Pinxten (2014). However, a study by Banson et al. (2022) showed that students had a positive attitude but had a negative relationship with their performance. Banson et al. (2022) additionally revealed that enjoyment, confidence, and usefulness affected students' performance but confidence was the highest prediction of students' performance. In this study, though enjoyment, usefulness, and interest were linked with MA, it was found that only usefulness had a significant impact on achievement, which is supported by Brezavšček et al. (2020) who indicated that usefulness has a significant impact on MA. It is still evident by some studies that direct association between attitude and achievement exists (Bakar; et al., 2010; Dowker; et al., 2019).

Also, the role of SRL as a mediator between EM, UM, and IM on MA was aimed at finding the indirect effect of EM, UM, and IM on MA, with SRL serving as a mediating variable. Indeed, it was indicated that EM, UM, and IM had a significant impact on SRL. This is evidence that those students who enjoyed math, realized the UM and also had an IM, would definitely be motivated to engage in SRL activities based on the findings of the study. Hidi (1990), as cited by Singh et al. (2002) reports that students may invest or withdraw from studying based on their fascination with the subject, regardless of any additional factors. Students' enjoyment, usefulness and interest levels are seen as very influential in their self-regulatory habits. It is discovered that SRL does not serve as a significant mediator between attitude and achievement. The indications from this study suggest that there was no mediating effect of SRL on EM, UM, IM, and MA. It is not surprising when Hsu et al. (2021) explained that students may exhibit a positive attitude in the sense of high levels of interest or confidence in a subject but it may not necessarily be a substitute for effective learning strategies. Although, SRL may have a direct influence on achievement, as indicated in studies (Boekaerts et al., 2003; Winne et al., 2002; Zee & de Bree, 2017), it does not guarantee to be an effective mediator between attitude and achievement, as revealed by the findings of the current study.

CONCLUSION AND RECOMMENDATIONS

Several factors have been studied that have an impact on MA of students and one of them is the broad component of attitude. Students' attitudes can be very broad and this study looked at students' EM, UM, and IM and the role of SRL as a mediating construct about MA. It was revealed that EM and IM did not have a significant impact on MA. This was parallel with SRL as it did not have a direct influence on MA. An exception is the UM which had a significant impact on MA. SRL did not serve as an effective mediator between these three attitudinal components (EM, UM, and IM) and MA, in as much as EM, UM, and IM had a significant impact on SRL. Educators may be motivated by the attitude of students as being a significant influencer of students' achievement, but the practical application of mathematics should be specially encouraged. It is still important that teachers pay attention to devising diverse strategies to help improve students' performance. They can ensure effective strategies to help students develop better learning practices that can enhance students' learning of mathematics. Studies have indicated that SRL has different components that can all stand alone as constructs. Further research can be conducted to investigate the effect of these SRL components on students' academic achievement

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Declaration of interest: No conflict of interest is declared by the authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

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