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Structural equation model of the mediating effects of teaching quality in the relationship between mathematics connection and achievement motivation

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ABSTRACT

This study assessed the mediating effect of teaching quality (TQ) in the relationship between mathematics connection (MC) and achievement motivation (AM) of senior high school students in Ghana. A descriptive survey was carried out on 400 students randomly selected from Kumasi Senior High Technical School. The survey instrument comprised of structured questionnaires designed to elicit students' responses on the main constructs. Following data input in SPSS (V. 23), confirmatory factor analysis was run in AMOS (V. 23) to ensure the data fit the hypothesized model. Construct validity and reliability assessment were also done and the results indicated that the data was valid and reliable. Path analysis was run in AMOS (V. 23) to determine direct, indirect, and total effects among the main constructs. The results showed that the direct effects of MC on AM was positive and significant. Similarly, the indirect effects of MC on AM through TQ was also revealed positive and significant. Therefore, TQ partially mediated the relationship between MC and AM. The study recommended that mathematics teachers should be professionally trained to adapt strategies that links classroom mathematics to students' lives, other subjects, and real-life situations to make learners develop the desire for the subject.

Keywords: Ghana, senior high school, teaching quality, mathematics connection, achievement motivation

INTRODUCTION

Mathematics education at the senior high school level is undeniably a pivotal component for preparing students for future studies and careers in fields such as science, engineering, finance, and technology. Beyond simply imparting mathematical knowledge, it serves as a crucible for nurturing critical thinking, problem-solving abilities, and analytical skills that are indispensable for success in a myriad of professional domains. Despite its irrefutable significance, fostering students' motivation and improving their performance in mathematics has long been a formidable challenge for educators, schools, and policymakers alike (Stipek, 2002). The perception of mathematics as a difficult and abstract subject often dampens students' enthusiasm, thereby exerting a profound impact on their academic progress (Wigfield & Eccles, 2000). Consequently, unravelling the multifaceted factors that influence students' motivation in mathematics is imperative, with one particularly studied factor being mathematics connection (MC)–the capacity of teachers to link classroom concepts to real-life scenarios, other academic disciplines, and students' everyday lives (Arthur et al., 2018).

Moreover, the quality of mathematics instruction emerges as a pivotal determinant of student achievement motivation (AM) (Scherer & Nilsen, 2016a). Teaching quality (TQ) transcends the mere conveyance of mathematical content and extends to how teachers engage, inspire, and facilitate student learning. However, while previous studies have explored the linear relationship between MC and AM, empirical evidence regarding the mediating role of TQ remains scarce. Consequently, the current study endeavors to unravel the intricate interplay between these critical factors. It seeks to delve into how TQ acts as a mediator in the relationship between MC and AM, employing the robust analytical tool of structural equation modelling to elucidate these complex dynamics.

To understand the nuances of mathematics motivation, it is imperative to recognize that the abstract nature of mathematics often serves as a formidable barrier (Kortenkamp, 2004). Students frequently perceive mathematics as disconnected from their daily lives and future careers, leading to diminished enthusiasm and motivation. MC takes the center stage in this discourse. It embodies the idea that teachers can bridge the gap between theory and practice by showcasing the real-world applications of mathematical concepts. This exemplifies the relevance of mathematics in various academic disciplines and personal contexts

(Selvianiresa & Prabawanto, 2017). As such, teachers who possess the ability to forge these connections are likely to invigorate their students' interest in mathematics and, by extension, boost their motivation towards excellence.

Furthermore, the significance of TQ cannot be overstated (Boadu et al., 2023). Effective mathematics instruction extends beyond the dissemination of content (Ben-Hur, 2006); it hinges on pedagogical strategies, communication skills, and the cultivation of a positive learning environment. Teachers who can inspire, engage, and support their students are more likely to enhance their motivation to learn and succeed in mathematics. Consequently, the quality of teaching can serve as a critical mediator in the relationship between MC and AM. When teachers effectively connect mathematical concepts to real-life scenarios and other disciplines, they not only make the subject more accessible but also create a conducive learning atmosphere that can amplify students' motivation to excel.

