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Despondency in learning mathematics: Relating achievement motivation to learning amid soaring anxiety

Isaac Bengre Taley [1*], Augustina Azumbila [2]

[1] Mampong Technical College of Education, GHANA
[2] Afia Donyina Girls' Model Junior High School, Atebubu, GHANA
* Correspondence: bengre.isaac@gmail.com

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ABSTRACT

Anxiety about learning mathematics and accompanying low grades in mathematics has caused many students to the extent that they wish never to learn mathematics again. This level of apathy epitomised by students' demotivated participation and low performance in learning mathematics reflects the general level of learning despondency among adolescent students. Although the literature suggests that the tide of learning despondency can be assuaged if students' achievement motivation is heightened, studies exploring the mathematics achievement motivation of high school students in Ghana are scarce. To address this gap in the literature, this study, conducted within a positivist paradigm, focused on examining the relationship between perceived mathematics learning, achievement motivation, and mathematics anxiety while controlling for learning styles and gender of 322 high school students. The results showed that the motivation to strive and the motivation to participate were respectively the most substantial and minor drivers of students' mathematics achievement motivation. Based on the correlation and regression analysis, achievement motivation positively predicted mathematics learning whiles both achievement motivation and mathematics learning were negatively related to mathematics anxiety. The study's results further showed that mathematics anxiety dampened the extent to which achievement motivation positively influenced mathematics learning in the regression analysis.

Keywords: achievement motivation, mathematics anxiety, learning despondency, learning mathematics

INTRODUCTION

Many high school students wish they never learn mathematics again. This wish of students is because, to them, either learning mathematics is very stressful (Putra et al., 2019), or they turn to earn low grades in mathematics examinations (Armah & Opoku-Amankwa, 2022), or they turn to obtain low achievement in mathematics (Abd Algani & Eshan, 2019; Mullis et al., 2012). Remarkably, in Ghana and many developing countries, mathematics is a core subject in the high school curriculum, which students can do without (Ministry of Education [MoE], 2020). However, high school students in Ghana not only perform poorly in mathematics, as illustrated in the TIMMS 2011 International Results in Mathematics report (Mullis et al., 2012), but also exhibit low morale in its study. For example, Eshun's (2006) description of high school students' attitude to mathematics was the three 'd' words – dull, difficult, and dislike. Besides, Armah and Opoku-Amankwa (2022) pointed out that high school students' mathematics achievement is often lower than their achievement in the other core subjects (English language, science, and social studies) in Ghana. In their analysis of the passing grades of Ghanaian students presented for the West African Secondary School Certificate Examination (WASSCE) between the 2016 and 2021 academic years, Armah and Opoku-Amankwa (2022) revealed that mathematics recorded the least average pass grade of 49.8% compared to 51.6%, 54.0%, and 64.3% in English Language, science, and social studies respectively. Irrespective of a fair idea about high school students' mathematics achievement, the measure of mathematics learning among high school students is still very relevant. By measuring how well students have learned mathematics, teachers can implement appropriate instructional interventions to ensure that high school students in Ghana and elsewhere effectively learn mathematics.

Learning mathematics is a personal decision (Gómez-Chacón et al., 2014; Sachdeva & Eggen, 2021). This decision entails developing the capacity to recognize one's current level of knowledge and making changes in the face of learning difficulties to succeed. Success in mathematics learning ensures that students can work diligently to solve problems, gain insight, learn processes, take delight in mathematising, apply mathematics to real-life situations, and develop a positive perception of mathematics (Murphy, 2017; Frymier & Houser, 1999). However, the level of apathy among high school students in learning mathematics, which is epitomised by students' demotivated participation (Putra et al., 2019) and low-performance (Armah & Opoku-Amankwa, 2022), can find space within the general level of learning despondency among adolescent students as acknowledged by Singh (2018). Singh (2018) remarked that adolescent students exhibit a general lack of desire, particularly with class tasks, uncertainty about the future, a pronounced "live-in-the-present" attitude linked to a reduced capacity for delayed satisfaction, and a lack of perseverance and less ability to exert effort. To intervene appropriately, Singh (2018) suggests that teachers engage in contemporary motivation research to assuage learning despondency.

Previously published studies on affective factors in mathematics have consistently shown a positive influence of achievement motivation on mathematics achievement (Duru & Okeke, 2020). However, an in-depth examination of international literature underscores the multifaceted nature of this relationship. Research conducted by Nagi and Maruthachalam (2017) indicates that achievement motivation interacts with various factors to impact success in learning. This aligns with the broader international consensus that considers achievement motivation within a complex interplay of variables. International studies (such as Dzeshie, 2020; Pizon & Ytoc, 2021; Sabti et al., 2019) contribute to nuanced perspectives. For instance, Sabti et al. (2019) highlight the intricate connection between achievement motivation and anxiety, suggesting that both factors need to be considered conjointly for a comprehensive understanding. Additionally, Pizon and Ytoc (2021) exploration of learning styles and their impact on mathematics learning adds a layer of complexity to the international discourse. Moreover, Dzeshie (2020) findings on the gender-specific prediction of mathematics achievement by motivation emphasize the importance of considering gender dynamics in the motivational context.

This comprehensive international context not only enriches our understanding of the relationship between achievement motivation and mathematics achievement but also lays the foundation for a more nuanced exploration within the Ghanaian high school setting. While the international literature provides valuable insights, it is crucial to acknowledge the inherent limitations within these studies. Notably, the studies cited exhibit variations in methodologies, sample sizes, and cultural contexts, which may influence the generalizability of their findings to the Ghanaian high school setting. For instance, the research by Duru and Okeke (2020) primarily focused on a specific demographic, potentially limiting its applicability to broader student populations. Moreover, the cross-cultural applicability of findings from studies by Sabti et al. (2019) and Pizon and Ytoc (2021) should be interpreted with caution, given that learning styles and anxiety may be influenced by cultural nuances. The gender-specific predictive patterns identified by Dzeshie (2020) may not necessarily translate uniformly to the Ghanaian context due to socio-cultural differences.

By acknowledging these limitations, we recognize the need for a localized investigation that considers the unique socio-cultural dynamics of high school students in Ghana. This study sought to fill these gaps by providing context-specific insights into the intricate relationship between achievement motivation, mathematics anxiety, learning styles, and gender within the Ghanaian educational landscape. Consequently, this study could set the foundation for a potential intervention (i.e., a longitudinal study) and provide implications for mathematics instruction at high schools in Ghana. Based on the purpose of this study, four research questions (RQ) were generated and presented as follows:

RQ 1. What is the level of perceived mathematics learning, achievement motivation and anxiety in mathematics across students' learning styles and gender?

RQ 2. How well are students' perceived mathematics learning, achievement motivation and anxiety in mathematics related?

RQ 3. How well do achievement motivation and mathematics anxiety predict the perceived mathematics learning of students while controlling for learning styles and gender?

