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Research Article

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The mediating effect of student motivation on enhancing student math interest through history of mathematics

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ABSTRACT

The study was purely quantitative and employed descriptive analysis. The study used stratified and simple random sampling techniques to sample 205 students from 431 first-year students pursuing "BSc mathematics education". The study exclusively utilized a structured questionnaire as its research tool, adopting a quantitative approach. To evaluate the proposed pathways, structural equation modeling was conducted using Amos 23. The study results revealed that the history of mathematics (HoM) had a direct and statistically significant positive effect on both math interest and student motivation (SMOT). Additionally, SMOT significantly and positively influenced math interest. Consequently, SMOT partially mediated the relationship between the HoM and students' math interests (SMI), which was statistically significant. The study concluded that both the HoM and SMOT directly and positively influence math interest, and the HoM positively affects SMOT. Finally, SMOT partially mediates the relationship between the HoM and math interest. Most studies have examined the influence of the HoM on students' interest, and the effect of students' motivation on their math interest, but there are inadequate empirical studies that examine the effect of students' motivation on their math interest and the mediating effect of students' motivation on the nexus between the HoM and SMI. This study adds to knowledge by examining the mediating role of students' motivation on the nexus between the HoM and SMI.

Keywords: history of mathematics, student motivation, student math interest

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INTRODUCTION

Mathematics has become a core compulsory subject undertaken from the basic schools to the senior high schools mostly in African countries especially Ghana, due to its significance to various aspects of human life. Knowledge gained from studying mathematics not only has a significant effect on academic achievement but also on effective functioning in everyday life. As mathematics has been the core component for students' advancement to tertiary institutions, students' mathematics performance is in question. Notable scholars in mathematics education have succeeded in finding factors that negatively influence students' math interest (SMI) in learning (Bah, 2022; Gegenfurtner et al., 2020; Kwarteng et al., 2018; Lo & Hew, 2021). Intrinsic factors (such as personal relevance, curiosity, and enjoyment), extrinsic factors (such as teacher influence, peer influence, and parent support), cultural factors (such as cultural attitude and social expectation), individual factors (such as self-efficacy and interest in the specific topic), and technology and media influence has shown to affect students' motivation and interest.

Student motivation (SMOT) describes the elements or causes that inspire people to enjoy and succeed in the study of mathematics (Hammoudi, 2020). To learn and be successful in any topic, including mathematics, a person must be motivated. Students who are driven are more likely to interact with the content actively. They ask questions, engage in class debates, and take on difficult assignments with willingness. This hands-on approach helps students grasp mathematical ideas more deeply. Mathematical concepts are frequently abstract and complicated, and mastering them may take some time (Yang et al., 2021). Motivated students are more likely to persevere in the face of challenges, disappointments, and periods of frustration, increasing their chances of success (Filgona et al., 2020).

Moreover, math interest defines a person's interest in, attraction to, or propensity for studying and investigating mathematical ideas, issues, and structures (Hyland et al., 2022). It includes the fulfillment that comes from interacting with mathematical concepts and activities on a personal level. Having an interest encourages curiosity and the drive to keep going in the face of difficulties. Students who genuinely enjoy mathematics are more inclined to take on challenging assignments, look for answers, and put up the work necessary to comprehend abstract

This article was written to fulfill the academic criteria for a first-year PhD (mathematics education) candidates as part of their taught courses.

ideas. Curiosity and a desire to learn more about mathematical topics are sparked by interest (Tang et al., 2022). Math-loving students are more inclined to look for extra materials, work independently, and investigate complex subjects outside of the required curriculum. Studies have demonstrated that interest enhances memory and retention (Inslicht et al., 2021; Park et al., 2023; Ni et al., 2020). Students who have a strong interest in mathematics are more likely to retain what they have learned, which lays a strong basis for their future academic success.

Using the history of mathematics (HoM) in teaching mathematics concepts is not new. According to Jahnke et al. (2022), HoM is the sole component that can favorably affect students' interest in mathematics. Jahnke et al. (2022) pointed out that HoM raises students' motivation to study mathematics. Examining the historical development of mathematical concepts, scientific advancements, and the lives of mathematicians may all have a positive and inspiring effect on students' attitudes and enthusiasm toward learning and using mathematics (Sriraman, 2021). As documented by Adolat (2019), adopting HoM in math lessons is a good idea when you want students to have an interest in the subject. This will support students' deeper and more thorough understanding of mathematical concepts. The importance of studying the HoM to mathematics students does not only influence their math interest but also has the potential to influence their motivation to study mathematics. Motivation may have influenced SMI. Therefore, the current study also examines the mediating effect of math motivation in the connection between the HoM and SMI.