This research article sought to contribute novel insights to the domain of mathematics education by elucidating the intricate interplay among MC, TQ, and AM. The outcomes are anticipated to yield practical implications for both educators and policymakers, facilitating the development of evidence-based strategies to enhance pedagogical approaches and foster student motivation, ultimately promoting proficiency in mathematics. Moreover, this study may serve as a catalyst for further scholarly inquiries into the optimization of mathematics instructional methodologies, tailored to address the diverse needs of learners.

Objectives of the Study

This study sought to:

(a) determine the direct effects of MC on AM and

(b) asses mediating effect of TQ on relationship between MC and AM.

Hypotheses Development

Hypothesis H1 posits that mathematics connection has a direct positive effect on senior high school students' achievement motivation

H1 is grounded in a substantial body of research that highlights the benefits of connecting mathematics to real-world situations and other disciplines. Arthur et al. (2018) found that using real-life analogies in teaching mathematics increased students' interest in mathematical activities. When students can see the practical applications of mathematical concepts, they are more likely to be motivated to learn and apply those concepts. Similarly, Wilensky (1993) emphasized the importance of connected mathematics, where learners make sense of mathematical ideas and establish links between mathematical concepts, skills, and other disciplines. This approach fosters motivation as students are motivated to explore and interpret mathematical concepts in meaningful ways.

Furthermore, the study by Cejka et al. (2006) demonstrated that using robotics to teach mathematics concepts in K-12 classes engaged students and inspired them by connecting mathematical concepts to real-world applications. This kind of experiential learning can significantly boost students' motivation. Additionally, Kwon's (2016) research on 3D printing and design software showed that students' motivation, interests, real-life abilities, and quantitative skills improved significantly when technology and real-world applications were integrated into mathematics education. The positive effect sizes in this study indicate the practical value of such approaches in enhancing students' motivation.

Hypothesis H2 proposes that high-quality mathematics instructions that foster engagement in real-life activities mediate relationship between mathematics connection & students' achievement motivation

H2 builds on a robust body of research that underscores the pivotal role of instructional quality in influencing students' motivation and learning outcomes. Numerous studies, including those by Boston (2012), Scherer and Nilsen (2016b), Teig and Nilsen (2022), and Tongsilp (2013), have highlighted the significance of effective instruction in promoting students' motivation and enhancing their problem-solving abilities. When teachers present lessons sequentially and engage in collaborative learning, students are more willing to accept challenges and exhibit a greater motivation to learn.

Furthermore, the research by Khotimah (2016) and Papadakis et al. (2016) provides additional support for **H2**. Khotimah's (2016) study demonstrated that contextualized instructions, which incorporated real-world situations, improved the quality of lecturers' course delivery and students' problem-solving skills. Similarly, Papadakis et al.'s (2016) research showed that realistic mathematics instruction, which emphasized real-world applications, significantly contributed to the development of young children's mathematical skills. These studies suggest that connecting mathematics to real-world situations enhances the quality of teaching, making it more engaging and relevant to students.

Conceptual Framework

Figure 1 displays the conceptual framework of the present study. The framework was developed from review of supportive literature including theoretical and empirical sources. According to **Figure 1**, there is an independent, a mediator and a dependent variable. The independent variables are MC, TQ, and AM. The arrow from MC to AM shows the direct effect of MC on AM and TQ serves as the mediator between MC and AM. The dashed arrow represents the indirect effects of MC on AM through TQ. The conceptual framework also comprised of **H1** and **H2**. **H1** is the hypothesis that MC has a direct positive effect on senior high school students' AM and **H2** is hypothesis that high-quality mathematics instructions that foster engagement in real-life activities mediate the relationship between MC and students' AM.