RQ 4. What is the moderation effect of mathematics anxiety on the relationship between achievement motivation and mathematics learning?

LITERATURE REVIEW

Motivation research shows that motivation is one factor that drives and encourages progress, particularly success in life endeavours such as learning (Singh, 2018; Werdhiastutie et al., 2020). Subsequently, Nagi and Maruthachalam (2017) describe that the desire to achieve meaningful learning goals as a component of motivation called achievement motivation. This description resonates with Wigfield and Eccles (2002) who identified achievement motivation as a personality trait that distinguishes persons based on their aspiration to do things well and compete against a standard of excellence. This makes academic achievement motivation to relate to individual's academic drive, attitude toward learning, and enthusiasm for academic performance (Pawar, 2017). Within the academic space, Nagi and Maruthachalam (2017) opine that a prerequisite for achievement is students' achievement motivation. Indeed, achievement motivation has been demonstrated to be a strong predictor of an individual's performance (Chea & Shumow, 2015; Emmanuel et al., 2014), especially in the learning of mathematics (Putra et al., 2019).

Although some level of anxiety is necessary to drive the mathematics learning (Taley & Ndamenenu, 2022), mathematics anxiety, unlike achievement motivation in mathematics, has proven to be a significant factor that negatively affects performance (Putra et al., 2019). Markedly, a learner can be mathematically anxious in two ways: learning anxiety and evaluation anxiety (Plake & Parker, 1982). Barroso et al. (2021) posited that the mathematics learning anxiety component measures students' anxiety about mathematics class, including walking into a mathematics class, purchasing mathematics textbooks, or beginning to learn a new mathematics chapter. On the other hand, mathematics evaluation anxiety refers to mathematical evaluation activities like taking an unannounced quiz, taking a mathematics exam, planning an upcoming mathematics examination, or even waiting for a math result. Put together, Pradeep (2011) explained mathematics anxiety as nervousness, tension, and worry about circumstances involving mathematics in both the classroom and real life, which could eventually cause a student to avoid mathematics situations. Beyond the statistical relationship between mathematics anxiety and achievement, Essuman et al. (2021) observed that students who experience test anxiety are more likely to perform poorly on tasks that require new learning. Regardless of the form of mathematics anxiety, Taley and Ndamenenu (2022) have corroborated previous studies about the prevalence of mathematics anxiety among high school students in Ghana. Based on a sample of 318 high school students in Ghana, Taley and Ndamenenu (2022) observed that about 83% of high school students experienced moderate to high levels of mathematics anxiety, with 20% and 17% of students experiencing high levels of mathematics evaluation anxiety and learning mathematics anxiety respectively.

In recognition of the relationship between achievement motivation and anxiety in mathematics, mathematics instruction researchers have not discounted how such a relationship could be affected by student presage factors such as learning style and gender. The term learning style describes the idea that everyone has a different preferred method of instruction or study (Pashler et al., 2008; Willingham et al., 2015). Subsequently, proponents of learning-style assessment have argued that identifying students' unique learning styles and adapting instruction is necessary for effective instruction (Pashler et al., 2008). Taking Silver et al.'s (2003) mathematics learning style inventory for secondary students, for example (a framework that considers how information is presented in mental activity), students may be identified with at least one of the four learning styles – mastery, understanding, self-expressive, and interpersonal learners. (1) Mastery learners are interested in acquiring practical knowledge and techniques, solving mathematics problems for utilising routine procedures and past knowledge, and they also learn best when instruction emphasises the modelling of new abilities with appropriate feedback. (3) Self-expressive learners enjoy engaging in non-routine problem-solving and are imaginative in exploring mathematical concepts. Irrespective of the learning style model, the review of related literature showed that the influences of students' learning style on their mathematics learning, achievement motivation and anxiety in mathematics were inconclusive. For instance, Camposano et al. (2015) and Taley and Ndamenenu (2022) found that students' learning styles were not significantly related to their mathematics achievement, however, Pizon and Ytoc (2021) concluded otherwise. In relating mathematics anxiety to learning styles, varying significance levels were found (Anggoro et al., 2019; Yazici, 2017). Esa and Mohamed (2017) observed a significant negative correlation between the learning styles and mathematics anxiety of 175 Korean students. Meanwhile, Banaga and Fabella (2018) and Taley and Ndamenenu (2022) could not establish the predictability of mathematics anxiety based on learning styles.

Gender, defined as either male or female, has been used in research as a confounding or predictive factor in analysis. However, from the predictive perspective, mathematics researchers have inconclusively sought to analyse students' mathematics learning, anxiety and achievement motivation along gender lines. For example, Ghasemi and Burley (2019) were opposed by Homayouni et al. (2016) and Szczygiel (2020) that female learners outperformed their male counterparts in mathematics achievement. Nonetheless, Taley and Ndamenenu (2022) observed that the Pearson Chi-Square test of independence between the levels of mathematics learning and gender did not reveal any statistically significant evidence of association, demonstrating that the gender of learners was not likely to be associated with their mathematics learning. When examining the relationship between gender and motivation for achievement, Richardson and Abraham (2009) found a significant difference in the motivation to achieve between male and female students. However, Pawar (2017) observed a higher achievement motivation among males than female high school students. Similarly, Duru and Okeke (2020) discovered that in contrast to female students, male students' mathematics achievement is primarily predicted by their motivation for achievement. Remarkably, Mann and Walshaw (2019) showed that girls at the secondary school level are more nervous about mathematics than boys.

The existing literature review provides a comprehensive overview of the relationship between motivation, anxiety, and achievement in the context of mathematics learning, considering factors such as learning styles and gender. However, the review notes inconclusive findings regarding the definitive impact of learning styles on mathematics learning, achievement motivation, and anxiety. Conflicting research outcomes regarding the influence of gender on mathematics achievement, motivation, and anxiety reflect the ongoing debate within the literature. In conclusion, the literature review provides a rich foundation for understanding the intricate relationships among motivation, anxiety, and achievement in the context of mathematics education.

Achievement Motivation in Mathematics

The motivation to achieve is a critical component in mathematics learning, which cannot be overlooked (Putra et al., 2019). Lussier and Achua (2007) posited that McClelland's achievement motivation theory (developed in 1961), which provides reasons for explaining and predicting performance, is anchored on the three needs of a person. These are the need for achievement, power, and affiliation. Based on the pioneering work of McClelland, motivation researchers have attempted to define achievement motivation by exploring factors that motivate students to pursue academic success in their learning. Consequently, Lussier and Achua (2007) maintained that esteeming increasing students' achievement motivation is liking learners initiating learning activities, maintaining their interest in learning, and committing to the learning process. One of the latest approaches to defining Achievement Motivation is a perspective shared by Ellez (2004). Ellez's (2004) approach incorporated the three broad needs of achievement motivation proposed by McClelland. It was based on the premise that achievement motivation stems from the way broad components of personality are directed towards performance. Ellez's (2004) framework pointed to four dimensions relevant to success in learning mathematics. These dimensions are (1) striving towards mathematics, (2) willingness to work in mathematics, (3) participation in mathematics, and (4) maintaining the work in mathematics.