The gap that remains in literature is the coaction between integrating the HoM in mathematics learning, SMOT, and SMI, which has not yet been discovered in the literature. There is a limited study that particularly examines how SMOT mediates the nexus between integrating the HoM in mathematics learning and SMI and how SMOT influences their math interest. Most students fully focused on the effect of integrating the HoM in mathematic learning (Bütüner, 2020; Bütüner & Baki, 2020; Fleener et al., 2002) or SMOT (Averill & Major, 2020; Dweck, 1986; Ekmekci & Serrano, 2022), without examine these constructs in a singly study. The specific variable through which the integration of the HoM in mathematics learning can influence SMOT, as well as SMOT, has not been established. To contribute to the literature, the researchers examined the mediating effect of students' motivation on the relationship between the HoM and SMI.

The study aims to examine how integrating the HoM can positively influence SMOT to learn mathematics and also its impact on SMI. The study will also examine the mediating effect of SMOT on the nexus between integrating the HoM in mathematics learning and SMI. The objectives for this study were to

(1) to ascertain how math interest is impacted by the HoM,

(2) to ascertain how SMOT is affected by the HoM,

(3) to investigate how math interest is influenced by motivation for mathematics, and

(4) to examine the role that SMOT plays as a mediator in the interaction between math interest and HoM.

Significant of the Study

By exploring how the HoM can boost SMOT, educators can develop more effective strategies to engage students who might otherwise be disinterested in math. Incorporating historical contexts will help students see the relevance of math in real life, making abstract concepts more concrete and relatable. The study provides a basis for developing innovative teaching methods that integrate history into math education. These methods can make math instruction more dynamic and engaging, helping to maintain student interest over time. By demonstrating the benefits of combining history and mathematics, the study encourages interdisciplinary teaching approaches. Findings from the study will inform professional development programs, equipping teachers with the skills and knowledge to incorporate historical perspectives into their teaching. Policymakers can use insights from the study to advocate for curriculum reforms that include historical perspectives in math education. This can lead to more comprehensive and balanced educational policies that prioritize SMOT and interest. The study adds to the body of research on educational psychology, mathematics education, and curriculum studies. By identifying effective practices for integrating history into math education, the study helps to establish best practices that can be adopted and adapted by educators worldwide.

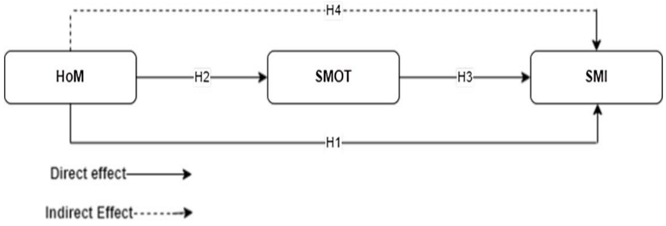

Figure 1. Conceptual framework (Source: Field Survey, 2024)

Conceptual Framework

Figure 1 illustrates the study's conceptual framework. It demonstrates that the HoM has a direct impact on SMI. Additionally, HoM directly affects SMOT. Furthermore, SMOT directly influences SMI. Lastly, SMOT serves as a mediating variable between the HoM and SMI.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

History of Mathematics and Student Math Interest

Studies have shown that incorporating historical narratives in mathematics education can positively influence student interest and engagement. For example, Arthur (2022) conducted a survey study with a sample size of 394 students from selected four senior high schools in the Ashanti Region using a structured questionnaire for the data collection. Structure equation modeling run from Amos 23 was used to examine his hypothesized paths. The findings from his study revealed that integrating the HoM in teaching and learning mathematics had a significant direct positive effect on student mathematics interest with a p-value below 1% ($\beta = 0.102$; CR = 1.690). In a similar vein, Bütüner and Baki (2020) conducted an action study of the use of the HoM in classroom teaching and learning with a population of twenty-four 8th-grade students. The data collection was based on written opinions and semi-structured interviews. The opinions from their students revealed that mathematics serves as a tool for solving real-life problems in everyday life and also improves development. Moreover, Griffiths (2000) argues that historical stories and anecdotes can make mathematics more accessible and relatable for students, thereby increasing their motivation to learn.

In addition, Ducloux (2018) discusses how learning about the historical development of mathematics can humanize the subject and reduce anxiety among students who may find mathematics daunting. This approach can lead to improved attitudes and perceptions of mathematics. Furthermore, Fauvel and van Maanen (2000) emphasize that studying the HoM can deepen students' understanding of mathematical concepts. By tracing the origins and evolution of ideas such as number systems, geometry, and algebra, students can develop a richer and more coherent understanding of these topics. Blum (2015) also emphasized that engaging with historical problems and methods encourages students to think critically and analytically about mathematics. Biehler and Scholz (2002) finally suggested that historical context provides a framework for understanding the relevance and applicability of mathematical concepts. This hypothesized that

H1: The HoM positively affects SMI.