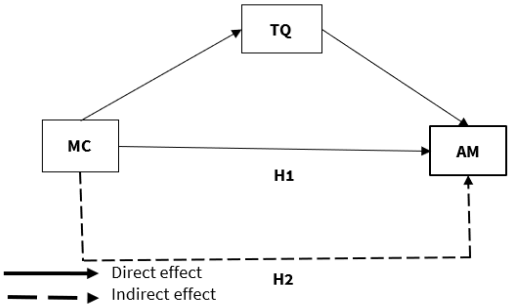

Figure 1. Conceptual framework (Source: Authors' own elaboration)

Theoretical Framework

Brown et al. (1989) are widely recognized as the pioneers of situated cognition theory, which posits that effective learning entails the development of complex cognitive processes and skills integrated into authentic contexts, rather than the mere acquisition of isolated knowledge and abilities. This theory underscores the inherently social and physical nature of learning, emphasizing that knowledge and skills are best acquired through active engagement in real-world activities and situations (Woolley & Jarvis, 2007). Situated cognition theory forms the basis for contextual learning, as proposed by Johnson (2002), which underscores the importance of acquiring knowledge and skills in genuine real-life circumstances. It advocates for immersing students in authentic mathematical activities within real-world contexts to enhance their comprehension of mathematical concepts and motivation to learn mathematics (Kelley & Knowles, 2016). Consequently, teachers are encouraged to create learning experiences that are relevant to students' immediate contexts, particularly in mathematics classrooms, where students should engage in problem-solving activities that have real-life relevance and allow them to apply mathematical concepts in meaningful ways (Arthur et al., 2018; Crawford, 2001).

Situated cognition theory places a strong emphasis on social interaction and collaboration as integral components of the learning process. It posits that learning is fundamentally a social activity that occurs through interaction with others, with knowledge being co-constructed through social engagement (Jaworski, 2002). This highlights the importance of enabling students to work in collaborative groups, engage in discussions to articulate their thought processes, and share their ideas and techniques with peers (Li & Lam, 2013). Several studies in the field of mathematics education have provided empirical support for situated cognition theory, demonstrating that students who are exposed to authentic problem-solving activities in small group settings exhibit significant improvements in their grasp of mathematical concepts and a heightened willingness to engage with the subject (Yackel et al., 1991).

Drawing on this theory, it is possible to understand how the mediating role of TQ can enhance the relationship between MC and AM. Situated cognition theory emphasizes the importance of contextual, socially interactive, and collaborative learning experiences, which, when incorporated into teaching practices, can promote students' engagement and understanding of mathematical concepts. Effective teaching strategies that bridge mathematics with real-world applications, encourage social interaction, and foster collaborative problem-solving can enhance students' motivation. Therefore, by embracing the principles of situated cognition theory, educators can create a learning environment that not only connects mathematics to real-life contexts but also fosters the kind of TQ that mediates the positive impact of MC on students' AM.

METHOD

Research Design

The study was a descriptive survey conducted at Kumasi Senior High Technical School (KSHTS). The survey was employed to investigate students' perspectives and judgments regarding the variables being examined. This approach relied on the use of questionnaires to capture and quantify variables, as outlined by Mathers et al. (2007). The primary objective of the survey was to gather data about the demographics and main variables understudy. Descriptive surveys had been widely employed across various domains, encompassing healthcare, social sciences, education, and marketing. They are typically utilized to explore topics such as attitudes, beliefs, behaviors, preferences, and demographic information, as elucidated by Koh and Owen (2000).

In the survey, standardized set of questions were administered to selected group of students in person. The questions were typically structured in closed-ended format, and offered the respondents limited set of options. The design facilitated the quantification and statistical analysis of the collected responses, allowed for the computation of descriptive statistics and regression coefficients. A notable advantage of the descriptive survey was its efficiency and cost-effectiveness. Additionally, it enabled the researcher to amass a substantial volume of data from the sample, which were made to draw generalizations about the broader senior high school population.

Sample & Data Collection

The research initially employed convenience sampling, followed by a subsequent application of simple random sampling techniques to select a representative sample of 400 participants from a larger school population comprising approximately 3,200 students. This strategic combination of sampling methods was chosen to strike a balance between representativeness and

Table 1. Construct reliability (Field Data, 2023)

Constructs	Cronbach's alpha	Composite reliability	Number of items
Teaching quality (TQ)	0.811	0.851	5
Mathematics connection (MC)	0.827	0.874	4
Achievement motivation (AM)	0.814	0.844	4

accessibility. Convenience sampling, characterized as a non-probability sampling approach, is predicated on selecting participants based on their availability, making it a pragmatic choice in research scenarios characterized by resource constraints and time limitations, such as those commonly encountered in school-based studies. In this particular investigation, convenience sampling was employed to select participants from a specific class who were willing and available to partake in the research. It is important to note, however, that convenience sampling, while expedient, can introduce selection bias and limit the generalizability of research findings.