The dimension identified as striving for success, or the need to perform well, is demonstrated through tenacity and effort in facing challenges. During difficulties, any little success challenges the individual to achieve more. Therefore, striving for success gives meaning to Singh's (2018) statement that "*achievement motivation tends to feed on itself*" (p. 166), as outstanding achievement inspires people to strive toward achieving even greater success. Since success is the basis of achievement motivation, and achievement motivation is the expectancy of finding satisfaction in the mastery of difficulty or challenging performances in pursuing excellence, it behoves students to strive for excellence.

The second dimension of achievement motivation, willingness to work (Ellez, 2004) in mathematics, refers to the desire of the learner to succeed. This desire manifests in learners when they are seen studying after class, indicating their readiness to learn more than they are taught (Ellez, 2004). A learner's willingness to learn is further explained by the desire to acquire new skills and improve the current ones. Students motivated to study regularly seek out novel approaches to solve problems, achieve academic goals, and complete increasingly challenging assignments (Usher & Kober, 2012). Seven (2020) noted that learners' effort, concentration, and motivation are examples of their willingness to learn within a learning community. The third dimension of achievement motivation, maintaining the work (Ellez, 2004) in mathematics, connotes building self-confidence to feel better when successful at a task. To build students' confidence levels, teachers may deploy strategies such as encouraging questions and curiosity, emphasizing conceptual understanding over procedural accuracy, taking an interest in real-world problems that motivate students to engage with mathematics, and promoting positive attitudes toward mathematics. All these strategies form part of the mechanism of maintaining a mathematical practice.

The fourth dimension of Ellez's (2004) achievement motivation is participation. According to Bergmark and Westman (2018), "student participation" occurs in three forms: Active and engaged participation in the classroom, curriculum design input, and a sense of community among the students, which stems from leading discussions to posing questions. This means that teachers note how students participate during mathematics instruction. The teacher's mental notes about how much their students participate in and contribute to the learning material, classroom conversations, online discussions, and student conduct in group situations are all possible evaluation criteria for student participation (Bergmark & Westman, 2018). Markedly, students who participate in class learn how to communicate their thoughts clearly to others. They gain knowledge about gathering facts to further their comprehension of a subject when they ask questions; they increase their enjoyment and aid their learning (Rogers et al., 2024). More importantly, student participation fosters engagement and motivation for present learning and future professional endeavours (Bergmark & Westman, 2018).

From the ongoing discussions, factors such as the effectiveness of the teacher, friends, the individual's attitude toward school, students' perceptions of their abilities, past experiences (positive or negative), and the importance placed on the student's success may influence students' motivation for academic achievement (Göç, 2010). Zhao et al. (2018) noted that students motivated to succeed in mathematics learning appreciate working through complex tasks, trying their luck with unsolved cases, and answering challenging mathematics questions. However, students demotivated to learn mathematics often miss classes, pay less attention, refuse to do their assignments, and show little interest in the covered mathematics content (Nagi & Maruthachalam, 2017; Pintrich & Schunk, 1996).

METHODS

Research Design

This study used a cross-sectional survey within a positivist paradigm (Rehman & Alharthi, 2016) to gauge students' thoughts about mathematics learning, mathematics anxiety, and relevant presage factors. This design permitted using quantitative data-gathering tools such as closed-ended questionnaires to collect data and thoroughly answer the research questions. We sought the quantitative data from a cross-section of second-year students who could appropriately assess their perceived mathematics learning, mathematics anxiety, and preferred learning styles. All data for this study were collected simultaneously. We gave the participants three days to answer the questionnaires. With the assistance of the mathematics teachers, the students returned the completed questionnaires within three days.

Participants

The analysis in this study relied on cross-sectional data from 349 second-year senior high school students in the Mampong Municipal Directorate of Ghana. The target population was all second-year students (approximately, 3000) of the six high schools in Ashanti Mampong Municipality, Ghana. Using a stratified random sampling technique, the high schools in the Ashanti Mampong Municipality were stratified according to the type of school (unisex or gendered). The strata were then sampled proportionally to ensure representation from each subgroup. Coincidently, three schools –one gendered and two unisex schools. Based on Krejcie and Morgan (1970) sample size determination, the final sample of 349 second-year high school students were then sampled using random sampling with 112 students from the gendered school and 237 students from the two unisex schools. Participation in this study was voluntary. After assuring the students of the confidentiality of their responses and the anonymity of their identity in this study, academic counsellors gave informed consent to students below 18 years old. However, older students (18 years and above) signed the informed consent form. The Municipal Education Directorate of Mampong approved ethical clearance and data collection in this study. After screening the data, we removed 27 copies of the questionnaires because they were not engaging. We used the remaining 322 responses in subsequent analyses. Of the 322 responses, 93 (29%) were boys, and 229 (71%) were girls.

Data Collection Instruments

In this study, we adapted four sets of questionnaires. Three of these five questionnaires, that is, the achievement motive (Ellez, 2004), mathematics anxiety (Plake & Parker, 1982) and the perceived mathematics learning (Frymier & Houser, 1999), were based on a 5-point Likert scale. The mathematics learning style (Silver et al., 2003) questionnaire was based on a four-point answering scheme suggested by Silver et al. (2003). The achievement motive scale (Ellez, 2004), with 23 items acknowledged as reliable (Afrifa-Yamoah, 2016), was adapted to explore students' achievement motivation. Items on the scale included "I don't try to learn more than I am taught in mathematics" and "I try persistently to solve questions in mathematics lessons even when I fail". The responses to the questionnaires ranged from (1 = not at all applicable to 5 = most applicable). A higher mean score indicated a high level of achievement motivation. The mathematics anxiety scale had 24 items, such as "Walking into a mathematics class makes me feel ..." and "Waiting to get a mathematics test returned in which I expect to do well makes me feel ...". The responses to the questionnaires ranged from (1 = no anxiety to 5 = high anxiety). A higher mean score indicated a high level of mathematics anxiety. The perceived mathematics learning scale had six items, such as "I think about the mathematics content outside the class" and "I feel I have learned a lot of mathematics in this semester". The responses to the questionnaires ranged from (1 = never to 5 = very often). A higher mean score indicated a high level of mathematics learning. The learning style scale was scored from 0 (least favourite preference) to 5 (most favourite preference) to statements that connote mathematics learning processes. For example, the statement "When it comes to mathematics, I want to ...", is answered using a 5, 3, 1, or 0 point once only (without a tie) to score each of the four options. The options for the statement "When it comes to mathematics, I want to ..." are

A. Learn practical information and set procedures [...]
B. Know why the mathematics I learn works [...]
C. Use my imagination to explore mathematics ideas [...]
D. Learn mathematics through dialog and collaboration [...]