History of Mathematics and Student Motivation

Integration of the HoM into the mathematics curriculum will significantly influence SMOT and engagement. Empirical studies and theoretical perspectives highlight how historical context and stories can enhance students' interest and motivation to learn mathematics. Swert (2020) conducted an empirical study showing that students exposed to the HoM demonstrated higher levels of motivation and interest in the subject. Moreover, Endris (2008) found that project-based learning involving historical research on mathematical topics increased SMOT and fostered a positive attitude toward mathematics. Jankvist (2009) also argues that the HoM helps students understand the evolution of mathematical concepts, leading to a deeper comprehension and appreciation of the subject's complexity. Furthermore, Liu (2003) found that incorporating historical narratives into mathematics education makes the subject more engaging. This hypothesized that

H2: The HoM positively affects SMOT to learn mathematics.

From hypothesis 1 and hypothesis 2, it was found that the HoM has a direct influence on mathematics motivation. Moreover, the HoM directly influenced SMOT. From these discoveries, the current study proposed that

H3: SMOT positively affects SMI.

H4: SMOT has a beneficial effect on the link between HoM and math interest.

METHODOLOGY

Design

The study was purely quantitative and employed descriptive analysis. Quantitative methods allow for precise measurement and quantification of variables. This is particularly useful when researchers need to gather numerical data to make specific, measurable comparisons. A structured questionnaire was used as a data collection tool for collecting data from the target population.

Population

The study's population comprises 421 first-year students enrolled in the BSc. Mathematics Education program at Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development (AAMUSTED) in Kumasi, Ghana. These students view mathematics as an alien language rather than a human one. By focusing on this group, the study aims to help them understand and learn how mathematical concepts and theorems are derived.

Table 1. Background characteristics of respondents

Background characteristics	Number of respondents	Percentages (%)
Gender	205	100
Male	113	55.1
Female	92	44.9
Age	205	100
18–25 years	106	51.7
26–33 years	78	30.0
Above 33 years	21	10.2
Religion	205	100
Christianity	115	75.6
Muslim	49	23.9
Traditional	1	0.5

Sample Size

Sample size refers to taking a part of the total population under study. The sample size for the study was calculated using Yamane and Sato's (1967) sample size determination formula, which was given, as follows:

$$n = \frac{N}{1 + Ne^2} \tag{1}$$

where n signified the unknown sample size, N signified the total population (set as 421) and e signified the error margin (set as 0.05).

By method of substitution, Eq. (1) becomes

$$n = \frac{N}{1 + Ne^2} = \frac{421}{1 + 421(0.05)^2} = 205.116 \approx 205. \tag{2}$$

From Eq. (2), the required sample size for the study based on Yamane and Sato's (1967) sample size determination was 205. From Table 1 out of 205 respondents, 55.1% were males and 44.9% were females. 51.7% were between the age ranges of 18 years to 25 years, 30% were between the age range of 26 years to 3 years, and 21% were above the age of 33 years. 75.6% were Christian, 23.9% were Muslim, and .5% were Traditionalist.

Sampling Approach

The study employed two sampling techniques: stratified sampling and simple random sampling. Stratified sampling involves dividing the population into subgroups or strata based on relevant characteristics, in this case, the student's courses of study. This technique helps minimize sampling error by ensuring adequate representation of each stratum, leading to more accurate and reliable results compared to simple random sampling alone. After stratifying the students according to their courses, simple random sampling was used to select respondents from each stratum. This method ensures that every member of the population has an equal chance of being selected.

Ethical Statement

The researchers saw that all research ethics were strictly followed. Following the respondents' assent to take part in the study, the data was managed with extreme confidentiality while preserving anonymity. A letter was sent to the head of the department of mathematics education requesting permission to use the responders from the chosen students for the survey participants. The purpose of the study was explained to the respondents by the researchers. The explanations provided persuaded the participants, who unhesitatingly provided their consent. The researcher from the danger of any kind, including political, psychological, and bodily injury, shielded all those who responded. The data the researchers gathered and provided did not in any manner reveal the participants' identities, ensuring the confidentiality of the participants.

Instrument and Measures

A questionnaire served as the primary data-gathering tool for the study. There were two sections to the questionnaire. The respondents' age, gender, and religion are among the demographic details included in part A. However, section B consists of questions about the three constructs, that is, the HoM, SMOT, and student's interest in mathematics, all of which are intended to address the research hypothesis. Five measuring items were adapted from Asare et al. (2023) to assess students' interests in mathematics. These statements encompassed: "I am capable of expressing my understanding of mathematics through various means (such as drawings, figures, tables, etc.)", "Studying mathematics is manageable", "A fundamental grasp of mathematics is essential for everyone", and "Mathematics significantly influences our daily lives". For the SMOT measure, five measuring items were adapted from Ersoy and Oksuz's (1980) study. The following statements were made: "I can relate my current learning to past mathematics knowledge", "I am willing to participate in mathematics class discussions", "I feel apprehensive about solving mathematics problems because I fear I might fail", "I am curious about what I will learn in new topics during mathematics lessons". In addition, five HoM measurement elements were changed from Arthur et al. (2022).