To mitigate potential limitations associated with convenience sampling, the research design included a subsequent step of simple random sampling, a probability-based technique that ensures each student in the school population has an equal and unbiased chance of being included in the sample. Specifically, 400 students were selected through computer-generated random numbers from a comprehensive list encompassing all students at KSHTS. This list was compiled into a sample frame, facilitated by a database containing student information. Subsequently, 400 questionnaires were prepared and distributed to students within KSHTS. The researcher personally oversaw the administration and collection of the surveys, having obtained prior consent from the school authorities. This consent process involved submitting an introductory letter to the school and coordinating a specific date for questionnaire administration. Participants autonomously completed the questionnaires, ensuring their own interpretation and understanding of the survey items. Ultimately, 390 completed questionnaires were returned, reflecting a response rate of 97.5% (calculated as 390 out of 400, multiplied by 100%). Throughout the research process, the researcher diligently maintained data security, confidentiality, and anonymity to safeguard the participants' information.

Questionnaires & Measures

Structured questionnaires were employed as the primary data collection tool in this study. These questionnaires contained standardized items designed to elicit information from the respondents regarding the variables under investigation. Such instruments have a long history of use in survey research, offering a systematic and efficient means to collect substantial amounts of data. The questionnaire comprised closed-ended questions, where respondents selected their answers from provided alternatives. To ensure clarity and specificity, the items were meticulously reviewed, and adjustments were made based on feedback received during a pilot study. The questionnaire design also prioritized reliability and validity, with items measured using a Likert scale along an evaluative continuum ranging from "strongly disagree" to "strongly agree." The questionnaire was structured into four sections, encompassing demographic information, measures of TQ, MC, and mathematics AM.

In the first section, participants provided demographic details, including age, gender, grade level, and course of study. The second section included five items adapted from Arthur et al. (2022c) to assess TQ, covering aspects like the organization of mathematical concepts and teachers' encouragement and interaction with students. The third section incorporated items adapted from Arthur et al. (2018) to measure MC, examining students' ability to apply mathematical thinking in daily life, understand the interconnections between mathematical ideas, and grasp the significance of mathematics in various contexts. Lastly, the fourth section included items adapted from Lang and Fries (2006) to gauge students' mathematics AM, assessing their enjoyment of mathematical challenges and their eagerness to engage with math problems they believe they can solve.

Construct Reliability Measures

To ensure the validity and reliability of the research instrument, the researcher took meticulous steps in its development, including pilot testing with a subset of participants and employing SPSS for the assessment of its psychometric properties. This comprehensive evaluation aimed to confirm that the questionnaire effectively and consistently measured the constructs under study. Reliability, which pertains to the questionnaire's stability and consistency across various samples and over time, was a central focus (Sujati et al., 2020). The assessment of reliability encompassed both internal consistency and composite reliability. Internal consistency pertains to the extent to which the questionnaire items are correlated and effectively measure the same construct. To ascertain internal consistency, Cronbach's alpha was computed, with a threshold of 0.70 or higher, as suggested by Taber (2018), being considered acceptable (**Table 1**). Composite reliability, as defined by Hair et al. (2019), gauges how well the items within the questionnaire function collectively to assess the same construct. It was computed based on the factor loadings and residual variances of the questionnaire items, ensuring that the composite reliabilities exceeded the requisite benchmark of 0.70 (**Table 1**).