To ascertain the validity and reliability of the factor structures of the scales used in this study, we performed exploratory and confirmatory factor analysis in Amos 21, which allowed us to reduce the number of items by removing those with factor loadings below 0.50 (Awang, 2012). A seven-factor model consisting of four constructs for achievement motivation, two constructs for mathematics anxiety, and a single-dimension mathematics learning construct were extracted and named accordingly. Altogether, a good model fit was achieved with the seven factors: Total variance extracted = 60.4%, *KMO* = .854, Bartlett's Test of Sphericity χ^2= 8312.346, *df* = 1081 at *Sig* = .000.

The mathematics anxiety scale produced the mathematics learning anxiety (MLA) and mathematics evaluation anxiety (MEA) constructs. The achievement motive scale produced strive (AMS), maintaining the working (AMM), participation (AMP), and willingness to work (AMW). The uni-dimensional mathematics learning scale was identified as the perceived mathematics learning (PML). Cronbach alpha (∝), the composite reliability (CR), and the average variance extracted (AVE) were used to check for internal consistency, reliability, and convergent validity. MLA ($N = 13, \propto = .921, CR = .927, AVE = .494$), MEA ($N = 8, \propto = .925, CR = .932, AVE = .633$), AMS ($N = 6, \propto = .887, CR = .900, AVE = .602$), AMM ($N = 5, \propto = .892, CR = .904, AVE = .656$), AMP ($N = 5, \propto = .833, CR = .875, AVE = .583$), AMW ($N = 4, \propto = .858, CR = .892, AVE = .673$), and PML ($N = 6, \propto = .732, CR = .818, AVE = .430$). With an AVE and CR for each construct greater than .4 and .6 respectively, convergent validities were met (Hair et al., 2017). In addition, the square root of the AVEs were all greater than the correlation of the latent variables, which showed that discriminant validity was met (Hair et al., 2019).

RESULTS

In the subsequent section, we present the study's results based on the research questions.

Table 1. Descriptive measures (N = 322)

	N	Static	PML	MLA	MEA	AMS	AMM	AMP	AMW
Male	93	M	2.281	2.705	3.232	3.781	3.688	2.415	2.855
		SD	0.786	1.029	1.100	1.029	1.084	0.838	1.077
Female	229	M	2.464	2.482	2.973	3.844	3.591	2.230	2.664
		SD	1.068	1.142	1.190	1.163	1.131	1.003	1.129
Total	322	M	2.411	2.546	3.048	3.826	3.619	2.283	2.719
		SD	0.997	1.114	1.169	1.125	1.117	0.961	1.116
		CV	41.4%	43.7%	38.3%	29.4%	30.9%	42.1%	41.1%

Learners' Levels of Perceived Mathematics Learning, Achievement Motivation and Anxiety in Mathematics Across Students' Learning Styles and Gender

To determine Learners' levels of perceived mathematics learning, achievement motivation and anxiety in mathematics (RQ1), we computed the descriptive statistics: Means (M), standard deviations (SD) and coefficients of variations (CV) of the students' rating of mathematics anxiety, achievement motivation, and perceived mathematics learning. The descriptive statistics are presented in **Table 1**.

Based on the mean rating (**Table 1**), students' perceived level of mathematics learning was low (*M* = 2.411, *SD* = .997), translating into about 48.2% perceived level of learning mathematics. Female students (*M* = 2.464, *SD* = 1.069) were perceived to have experienced more mathematics learning than male students (*M* = 2.281, *SD* = .786). Across the gender and learning style of students, the results showed that, unlike male students, female students' perceived mathematics learning was higher with mastery, self-expressive, and interpersonal learning styles. However, for understanding learning stylers, male students perceived mathematics learning was higher than female students.

Students experienced higher mathematics evaluation anxiety (*M* = 3.048, *SD* = 1.169) than mathematics learning anxiety (*M* = 2.546, *SD* = 1.114). With the prevalence of mathematics anxiety among learners, about 61% was attributable to taking tests and their related activities. However, approximately 50.9% of learners' mathematics anxiety was linked to other learning activities such as starting a new topic, buying a mathematics book and the like. The data (**Table 1**) showed that male students experienced higher mathematics evaluation anxiety and mathematics learning anxiety than female students. A detailed analysis of the data showed that mathematics evaluation anxiety was the most perceived source of mathematics anxiety for both male and female students, irrespective of learning preference.

Table 1 also shows student's perception of the overall achievement motivation (*M* = 3.112, *SD* = 1.080). The overall achievement motivation of students was primarily driven by the strive (76.5%, *M* = 3.826, *SD* = 1.125) to succeed, while their participation (45.7%, *M* = 2.283, *SD* = .961) in mathematics did little to raise their achievement motivation. Across the gender and learning style of students, the data revealed that for mastery and interpersonal learning styles, strive was the primary driver for both male and female students. At the same time, participation was the most negligible factor responsible for students' motivation to achieve. For male students, understanding and self-expressive learning styles were the main factors determining achievement motivation; however, for female students, maintaining the work and striving were also significant dimensions of achievement motivation.

The data further showed that out of the 322 participants, 166 (52%) were mastery learners, 65 (20%) belonged to the understanding group of learners, 30 (9%) were self-expressive learners, and 61 (19%) were interpersonal learners. This data imply that most learners are mastery learners. Across the gender, the distribution was

Table 2. Correlation measures (N = 322)

	PML	MLA	MEA	AMS	AMM	AMP	AMW
PML		-.310**	-.229**	.365**	.400**	.555**	.458**
MLA			.743**	-.053	-.183**	-.120*	-.148**
MEA				-.143*	-.064	-.032	-.196**
AMS					.081	.154**	.180**
AMM						.207**	.120
AMP							.205**

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

similar compared to the overall distribution. The order of the distribution showed that mastery and self-expressive learners were, respectively, the most popular and least popular learners.

Correlations Among Students' Perceived Mathematics Learning, Achievement Motivation and Anxiety in Mathematics

A correlation analysis was performed to measure the correlation among the perceived mathematics learning, achievement motivation, and mathematics anxiety (RQ2). Extracts of the results of the correlation analysis are presented in **Table 2**. The strength of the correlation was determined using Cohen's (1988) benchmark (small, r = .1; moderate, r = .3; and large, r = .5). For all students put together, the correlation between perceived mathematics learning and the four constructs of achievement motivation, and between perceived mathematics learning and mathematics anxiety constructs (**Table 2**) were statistically significant and respectively positively and negatively correlated.

The correlation between perceived mathematics learning and mathematics anxiety constructs was statistically significant and negatively correlated for both female and male students analysed separately. The strengths of the correlations based on Cohen's (1988) benchmark ranged from small, moderate, to high. However, for male students across all learning styles, perceived mathematics learning was statistically non-significant and negatively correlated with mathematics anxiety. Nevertheless, with male mastery learning stylers, perceived mathematics learning was statistically non-significant and positively correlated with achievement motivation factors except participation which reached statistical significance (r = .485). For male understanding learning stylers, perceived mathematics learning was statistically significant and positively correlated with achievement motivation factors except strive to succeed, which was not statistical significance. For male self-expressive learning stylers, perceived mathematics learning was statistically not significant though positively related to achievement motivation factors. For male interpersonal learning stylers, perceived mathematics learning was statistically significant and positively related to achievement motivation factors of participation in mathematics and willingness to work in mathematics. For female students across learning stylers except for understanding stylers, perceived mathematics learning was statistically significantly negatively correlated with mathematics anxiety.