The study utilized a pre-existing questionnaire to enhance reliability, validity, and comparability across studies, as supported by Martin-Cook et al. (2021) and Sekhon et al. (2022). Leveraging validated scales, as suggested by Aithal and Aithal (2020), reduced the effort of creating and validating new items. The selected items were tailored to measure the study's constructs accurately while considering Ghana's unique educational context. To ensure cultural relevance and clarity, some items were modified, and the language was adapted to suit the target population. Although derived from prior research, all items were adjusted to fit the study's specific objectives.

Data Analysis Methodology

Amos 23 and SPSS (version 23) software were used for the data analysis. Five distinct categories were used in the study's data analysis. First and foremost, the study dataset's missing data was examined using descriptive analysis, or frequency. This will assist the data analyst in identifying the response or responses that are missing from the research dataset. Following the descriptive analysis, the constructs whose measurement items had inadequate loading or no loading were identified using exploratory factor analysis (EFA). Additionally, the EFA helps identify the true factors for the variables whose measurement items were exactly loaded at their respective construct(s) and the threshold of 0.5. CFA was used to assess the research data's model fitness. Amos 23, an add-on program for SPSS (version 23), was used to apply discriminant validity to look at the intercorrelation between the components. Ultimately, to address the study concerns about their research hypothesis, pathways analysis was carried out utilizing structural equation modeling (SEM) run via Amos 23 software.

Table 2. EFA

Rotated component matrix			
Items	**Component 1**	**Component 2**	**Component 3**
SMOT1	0.949		
SMOT3	0.900		
SMOT4	0.959		
SMOT5	0.698		
SMOT9	0.946		
HoM4		0.744	
HoM5		0.673	
HoM6		0.779	
HoM7		0.740	
HoM8		0.748	
HoM9		0.764	
SMI4			0.716
SMI5			0.755
SMI6			0.739
SMI7			0.672
SMI8			0.801
SMI9			0.767
KMO and Bartlett's test			
Total variance explained			70.585%
KMO measure of sampling adequacy			0.900
Bartlett's test of sphericity		Approximate Chi-square	2,922.131
		df	136
		Significance	0.000
Determinant			0.0024

Table 3. Validity and reliability analysis

Variables	Number of items	Cronbach's alpha value
HoM	5	0.877
SMOT	6	0.911
SMI	6	0.890

DATA ANALYSIS

Exploratory Factor Analysis

The number of measuring items loaded at the proper construct was ascertained using the EFA. Measurement items exhibiting loadings below 0.5 or at a different construct will be removed and excluded from further analysis of the data. Five measuring items from **Table 2** with loadings greater than 0.05 were loaded for SMOT. For HoM, six measurement items were loaded, and the loading was more than 0.05. Six measurement elements were loaded for math interest, and as advised by Tian et al. (2021), their loading surpassed 0.5. 3.753E–7, or 4115.66, was computed as the coefficient of the determinant, and the Kaiser-Meyer-Olkin (KMO) measure of adequacy was 0.900.

Moreover, the adequacy presumption of 90% was found in the KMO for the measurement items loaded at their correct construct on the latent variables. Bartlett's test of sphericity yielded a significant p-value of 0.000 with a Chi-square of 2922.131 and a degree of freedom of 136. Additionally, the three latent variables had a total variance of 70.585%. For the measurement items loaded with the relevant latent variables, the final EFA result is displayed in **Table 2**.

Validity and Reliability Analysis

Table 3 shows the reliability results for the study constructs run from SPSS (v. 23) to estimate the Cronbach's alpha value. Increased

Table 4. CFA

Model fit criterial: CMIN = 199.370; df = 112; CMIN/df = 1.780; TLI = .963; CFI = .970; GFI = .901; RMSEA = .062; SRMR = .061; PClose = .083	**Factor Loading**	**Significance**
SMOT: CA = .911; CR = .954; & AVE = .809		
SMOT1. I can establish a link between what I am studying now and what I have learned in the past about mathematics.	0.975	***
SMOT3. I can convey the concepts I have learned in mathematics in a variety of methods (drawings, figures, tables, etc.).	0.891	***
SMOT4. In math class, I'd want to put up my hands.	0.989	***
SMOT5. I fear tackling arithmetic problems because I believe I am incapable of doing so.	0.630	***
SMOT9. I'm interested to see what the new math lesson topics will cover.	0.960	***
HoM: CA = .877; CR = .875; & AVE = .541		
HoM4. My ability to solve mathematical puzzles is enhanced by studying mathematical history.	0.713	***
HoM5. For me, mathematics becomes tangible through its history.	0.722	***
HoM6. Studying mathematics is made more engaging by its history.	0.726	***
HoM7. The value of knowing mathematics is reviewed by the history of mathematics.	0.808	***
HoM8. My capacity to analyze critically is enhanced by studying the history of mathematics.	0.618	***
HoM9. My interest in studying mathematics is piqued by the history of mathematics.	0.809	***
SMI: CA = .890; CR = .887; & AVE = .569		
SMI4. I can express the things that I learned in mathematics in different ways (drawings, figures, tables, etc.).	0.751	***
SMI5. Mathematics is easy to study.	0.788	***
SMI6. I contribute a lot in mathematics class.	0.647	***
SMI7. Mathematics plays a crucial role in our daily lives	0.688	***
SMI8. Our everyday lives depend heavily on mathematics.	0.788	***
SMI9. Everyone requires a basic understanding of mathematics.	0.847	***