Construct Validity

As per DeVellis and Thorpe (2021), validity pertains to the degree to which a questionnaire accurately measures the intended constructs. In this study, an evaluation of both convergent and discriminant validity was conducted in line with the approach advocated by Schumaher et al. (2019). Convergent validity focuses on the extent to which items within the same construct are correlated, while discriminant validity concerns the extent to which items from different constructs do not exhibit strong correlations (Hair et al., 2019). Convergent validity was assessed through the calculation of average variance extracted (AVE), with the requirement that AVE values exceed 0.5 (Mendes dos Santos & Cirillo, 2021). Discriminant validity, on the other hand, was examined using Heterotrait-Monotrait (HTMT) ratio, as recommended by Henseler et al. (2015), with the criterion that all HTMT ratios should be below 0.85, as indicated in **Table 2**.

Table 2. HTMT ratios for assessing discriminant validity (Field Data, 2023)

	TQ	TC	MC	AM
TQ				
MC	.198	.211		
AM	.485	.402	.338	

Table 3. Results of CFA (Field Data, 2023)

CFA	SFL
Teaching quality (TQ): CA=0.758; CR=0.851; & AVE=0.532	
(TQ1): A quality teacher presents mathematical concepts in an orderly manner.	.686
(TQ3): Teachers provide enough classroom tasks for me to do in order to assess my grasp of the idea being taught.	.735
(TQ4): My mathematics instructor urges me to learn the subject.	.737
(TQ5): My mathematics teacher offers inspiring comments for improved understanding.	.749
(TQ8): Teachers have cordial relationship with students.	.739
Mathematics connection (MC): CA=0.827; CR=0.874; & AVE=0.633	
(MC7): Teacher explains the role of mathematics in our lives.	.785
(MC8): I can see the parallels and contrasts between mathematical ideas.	.788
(MC9): I can solve challenges in my daily life by thinking mathematically.	.811
(MC10): I can explain the significance of mathematics in several areas.	.799
Achievement motivation (AM): CA=0.814; CR=0.844; & AVE=0.575	
(AM1): I enjoy mathematics situations in which I may test my abilities.	.724
(AM2): When I am presented with a mathematics problem that I believe I can solve, I am attracted to begin working on it right away.	.767
(AM3): I appreciate mathematics questions in which I can put my skills to solve.	.779
(AM4): Mathematics activities that allow me to put my skills to test attract me.	.761

Note. Model fit indices: CMIN=290.073; df=159; CMIN/df=1.82; CFI=.952; TLI=.943; RMR=.055; RMSEA=.046; Pclose=.776; GFI=.933; & AGFI=.911

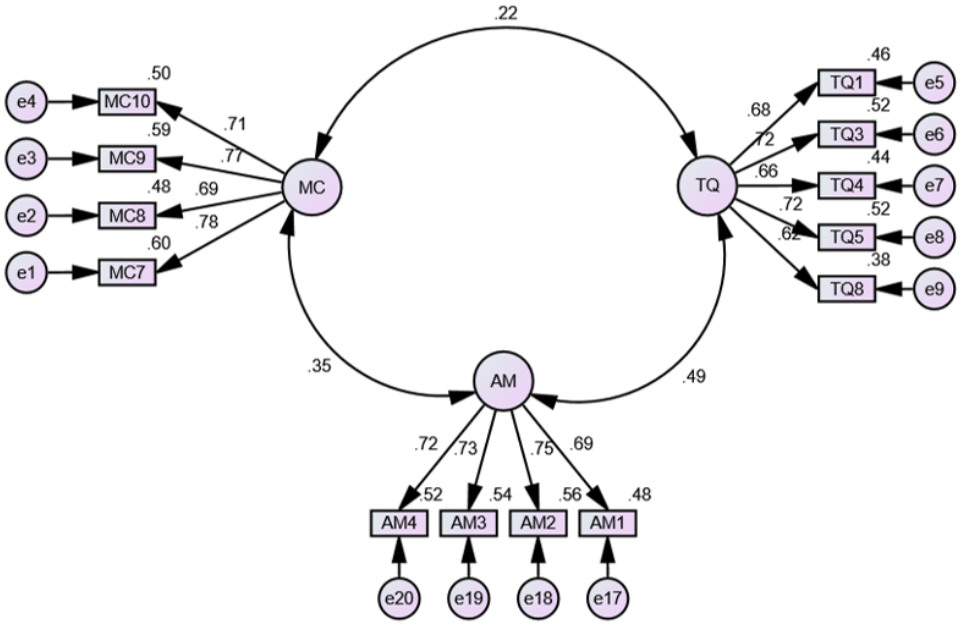

Figure 2. Figure on top of a column (Field Data, 2023)