Nevertheless, with female mastery learning stylers, perceived mathematics learning was statistically significant with achievement motivation factors and mathematics anxiety, respectively, positively and negatively correlated. For female understanding learning stylers, perceived mathematics learning was statistically significant and positively correlated with achievement motivation factors except striving to succeed and willingness to work in mathematics. Again, the correlation between perceived mathematics learning and anxiety did not reach statistical significance. For female self-expressive learning stylers, perceived mathematics learning was statistically significant and positively correlated with achievement motivation factors. In contrast, perceived mathematics learning was statistically significant and negatively related to mathematics learning anxiety. For female interpersonal learning stylers, perceived mathematics learning was statistically significant and positively correlated to achievement motivation factors except maintaining the

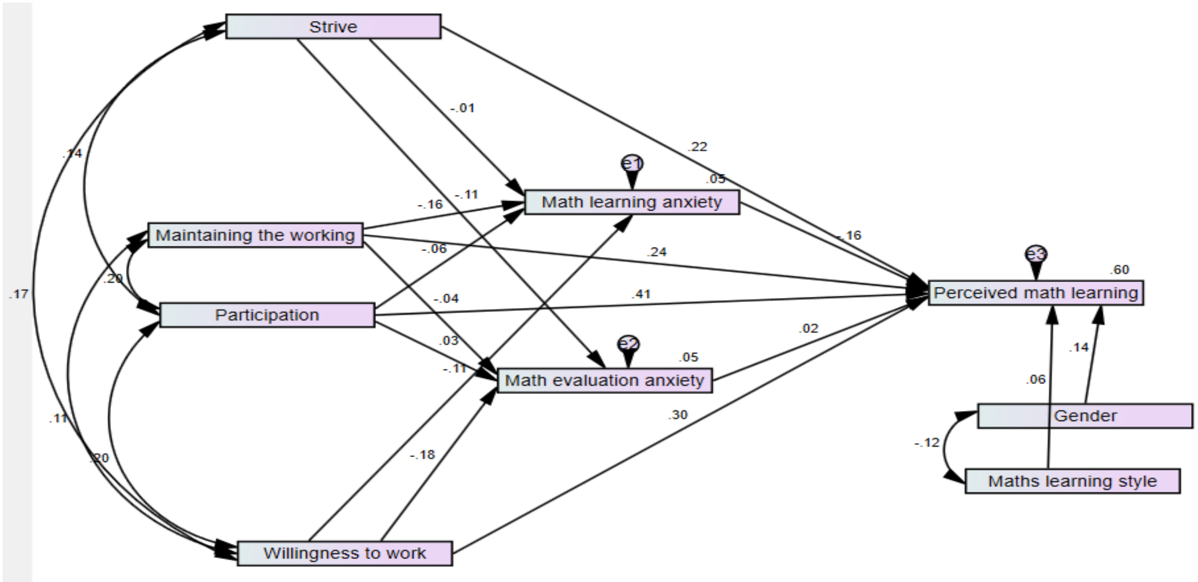

Figure 1. Path diagram associating achievement motivation, mathematics anxiety, and mathematics learning

Table 3. Regression results of achievement motivation and mathematics anxiety on mathematics learning

Paths	Estimate	SE	CR	*p*
AMS---PML	.217	.033	5.860	.000*
AMM---PML	.240	.033	6.476	.000*
AMP---PML	.409	.039	10.862	.000*
AMW---PML	.299	.033	7.995	.000*
MLA---PML	-.163	.049	-2.952	.003*
MEA---PML	.022	.047	.396	.692
AMS---MLA	-.010	.055	-.175	.861
AMM---MLA	-.155	.056	-2.781	.005*
AMP---MLA	-.063	.066	-1.102	.270
AMW---MLA	-.115	.056	-2.044	.041*
AMS---MEA	-.112	.058	-2.017	.044*
AMM---MEA	-.039	.058	-.707	.480
AMP---MEA	.030	.069	.528	.597
AMW--MEA	-.163	.059	-3.147	.002*

* significant at the 0.05 level

work, while perceived mathematics learning was statistically significant and negatively related to mathematics anxiety.

Regression of Perceived Mathematics Learning on Achievement Motivation and Mathematics Anxiety

RQ3 was tested using structural equation modelling in AMOS 21. The path diagram and the standard regression estimates of the model are presented in **Figure 1** and **Table 3** respectively. While controlling for learning styles *(critical ratio* = 1.998*, p* < .05*)* and gender *(critical ratio* = 3.970*, p* < .001*)*, which were statistically significantly related to perceived mathematics learning, the model (**Figure 1**) indices as suggested by Gaskin and Lim (2016): *PCLOSE* = .589, *RMSEA* = .053, *TLI* = .965, *CFI* = .988, *GFI* = .986, the *standard RMR* = .0364, $\chi^2 = 20.781$, $df = 13$, $\chi^2/df = 1.599$, and $p = .077$ were indicative that the model fit was excellent.

Subsequently, the regression coefficients were analysed based on Cohen's (1988) criteria: $.02 < R^2 < .15$ small effect size, $.15 < R^2 < .35$ medium effect size, and $R^2 > .35$ large effect size). The regression

Table 4. Results of statistically significant interaction effects

					95% CI		
Paths	**Estimate**	**SE**	***t***	***p***	**LL**	**UL**	**Interpretation**
AMS*MLA---PML	-.030	.038	-.801	.424	-.104	.044	No effect
AMS*MEA---PML	-.041	.038	-1.072	.285	-.117	.034	No effect
AMM*MLA----PML	-.104	.039	-2.699	.007	-.180	-.028	Has effect
AMM*MEA----PML	-.080	.037	-2.174	.030	-.153	-.008	Has effect
AMP*MLA----PML	-.114	.040	-2.826	.005	-.194	-.035	Has effect
AMP*MEA---PML	-.040	.041	-.979	.328	-.121	.041	No effect
AMW*MLA---PML	-.064	.036	-1.774	.077	-.135	.007	No effect
AMW*MEA----PML	-.073	.037	-1.983	.048	-.146	-.001	Has effect
AMS*Male----PML	-.213	.107	-1.979	.049	-.424	-.001	Has effect

Note: Model 1 (R^2 = 24%); Model 2 (R^2 = 21%); Model 3 (R^2 = 38%); Model 4 (R^2 = 24%); Model 5 (R^2 = 15%). Significant at the 0.05 level

analysis revealed that the four constructs of achievement motivation were all positively associated significantly with mathematics learning (Striving; $\beta = .217, p < 0.001$), (Maintaining the working; $\beta = .240, p < 0.001$), (Participation; $\beta = .409, p < 0.001$) and (Willingness to work; $\beta = .299, p < 0.001$). Unlike mathematics evaluation anxiety, mathematics learning anxiety was the only construct of mathematics anxiety that significantly predicted mathematics learning. Nevertheless, the effect was negative ($\beta = -.163, p < 0.05$). Additionally, two constructs of achievement motivation (Maintaining the working; $\beta = -.155, p < 0.05$) and (Willingness to work; $\beta = -.115, p < 0.05$) were significantly associated with mathematics learning anxiety, two other constructs of achievement motivation (Strive; $\beta = -.112, p < 0.05$) and (Willingness to work; $\beta = -.163, p < 0.05$) were also significantly associated with mathematics evaluation anxiety. Notedly, the association was negative.