*** Signified 1% level of significant

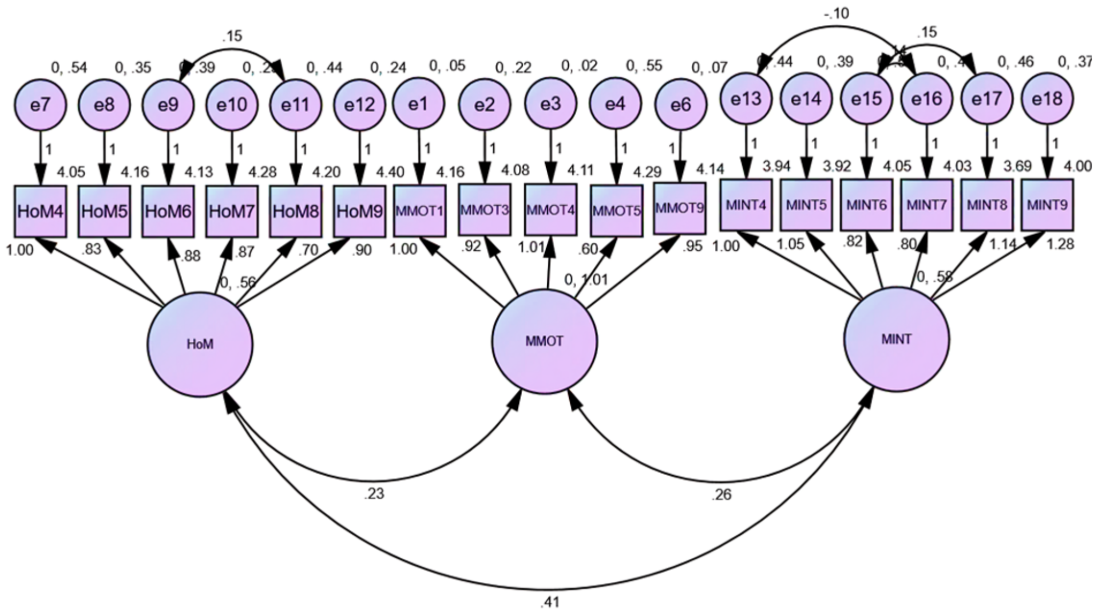

Figure 2. CFA (Source: Field Survey, 2024)

coefficient values, ranging from 0 to 1, indicate a higher degree of internal consistency. Values of 0.70 or greater are generally considered to be acceptable, whereas values above 0.80 are preferred (Goni et al., 2021). Moreover, the latent variables' Cronbach's alpha values are given, derived from **Table 3**. The value was above 0.80, indicating that the measurement item accepted from the EFA findings can be utilized for additional analysis.

Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) was performed to see if the model fit the study data using Amos 23. Using the retained measurement items from **Table 2** that were loaded at the correct construct, CFA was carried out. For a model to be deemed fit, Amoako et al. (2022) state that the following criteria must be met: the CMIN/df value must not exceed 3, the CFI and TLI values must be at least 0.9, the SRMR and RMSEA values must be less than either 0.06 or 0.08, and the PClose value must all be statistically insignificant (PClose > 0.05).

Table 4 indicates that the model fitness requirements correspond to Dogbe et al. (2020) and Bright et al. (2024) model fitness. This implies that the route analysis may be estimated using the same measurement items that were used for the CFA analysis. The findings of the CFA are shown in **Table 4**.

Confirmatory factor analysis illustration

Figure 2 demonstrates the graphical representation for **Table 2**. From **Figure 2**, HoM had six measurement items, SMOT had five measurement items, and math interest had six measurement items. The covariances among the variables (HoM, SMOT, and SMI) are also shown in **Figure 2**. The purpose for joining e9↔e11, e13↔e16, and e15↔e17 are for better model fitness.

Table 5. Discriminate validity

Variables	CR	AVE	HoM	MMOT	MINT
HoM	0.875	0.541	**0.739**		
SMOT	0.854	0.809	0.306***	**0.899**	
SMI	0.887	0.569	0.720***	0.336***	**0.754**

***~Significant at 0.01 (1%)

$\sqrt{AVE}s$ are in **bold**

Table 6. Path analysis (direct effect)

Direct effect	Standard Estimate	Standard Error	CR	p
Gender → MI	0.116	0.081	1.432	0.153
Age → SMI	−0.154	0.061	−2.525	0.012
Religion → SMI	0.279	0.093	3.000	0.003
HoM → SMI	0.648	0.086	7.535	0.000
HoM → SMOT	0.407	0.100	4.070	0.000
SMOT → SMI	0.087	0.043	2.023	0.046
Indirect effect	**SE**	**LB**	**UB**	**p**
HoM → SMOT → SMI	0.208	0.124	0.302	0.000

Discriminate Validity

Discriminant validity tests whether the items or scales used to measure different constructs are sufficiently different from each other, so they do not overlap or correlate strongly (Asare et al., 2024). It ensures that the measures are not capturing the same underlying construct, as this would lead to issues of construct redundancy or construct overlap. Researchers frequently use statistical methods like SEM or CFA to evaluate discriminant validity. With the use of these tools, researchers may assess the connections between the variables or indicators that can be detected and the underlying latent structures. The squared root of the AVEs is compared to the associated scores to ascertain discriminant validity.