RESULTS

Assessment of Measurement Model

Confirmatory factor analysis (CFA) was conducted to assess how well the hypothesized model aligned with the observed data. This process involved establishing a priori factor loadings, which represent the expected relationships between the latent factors and the observed variables. During CFA, items with factor loadings below 0.50 were progressively removed, resulting in a reduction of the initial 30 items on the scale to 13, with five pertaining to TQ, four to AM, and four to MC. Furthermore, the model fit indices were assessed to ensure that they met the criteria established by Hu and Bentler (1999) for a well-fitting measurement model. These indices included comparative fit index (CFI), Tucker-Lewis index (TLI), goodness of fit index (GFI), root mean square error of approximation (RMSEA), and relative mean root squared residual (RMR). The obtained values of these indices demonstrated the overall appropriateness of the measurement model: CMIN=290.073; df=159; CMIN/df=1.824 (falling between one and three); GFI=0.933 (greater than 0.900); CFI=0.952 (greater than 0.900); TLI=0.947 (greater than 0.900); RMSEA=0.046 (less than 0.080); RMR=0.055 (less than 0.080). **Table 3** and **Figure 2** shows results of CFA.

Table 4. Summary of direct path estimates (Field Data, 2023)

Direct paths	Unstandard estimate	Composite reliability	Standard error	p-value
AM←age	-0.084	-0.893	0.094	0.372
AM←gender	-0.036	-0.513	0.070	0.608
AM←course	0.010	0.453	0.022	0.651
AM←form	0.018	0.208	0.086	0.835
AM←TQ	0.336	4.574	0.074	***
AM←MC	0.112	2.548	0.044	0.011**

Note. Model fit indices: CMIN=462.715; df=241; CMIN/df=1.920; CFI=.922; TLI=.911; RMR=.058; RMSEA=.049; Pclose=.624; ***~p-value significant at 1% (0.01); & **~p-value significant at 5% (0.05)

Table 5. Summary of mediation analysis

Relationship	Direct effects	Indirect effects	Confidence interval		p-value	Conclusion
			Lower bound	Upper bound		
AM←TQ←MC	0.192***	0.067	0.017	0.142	0.007***	Partial mediation

Note. ***Significant at 1%

Assessment of Structural Model

To evaluate the structural model and explore the connections between variables, path analysis, a statistical method employed to examine both direct and indirect effects among variables, was carried out. This analysis was conducted using AMOS (V. 23) to analyses the intricate causal relationships among the constructs, as outlined by Kline (2015).

Direct Effects

The findings presented in **Table 4** showcase the outcomes of direct effects of the control variables (age, gender, course, and form) as well as the independent variables (MC and TQ) on the dependent variable (AM). According to **Table 4**, the influence of age on AM was negative and statistically insignificant (β=-0.084, t=-0.893, p=0.372), while the impact of gender on AM was also negative and lacked statistical significance (β=-0.039, t=-0.513, p=0.608). Conversely, the effect of course on AM was positive and statistically significant (β=0.010, t=0.453, p=0.651), and the impact of form on AM was similarly positive and statistically significant (β=0.018, t=0.208, p=0.835). Furthermore, the influence of TQ on AM was positive and highly significant (β=0.336, t=4.574, p<.001). These results collectively suggest that gender, age, course, and form do not exert a significant influence on students' mathematics AM. To test **H1**, the direct effect of MC on AM was evaluated, and the results demonstrated that MC has a positive and statistically significant effect on AM (β=0.112, t=2.548, p=0.011). This test was conducted at a 5.0% significance level, where a p-value less than.05 was revealed, indicating substantial evidence to support **H1**. Consequently, **H1** was supported. As per students' responses, teachers' ability to establish connections between mathematics and real-life scenarios and other disciplines contributes to approximately a 16.0% increase in AM of senior high school students in mathematics.