Moderating the Effects of Achievement Motivation on Perceived Mathematics Learning

To test the moderating role of mathematics anxiety and gender on positive relationship between achievement motivation and mathematics learning (RQ4), we selected 'Model 1' in the options menu of the Hayes-PROCESS Macro 3.5, and applied 5000 bootstrap samples at 95% bias-corrected confidence intervals. Systematically, Mathematics learning anxiety (MLA), mathematics evaluation anxiety (MEA) and gender were included in the 'W' options. The results showed that the interactions $AMS \times MLA$, $AMS \times MEA$, $AMP \times MEA$, $AMW \times MLA$, $AMM \times Gender$, $AMP \times Gender$, and $AMW \times Gender$ were statistically not significant moderators (**Table 4**).

However, as presented in **Table 4** and with the moderation lines in **Figure 2**, the interaction effect of $AMM \times MLA$ on PML was negative ($\beta = -.104, p < .001$) with a significant model summary; $F(3,318) = 32.636, p < .001, R^2 = .24$ and a test of highest order unconditional interaction; $F(1,318) = 7.283, \Delta R^2 = .02, p < .05$. The interaction effect of $AMM \times MEA$ on PML was negative ($\beta = -.080, p < .05$) with a significant model summary; $F(3,318) = 28.689, p < 0.001, R^2 = .21$ and a significant test of highest order unconditional interaction; $F(1,318) = 4.724, \Delta R^2 = .01, p < .05$. The interaction effect of $AMP \times MLA$ on PML was negative ($\beta = -.114, p < .05$) with a significant model summary; $F(3,318) = 66.020, p < .001, R^2 = .38$ and a significant test of highest order unconditional interaction; $F(1,318) = 7.989, \Delta R^2 = .02, p < .05$. The interaction effect of $AMW \times MEA$ on PML was negative ($\beta = -.073, p < .05$) with a significant model summary; $F(3,318) = 33.348, p < .001, R^2 = 0.24$ and a significant test of highest order unconditional interaction; $F(1,318) = 3.934, \Delta R^2 = .01, p < .05$. These results indicate that mathematics anxiety (MLA and MEA) dampened the positive relationship between the achievement motivation to maintain working and the perceived mathematics learned. Also, mathematics learning anxiety dampened the positive relationship between the achievement motivation to participate, and the perceived mathematics learned. More so,

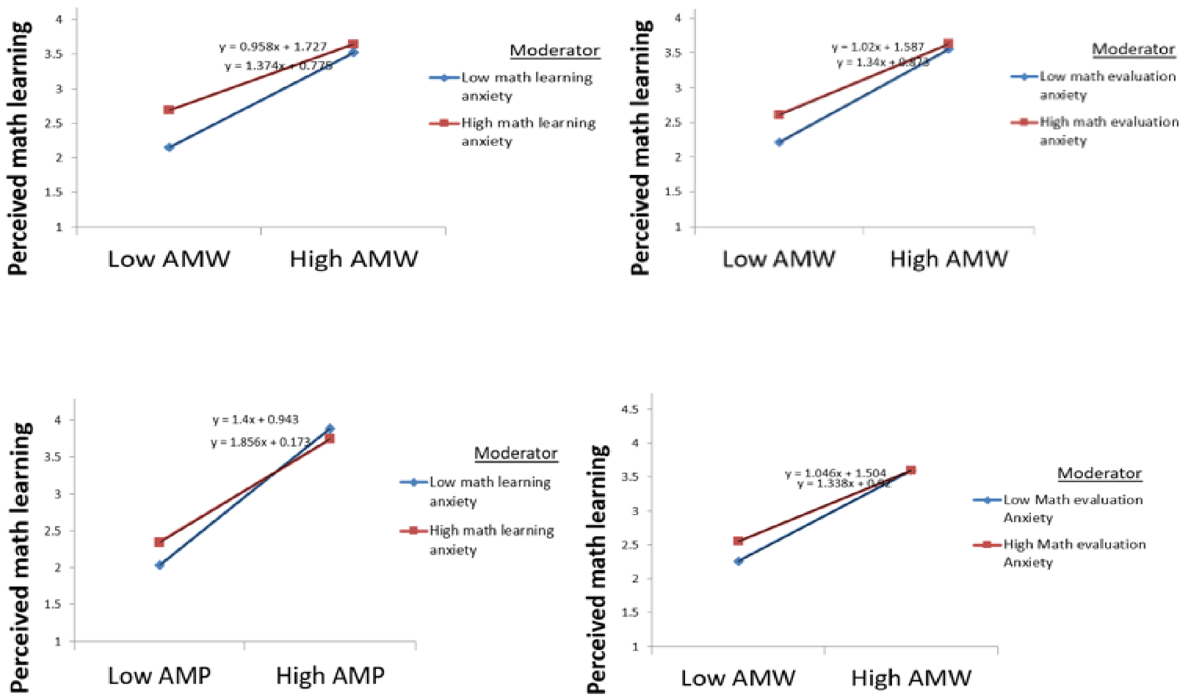

Figure 2. Two-way interaction effects on mathematics learning

mathematics evaluation anxiety dampened the positive relationship between the achievement motivation of one's willingness to work and the perceived mathematics learned.

The interaction effect of $AMS \times Gender$ (Male) on PML was positive $(\beta = -.213, p < .001)$ with a significant model summary; $F(3, 318) = 18.621, p < .001, R^2 = .15$ and a significant test of highest order unconditional interaction; $F(1, 318) = 3.917, \Delta R^2 = .01, p < .05$. Hence, gender seemed to strengthen the positive relationship between the achievement motivation to strive and the perceived mathematics learned.

DISCUSSION

This study sought to identify the levels of perceived mathematics learning, achievement motivation, and anxiety in mathematics across students' learning styles and genders. The correlations among perceived mathematics learning, achievement motivation, and anxiety in mathematics were examined. Furthermore, this study explored the moderation effect of mathematics anxiety on the association between perceived mathematics learning and achievement motivation.