Also, to agree that discriminant validity has been achieved, the least value for AVE must be greater than the highest correlation scores as recommended by Roemer et al. (2021). From **Table 5**, it can be seen that the lowest square root of the AVEs is .737 which is greater than the highest value of the correlation score which is .720 (HoM and math interest). The result proved that discriminant validity was achieved.

RESEARCH RESULTS

Path analysis is a statistical method used to analyze relationships between variables in a study. Researchers can evaluate complex causal hypotheses using this form of SEM, which estimates the effects of multiple variables on an end variable. The study aims to determine the direct and indirect influences of factors on the outcome of interest, assessing the strength and significance of these pathways. The results of the path analysis are presented in **Table 6**, generated using Amos 23.

Amos 23 was employed to examine how the theories developed. The hypothesized path's final results are shown in **Table 6**, where it is shown that gender has a positive, statistically insignificant influence on interest in mathematics with a p-value greater than 0.5 (β = 0.116; CR = 1.432). Conversely, age has a statistically significant and negative impact on interest in mathematics, with a p-value of less than 0.05 (β = −0.154; CR = −2.525). Lastly, religion has a p-value of less than 0.01 (β = 0.279; CR = 3.007), suggesting that it has a positive and statistically significant impact on interest in mathematics.

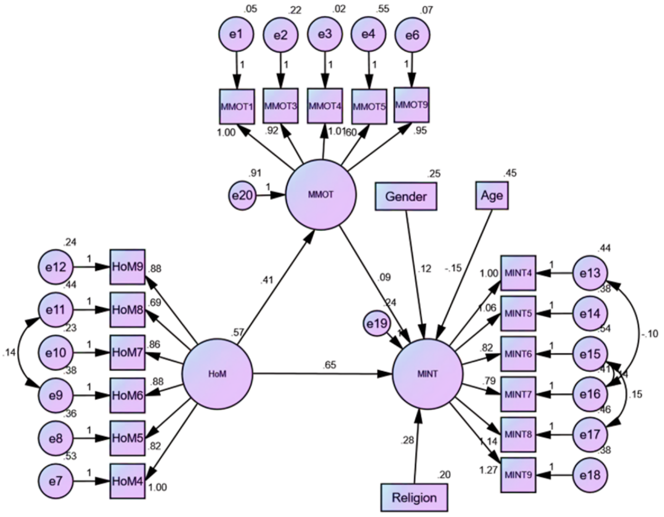

Figure 3. Path analysis (Source: Field Survey, 2024)

In this study, four research hypotheses were considered. First, SMI is positively impacted by HoM in a direct and statistically significant way (β = 0.648; CR = 7.535). H1 is therefore approved in this investigation. Second, students' desire for mathematics is positively impacted by HoM in a direct and statistically significant way (β = 0.407; CR = 4.070). H2 is therefore approved in this investigation. Thirdly, students' interest in mathematics is positively impacted by SMOT in a direct and statistically significant way (β = 0.087; CR = 2.023). H3 is so approved in this investigation. Lastly, the study looks at how SMOT influences the connection between students' interests in mathematics and their level of motivation in the subject. The findings shown in **Table 6** suggest that students' interest in mathematics is somewhat mediated by their motivation for mathematics, with both the upper limit (UB = 0.302) and lower bound (LB = .124) values being positive and not falling below the zero range. Regarding students' interest in mathematics, the mediating impact was favorable and statistically significant (β = 0.208***). As a result, H4, which claims that "SMOT positively impacts the connection between math interest and history," is approved in this study.

Hypothesized Paths Illustration

Figure 3 represents the graphical representation for **Table 4**. From **Figure 3**, the HoM has a positive effect on SMI and SMOT. In addition, SMOT has a positive effect on SMI. Moreover, SMOT partially mediates the association between the HoM and SMI. Gender and religion had a positive effect on SMI. Finally, age hurts SMI.

DISCUSSION

First, hypothesis one which the study's data supported was that HoM directly enhances students' interests in mathematics. This suggests that the application of HoM in mathematics education fosters students' interest in the subject matter. Our research confirms other empirical investigations, such as Hoffmann et al. (2019), which found that HoM had a favorable impact on students' interest in mathematics instruction and learning. Students' interest in studying Pythagoras' theorem and using it to solve mathematical problems is greatly influenced by its historical background. According to Kusumawati et al. (2020), there is a direct link between students' interests in mathematics and their HoM.