Mediating Effects

Furthermore, the mediating effects of TQ was computed. This analysis employed the bias-corrected (BC) percentile bootstrap method, which involved utilizing 5,000 bootstrap samples at a 95% confidence interval (CI). The bias correction factor was applied to adjust the point estimate of the indirect effect and compute bias-corrected CIs. This adjustment was made to provide a more precise representation of the true indirect effect within the population, minimizing potential bias introduced by standard bootstrapping techniques. It is noteworthy that model fit indices were maintained in accordance with their respective standards. The calculated indirect effect of MC on AM was 0.067 (a×b=0.141×0.476), and it was found to be both positive and statistically significant (p=0.007), as CI (0.017, 0.142) did not encompass zero. Moreover, the direct effect of MC on AM in the presence of the mediator (TQ) was also determined to be significant (β=0.192, p < 0.001). Consequently, it was established that TQ partially mediated the relationship between MC and AM. Thus, **H2** was supported. **Table 5** shows summary of mediation analysis.

DISCUSSION

Direct Effects of Mathematics Connection on Achievement Motivation

The study sought to investigate the direct impact of MC on AM of senior high school students. The findings unequivocally revealed a notable and statistically significant positive effect of MC on AM (β=0.112, t=2.548, p=0.011). β coefficient serves as an indicator of the anticipated change in AM for each percentage increase in MC. In this context, the computed β coefficient of 0.112 signifies that with every 1.0% increment in MC, a corresponding rise in AM by 11.2% is expected. The statistical significance of this effect was established by examining the associated t-value, which, at 2.548, confirmed that the influence of MC on AM was statistically significant. Furthermore, the p-value, amounting to 0.011 and being less than the significance threshold of 0.05, underscored the statistical significance of the observed impact. Hence, it can be reasonably concluded that MC exerts a statistically significant influence on AM.

These findings align consistently with prior research emphasizing the critical role of establishing connections between diverse mathematical concepts and real-world applications, as well as other academic disciplines (Abdulrahim et al., 2023; Cejka et al., 2006; Kwon, 2016; Rodionov & Dedovets, 2017; Rooch et al., 2012; Trifunov, 2017). When students perceive a clear and tangible

connection between mathematics and its practical applicability, it heightens their intrinsic motivation to engage with and excel in mathematics (Arthur et al., 2018). This significant effect of MC on AM has been documented across various educational settings and age groups (Abramovich et al., 2019). Such a relationship finds support in theoretical frameworks like expectancy-value theory (Wigfield & Eccles, 2000), which posits that when students recognize the usefulness and relevance of mathematics in real-world contexts, they are more likely to experience heightened intrinsic motivation, task satisfaction, and a belief that their efforts will yield favorable outcomes. These motivational factors can, in turn, shape their achievement-related behaviors and performance (Hulleman et al., 2008). The present study's outcomes are consistent with investigations in which MC significantly bolstered students' self-efficacy beliefs and their expectations of achieving positive outcomes in mathematics (Ozgen, 2013). Eccles and Wigfield (2020) underscore the pivotal role of perceived value and utility in driving students' engagement and achievement. By demonstrating how mathematical principles can be practically applied beyond the classroom, students gain increased confidence in their ability to address real-world challenges, which in turn fosters heightened motivation (Crawford, 2001).

The present findings are congruent with the work of Groenendijk et al. (2013), Hulleman and Harackiewicz (2009), and Pajares and Miller (1994). Pajares and Miller (1994) explored the influence of self-efficacy beliefs on the relationship between mathematics problem-solving and perceived connection to real-world contexts. Their results indicated that when students perceive a strong alignment between mathematics and real-world situations, it enhances their self-efficacy beliefs, ultimately contributing to higher levels of motivation and achievement. Groenendijk et al. (2013) found that witnessing others effectively apply mathematical principles to real-life scenarios boosts students' confidence in their own abilities and inspires a determination to achieve similar results. Additionally, Hulleman and Harackiewicz (2009) delved into the impact of values-affirmation interventions on students' motivation and performance in mathematics. By prompting students to reflect on their personal values and how mathematics relates to their lives, these interventions aimed to reaffirm the relevance and significance of mathematics. The results revealed that values-affirmation interventions enhanced motivation and performance, emphasizing the critical role of meaningful connections in cultivating AM. In summary, the body of research consistently affirms the positive and statistically significant influence of MC on AM. The collective evidence underscores that bridging mathematics with real-world applications enhances students' motivation, self-efficacy beliefs, and performance in the subject.