The study affirmed Plake and Parker's (1982) assertion that two factors accounted for students' mathematics anxiety: anxiety resulting from the learning process and the anxiety occasioned by the evaluation processes in mathematics instruction. Compared to learning practices, evaluation activities featured less in mathematics instructional processes, yet mathematics evaluation anxiety was higher than mathematics learning anxiety. It can be speculated that mathematics evaluation anxiety was high because mathematics assessment in mathematics is not often or regularly performed. This assertion is supported by Onwuegbuzie (2004), who observed that statistics anxiety heightens as procrastination about writing examinations intensifies. The findings of this study also confirmed Ellez's (2004) four factors that drive achievement motivation in mathematics. Markedly, striving for success was the primary factor defining students' mathematics motivation for achievement. Besides, the study showed that participants' ratings differed across the genders and learning styles of the students. The data thus indicated that factors that define the motivation for students to achieve might differ according to the gender of students (Pawar, 2017; Richardson & Abraham, 2009). That notwithstanding, students seldom participated fully in mathematics instructional processes because participation was the most negligible factor defining achievement motivation. This observation is similar to the findings of Kavousipour et al. (2015), who also identified the lack of interest in participation as among the minor factors that affected students' academic motivation.

Similarly, Afrifa-Yamoah et al. (2016) also observed that participation was not a significant measure of achievement motivation in mathematics. The low participation of students raises questions about opportunities for students to be actively engaged in mathematics instruction. Bergmark and Westman (2018) noted that students' active and engaged participation in mathematics classrooms becomes questionable if students' participation is inadequate. Interestingly, Eccles et al. (2015) opined that academic engagement is increased by enjoyable participation. Like Afrifa-Yamoah et al. (2016), students' achievement motivation in mathematics in this present study was relatively high (62.2%). Although it is unclear why the achievement motivation in this study was high, it can be hazarded that the location of the schools in urban areas might account for this phenomenon. As observed by Pawar (2017), high school students in urban cities have high academic achievement motivation.

With a moderately high motivation for mathematics achievement amidst an elevated level of mathematics anxiety among high school students observed in this study, the perceived mathematics learning was relatively low. Sabti et al. (2019) opined that performance suffers when anxiety levels are high, while performance improves when achievement motivation levels are higher. Nevertheless, this study's relatively low perceived mathematics learning resonated with students' performance in WASSCE. Armah and Opoku-Amankwa (2022) noted that high school students' performance in WASCE has been low in recent years.

Based on the correlation and regression analysis, this study further confirmed the findings of previous studies. For example, mathematics learning, which may result in the desired achievement (Kunnath, 2017), correlates positively with achievement motivation but negatively with the mathematics anxiety (Putra et al., 2019; Sabti et al., 2019). Nonetheless, the varying correlations between perceived mathematics learning and the constructs of achievement motivation indicate that students with high achievement motivation tended to excel (Nagi & Maruthachalam, 2017).

Furthermore, the dampening effect of mathematics anxiety on the positive relationship between achievement motivation and perceived mathematics learning supports the inclination that high anxiety in mathematics may restrain achievement motivation and negatively impact the learning of mathematics (Aguilera-Hermida, 2020). As expected, students with high achievement motivation tend to achieve high success levels because, as Erdogan et al. (2011) suggested, low motivation for achievement corresponds with low competence, low expectations, and a high deviation from success.

CONCLUSION

From the findings, it can be concluded that high school students in Mampong Municipality are mathematically motivated to achieve based on four reasons identified by Ellez (2004): the motive to strive, maintaining the working, participation and willingness to work. Nevertheless, the motivation to strive and participate were the strongest and least drivers of students' achievement motivation. Beyond the mere description of students' achievement motivation (Afrifa-Yamoah et al., 2016), this study has showed that the relationship between achievement motivation in mathematics, mathematics anxiety, learning styles, and gender of high school students can further be explored. Based on the correlation and regression analysis, it can also be concluded that achievement motivation predicts mathematics learning among high school students; however, mathematics anxiety reduces the level of prediction. Therefore, in improving mathematics learning, factors like achievement motivation and mathematics anxiety need to be considered in instruction (Sabti et al., 2019). Besides, the study affirms that the influence of students' learning styles (Pizon & Ytoc, 2021) and their sex differences (Dzeshie, 2020) on mathematics learning cannot be underestimated.

LIMITATIONS

Although students' perceived mathematics learning can sometimes predict mathematics performance, researchers intending to use the findings in this study should be circumspect since the data on perceived mathematics learning was not validated with students' actual high school mathematics performance.

RECOMMENDATIONS

Given that achievement motivation positively predicts mathematics learning, while mathematics anxiety diminishes this prediction, instructional approaches should be designed with a dual focus. Mathematics teachers should implement teaching methods that foster and sustain achievement motivation while concurrently addressing and alleviating mathematics anxiety. This might involve creating a positive and supportive learning environment, implementing stress-reducing techniques, and providing additional resources for students experiencing anxiety. Implementing varied teaching techniques that cater to different learning styles—whether mastery, understanding, self-expressive, or interpersonal—can enhance students' comprehension and engagement. mathematics teachers should be mindful of these differences and implement inclusive teaching practices that accommodate the diverse needs of both male and female students.

SUGGESTIONS FOR FUTURE RESEARCH

This study suggests that the relationship between achievement motivation, mathematics anxiety, learning styles, and gender is ripe for further exploration. Future research endeavours could delve deeper into understanding the nuanced interactions among these variables. This exploration may lead to the development of tailored interventions and instructional strategies that cater to the diverse needs and preferences of high school students. With recourse to the importance of mathematics to students (Taley, 2022a), future studies should look at how a teacher's popularity can enhance students' motive to achieve, influence the relationship between achievement motivation and mathematics learning, and between mathematics anxiety and mathematics learning. By combining the findings of this present study with the results of previous studies (Fauth et al., 2018; Taley, 2022b.) that the popularity of a teacher can make a student like mathematics, a significant relationship might be expected between teacher popularity, mathematics anxiety, achievement motivation and students' achievement.

REFERENCES

Abd Algani, Y., & Eshan, J. (2019). Reasons and suggested solutions for low-level academic achievement in mathematics. International e-Journal of Educational Studies, 3(6), 181-190. https://doi.org/10.31458/IEJES.604884

Afrifa-Yamoah, E. (2016). Achievement motivation as a function of participation, strive, willingness to work and maintaining work: Application of structural equation modelling (SEM). *International Journal of Psychology and Behavioral Sciences*, *6*(3), 133–138.

Afrifa-Yamoah, E., Cofie, P. O., Saeed, B. I., Karim, A., & Paul, A. (2016). Measuring and relating senior high school students' achievement motivation towards mathematics lessons. *Education*, *6*(4), 89–95.