Second, the analysis of the current study supported the hypothesis that HoM has a favorable impact on SMOT. The present study's findings are also consistent with earlier research conducted by Hoffmann et al. (2019) and Kusumawati et al. (2020). According to their research, utilizing or teaching the HoM helps raise students' motivation, reduce math anxiety, and increase students' enthusiasm for the subject matter.

According to Dorce (2022), utilizing Math-Island has a significant favorable impact on pupils' motivation and interest in mathematics. According to Mersin and Durmus's (2021) research, students' enthusiasm to learn mathematics is significantly increased when the HoM is provided effectively. The influence of the HoM on students' excitement to learn the subject was examined by Tong et al. (2019), using factor and multi-regression analysis. The study's findings showed that HoM significantly increases students' desires.

Thirdly, the study findings review that student's math interest is influenced by SMOT, which was also confirmed by the analysis of the current study. The study revealed that student's math interests are enhanced when students are motivated to learn mathematics. This most recent study is consistent with earlier ones (Casinillo et al., 2020; Prast et al., 2018; Tambunan, 2018). Their research revealed that SMI was significantly increased when they were motivated. To ascertain the impact of motivating on student mathematics interest, Gegenfurtner et al. (2020) undertook research with 200 students. The study's findings show that motivating students has a 75% favorable impact on their math interests, which in turn has a beneficial impact on their performance.

In the end, the study found that motivation mediates some of the association between HoM and students' mathematical ability. Consequently, integrating HoM into mathematics instruction will either directly or significantly raise students' interest in the subject, or it may first directly and favorably impact students' motivation before having a favorable, substantial effect on students' interest in the subject. The study's findings are consistent with those of Niati et al. (2021). According to this study, encouraging pupils to learn mathematics has a big impact on their interest in the subject. Yeh et al. (2019) assert that using positive reinforcement to motivate students has a favorable impact on their interest in math and their performance in the subject.

CONCLUSION

In determining the connection between the HoM and SMI, the current study focused on the moderating role of mathematics motivation. The analysis was based on the sample of 205 first-year students pursuing "BSc mathematics education at AAMUSTED in Kumasi". The results of the study revealed that HoM directly and significantly had effects on SMOT. On the other hand, SMOT had a statistically significant and direct beneficial effect on SMI. Additionally, HoM had a favorable and statistically significant effect on SMI. Finally, SMOT had a somewhat significant, positive mediation impact on the connection between HoM and SMI.

Limitations of the Study

The use of HoM to enhance SMI as mediated by SMOT was the only focus of the current investigation. Only university students pursuing BSc degrees in mathematics education and information technology education at the AAMUSTED in Kumasi, were included in the study. Further study must be conducted at different universities to examine what persists there. Moreover, the study was limited to the use of quantitative data and statistical analysis to understand and solve the problem at hand.

Suggestions for Further Studies

The current study used a structured questionnaire to gather data from respondents, future studies must use interviews to help students express their views on the use of the HoM in mathematics teaching and learning. Future study must include students who study any mathematics-related courses. Researchers should conduct focus group discussions with students to explore their perceptions of how HoM influences their interest in mathematics. Moreover, using case studies to document the in-depth experiences of students exposed to HoM content. Furthermore, further studies should use semi-structured interviews with students to understand the motivational changes induced by lessons featuring HoM. In addition, studies should conduct narrative inquiries where students describe their motivational experiences and their impact on their interest in mathematics. Finally, further studies should use thematic analysis of interviews or written reflections to identify motivational themes that link HoM to changes in math interest.

Educational Implications

As educational implications, mathematics lecturers should use assessments that allow students to explore historical contexts, such as essays, presentations, and projects, rather than relying solely on traditional problem-solving tests. Moreover, mathematics lecturers should incorporate storytelling techniques to present mathematical concepts. In addition, mathematics instructors should highlight diverse mathematicians from various backgrounds and eras to inspire students and show that mathematical achievements are accessible to everyone. Furthermore, mathematics instructors should make sure that the historical context of mathematics can help students find intrinsic motivation by understanding the importance and impact of math throughout history. Finally, curriculum planners should include reflective assessments where students can discuss how learning about the HoM has changed their perception and interest in the subject.

Practical Implications

As practical implications, the study suggests that mathematics lecturers should help students create portfolios that include their math work along with historical research and reflections. Moreover, educational institutions should organize workshops focused on integrating the HoM into teaching practices. Again, mathematics lecturers should integrate videos that cover the HoM into their mathematics course outline. Finally, mathematics lecturers should start each new topic with a story about how the concept was discovered or used in the past.

Recommendations

The study recommended that teachers and educational authorities should be innovative in using creative approaches that as HoM which will motivate students to develop a positive attitude towards mathematics learning. Moreover, it is recommended that further research explores the effectiveness of HoM in different settings or investigate its long-term effects on student learning and attitudes. Moreover, mathematics teachers must use a variety of resources such as books, documentaries, podcasts, and online courses to present different perspectives and approaches to the HoM. In addition, mathematics teachers should arrange visits to mathematics museums, historical sites, or institutions that showcase the evolution of mathematical ideas. Finally, it is recommended that mathematics teachers organize hands-on activities and experiments that allow students to experience historical mathematical concepts in action.