Mediating Effects of Teaching Quality on Relationship Between Mathematics Connection & Achievement Motivation

In the realm of statistical analysis, mediation occurs when a third variable, in this case, TQ, intervenes in explaining the relationship between the independent variable, MC, and the dependent variable, AM. To gain a deeper understanding of how TQ influences the relationship between MC and AM, the study delved into investigating mediation effects. The research findings unveiled that MC exerts a robust indirect impact on AM through the mediating factor of TQ. This mediation analysis employed BC percentile bootstrap method with 5,000 bootstrap samples, maintaining a 95% CI. The magnitude of the indirect effect, represented by the product of the path coefficients (a×b), was determined to be 0.067. This signifies that a one-unit increase in MC corresponds to a 0.067-unit increase in AM through the intermediary mechanism of TQ. The statistical significance of this indirect effect was confirmed ($p=0.007$) since CI (0.017, 0.142) did not encompass zero. Hence, MC exerts a positive and statistically significant influence on AM through TQ. Furthermore, it was discerned that the direct effect of MC on AM, even when TQ serves as a mediator, remained significant ($\beta=0.192$, $p<0.001$). This implies that MC possesses a direct impact on AM, irrespective of the mediating role played by TQ. Based on these outcomes, it can be inferred that TQ partially mediates the relationship between MC and AM, elucidating a portion of the relationship but not accounting for it entirely.

These findings resonate with the results of Boston's (2012) survey of middle school educators in a medium-sized urban district. Boston's (2012) research highlighted that high-quality assignments and tasks, including cognitively demanding activities like real-world problem-solving activities, foster students' critical thinking and motivation. Additionally, numerous other studies substantiate the findings that TQ mediates the association between MC and AM. For instance, Khotimah's (2016) investigation of mathematics education students demonstrated that instructors' competence in crafting discovery-based contextual learning environments led to effective teaching, ultimately enhancing students' motivation to learn. Similarly, research conducted by Papadakis et al. (2016) identified the positive impact of quality instructional methods incorporating real-world applications, rendering mathematics relevant, on the mathematics interest and learning abilities of early-grade students. These outcomes also align with Bandura's (1986) theoretical framework, which underscores the pivotal role of educators as social models and their influence on students' motivation and self-efficacy beliefs. According to this theoretical perspective, when teachers proficiently establish connections between mathematics and real-world contexts by furnishing concrete examples and delivering high-quality instruction, students' motivation and academic achievement experience marked improvements.

CONCLUSIONS

The research explored the mediating effect of TQ in the relationship between MC and AM. It was found that MC exerts an indirect influence on AM through the mediation of TQ. A one-unit increase in MC corresponded to a 0.067-unit increase in AM through the intermediary mechanism of TQ. This mediation effect was statistically significant, suggesting that the quality of teaching plays a substantial role in translating the benefits of MC into heightened motivation.

Importantly, the study revealed that even when TQ served as a mediator, the direct effect of MC on AM remained significant. This signifies that MC has a direct impact on AM, regardless of the mediating role of TQ. Thus, while TQ partially explained the relationship, it does not account for it entirely.

These findings align with previous research emphasizing the importance of bridging mathematics with real-world applications to enhance motivation, self-efficacy beliefs, and academic performance. The study's outcomes also resonate with theoretical

frameworks, such as expectancy-value theory and Bandura's (1986) social learning theory, underscoring the crucial role of perceived relevance and the quality of instruction in driving student motivation.

In practical terms, educators and policymakers can draw valuable insights from this research to design instructional strategies that promote MC and enhance TQ, thereby fostering students' AM. By emphasizing the practical applications of mathematics and providing high-quality instruction, educational institutions can empower students with the motivation and skills necessary for success in the subject.

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