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Data availability: Data generated or analyzed during this study are available from the authors on request.

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APPENDIX A: RESEARCH QUESTIONNAIRE

Dear Sir/Madam,

Please take a few moments to complete this questionnaire, which is solely for academic purposes. A high level of anonymity and secrecy is guaranteed. The study assessed "**The mediating effect of student motivation on enhancing student math interest through its history**". There are no correct or incorrect replies. Please mark (√) where applicable. It will take roughly 20 minutes to complete the entire questionnaire.

Section A. Demographics

1. Gender of the respondent: Male [ ] Female [ ]
2. Age of the respondent: 11–15 years [ ] 16–20 years [ ] 21–25 years [ ] 26 years or above [ ]
3. Religious affiliation of the respondent: Christian [ ] Muslim [ ] Traditionalist [ ]

Section B. History of Mathematics, Student Motivation, and Student Math Interest

Q5. Please indicate your level of agreement or disagreement with the statement below. They have been rated in the form *1-strongly agree (SA)*, *2-agree (A)*, *3-neutral (N)*, *4-disagree (D)*, and *5-strongly disagree (SD)*.

Please tick (√) in the box where appropriate.

Code		1 = SA	2 = A	3 = N	4 = D	5 = SD
HoM (Arthur et al., 2022)						
HoM1	History of mathematics improves my mathematics thinking ability.	[1]	[2]	[3]	[4]	[5]
HoM2	History of mathematics improves my interest in mathematics.	[1]	[2]	[3]	[4]	[5]
HoM3	The value of learning mathematics is demonstrated by its history.	[1]	[2]	[3]	[4]	[5]
HoM4	My ability to solve mathematical puzzles is enhanced by studying mathematical history.	[1]	[2]	[3]	[4]	[5]
HoM5	For me, mathematics becomes tangible through its history.	[1]	[2]	[3]	[4]	[5]
HoM6	Studying mathematics is made more engaging by its history.	[1]	[2]	[3]	[4]	[5]
HoM7	The value of knowing mathematics is reviewed by the history of mathematics.	[1]	[2]	[3]	[4]	[5]
HoM8	My capacity to analyze critically is enhanced by studying the history of mathematics.	[1]	[2]	[3]	[4]	[5]
HoM9	My interest in studying mathematics is piqued by the history of mathematics.	[1]	[2]	[3]	[4]	[5]
SMOT (Ersoy & Oksuz, 980)						
SMOT1	I can build up a connection between my current learnings and previous learnings in mathematics.	[1]	[2]	[3]	[4]	[5]
SMOT2	Challenge topics (i.e. circle theorem, business mathematics, logic, and mensuration II) in mathematics motivate me to learn mathematics.	[1]	[2]	[3]	[4]	[5]
SMOT3	I can express the things that I learned in mathematics in different ways (drawings, figures, tables, etc.).	[1]	[2]	[3]	[4]	[5]
SMOT4	I would like to raise my hand in mathematics class.	[1]	[2]	[3]	[4]	[5]
SMOT5	I am afraid of solving mathematics problems thinking that I can't do it.	[1]	[2]	[3]	[4]	[5]
SMOT6	Mathematics teachers provide students with incentives to support their mathematics learning.	[1]	[2]	[3]	[4]	[5]
SMOT7	Some topics in mathematics (i.e., sets, surds, linear equations, & fractions, etc.) motivate me to learn mathematics.	[1]	[2]	[3]	[4]	[5]
SMOT8	Mathematics classroom settings encourage me to learn mathematics.	[1]	[2]	[3]	[4]	[5]
SMOT9	I am curious about what I would learn in new topics in mathematics lessons.	[1]	[2]	[3]	[4]	[5]
SMI (Asare et al., 2023)						
SMI1	In a mathematics lesson, I'm always under a lot of pressure.	[1]	[2]	[3]	[4]	[5]
SMI2	Even the prospect of having to solve a mathematics issue makes me uneasy.	[1]	[2]	[3]	[4]	[5]
SMI3	Ever since elementary school, I have enjoyed mathematics.	[1]	[2]	[3]	[4]	[5]
SMI4	I can express the things that I learned in mathematics in different ways (drawings, figures, tables, etc.).	[1]	[2]	[3]	[4]	[5]
SMI5	Mathematics is easy to study.	[1]	[2]	[3]	[4]	[5]
SMI6	I contribute a lot in mathematics class.	[1]	[2]	[3]	[4]	[5]
SMI7	Mathematics plays a crucial role in our daily lives.	[1]	[2]	[3]	[4]	[5]
SMI8	I devote more time to studying mathematics.	[1]	[2]	[3]	[4]	[5]
SMI9	Everyone requires a basic understanding of mathematics.	[1]	[2]	[3]	[4]	[5]