Aguilera-Hermida, A. P. (2020). College students' use and acceptance of emergency online learning due to COVID-19. *International Journal of Educational Research Open*, *1*, Article 100011. https://doi.org/10.1016/j.ijedro.2020.100011

Anggoro, B. S., Agustina, S., Komala, R., Komarudin, K., Jermsittiparsert, K., & Widyastuti, W. (2019). An analysis of students' learning style, mathematical disposition, and mathematical anxiety toward metacognitive reconstruction in mathematics learning process abstract. *Al-Jabar: Jurnal Pendidikan Matematika*, *10*(2), 187–200. https://doi.org/10.24042/ajpm.v10i2.3541

Armah, P. H., & Opoku-Amankwa, K. (2022). *Comparative analysis of WASSCE core subjects from 2016 to 2020*. Modernghana News. https://www.modernghana.com/news/1043154/comparative-analysis-of-wassce-core-subjects-from.html

Awang, Z. (2012). *Structural equation modeling using AMOS graphic*. Penerbit Universiti Teknologi MARA.

Banaga, A., & Fabella, F. E. (2018). Learning style and mathematics anxiety of Calawis national high school students. [Master's Thesis, Faculty of the Graduate School, Roosevelt College]. https://doi.org/10.2139/ssrn.3277772

Barroso, C., Ganley, C. M., McGraw, A. L., Geer, E. A., Hart, S. A., & Daucourt, M. C. (2021). A meta-analysis of the relation between math anxiety and math achievement. *Psychological Bulletin*, *147*(2), 134-168. https://doi.org/10.1037/bul0000307

Bergmark, U., & Westman, S. (2018). Student participation within teacher education: emphasising democratic values, engagement and learning for a future profession. *Higher Education Research & Development*, *37*(7), 1352–1365. https://doi.org/10.1080/07294360.2018.1484708

Camposano, J. L. L., Villanueva, A. M., & Yazon, A. D. (2015). Learning styles and mathematics performance of grade eight students in Los Baños Integrated School, SY 2014–2015. In A. G. Magdaraog, S. L. Apan, M. K. Camitoc, A. A. Magdaraog, & L. L. A. Longid (Eds.), *Proceedings Journal of Education, Psychology and Social Science Research*. Sons and Daughters Publications. https://doi.org/10.2139/ssrn.3104716

Chea, S., & Shumow, L. (2015). The relationships among writing self-efficacy, writing goal orientation, and writing achievement. *Asian-Focused ELT Research and Practice: Voices from the Far Edge*, *12*(1), 169-192. https://doi.org/10.5746/LEiA/14/V5/I2/A07/Chea_Shumow

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd Ed). Lawrence Erlbaum Associates.

Duru, D. C., & Okeke, S. O. C. (2020). Secondary school students learning style, achievement motivation and gender as predictors of mathematics achievement in Imo State. *UNIZIK Journal of STM Education*, *3*(2), 88–99.

Dzeshie, V. P. A. K. (2020). *A comparison of female students attitude towards mathematics achievement in single sex and mixed sex senior high schools*. [Abstract, University of Education].

Eccles, J. S., Fredricks, A., & Baay, P. (2015). Expectancies, values, identities, and self-regulation. In G. Oettingen & P. M. Glwitzer (Eds.), *Self-Regulation in Adolescence* (pp. 31–56). Cambridge University Press. https://doi.org/10.1017/CBO9781139565790.003

Ellez, M. A. (2004). *The relationships among effective learning, use of strategy, mathematical achievement, motivation and gender* [Doctoral Dissertation, Nizhny Novgorod University].

Emmanuel, A. O., Adom, E. A., Josephine, B., & Solomon, F. K. (2014). Achievement motivation, academic self-concept and academic achievement among high school students. *European Journal of Research and Reflection in Educational Sciences*, *2*(2), 24–37.

Erdogan, A., Kesici, S., & Sahin, I. (2011). Predicting of high school students' mathematics anxiety by their achievement motivation and social comparison. *Elementary Education Online*, *10*(2), 646–652.

Esa, S., & Mohamed, N. A. (2017). A study of students' learning styles and mathematics anxiety amongst form four students in Kerian Perak. *AIP Conference Proceedings*, *1847*(1). https://doi.org/10.1063/1.4983879

Eshun, B. A. (2006). Sex-difference in attitude of students towards mathematics in secondary school. *Mathematics Connection*, *4*(1), 1–13. https://doi.org/10.4314/mc.v4i1.21495

Essuman, S. A., Nyarko, J., & Frimpong, K. (2021). Impact of mathematics anxiety on the academic performance of junior high school pupils in the Bongo district of Ghana. *International Journal of Social Sciences and Humanities Invention*, *8*(9), 6562–6569. https://doi.org/10.18535/ijsshi/v8i09.05

Fauth, B., Decristan, J., Rieser, S., Klieme, E., & Büttner, G. (2018). Exploring teacher popularity: Associations with teacher characteristics and student outcomes in primary school. *Social Psychology of Education*, *21*(5), 1225–1249. https://doi.org/10.1007/s11218-018-9462-x

Frymier, A. B., & Houser, M. L. (1999). The revised learning indicators scale. *Communication Studies*, *50*(1), 1–12. https://doi.org/10.1080/10510979909388466

Gaskin, J., & Lim, J. (2016). *Model fit measures: AMOS Plugin*. Gaskination's StatWiki.

Ghasemi, E., & Burley, H. (2019). Gender, affect, and math: A cross-national meta-analysis of Trends in International Mathematics and Science Study 2015 outcomes. *Large-Scale Assessments in Education*, *7*(1), 1–25. https://doi.org/10.1186/s40536-019-0078-1

Göç, T. (2010). *Attitudes of primary school students towards mathematics courses and their level of motivation for success*. [Master's Thesis, Dokuz Eylül University].

Gómez-Chacón, I. M., Leder, G., & Forgasz, H. (2014). Personal beliefs and gender gaps in mathematics. In S. Oesterle, P. Liljedahl, C. Nicol, & D. Allan (Eds.), *Proceedings of the Joint Meeting of PME 38 and PM* (pp. 193–200). North American Chapter of the International Group for the Psychology of Mathematics Education.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (7th ed.). Prentice-Hall.

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2017). *A primer on partial least squares structural equation modeling (PLS-SEM)* (2nd ed.). SAGE.

Homayouni, A., Gharib, K., Mazini, F., & Otaghsara, A. K. (2016). Comparative investigation of mathematics anxiety and learning mathematics in male and female students of distance education system. *International Journal of Teaching and Education*, *2*(2), 34–38.

Kavousipour, S., Noorafshan, A., Pourahmad, S., & Dehghaninazhvani, A. (2015). Achievement motivation level in students of Shiraz University of Medical Sciences and its influential factors. *Journal of Advances in Medical Education & Professionalism*, *3*(1), 26–32.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and psychological measurement*, *30*(3), 607-610. https://doi.org/10.1177/001316447003000308

Kunnath, J. (2017). Creating meaningful grades. *Journal of School Administration Research and Development*, *2*(1), 53–56. https://doi.org/10.32674/jsard.v2i1.1926

Lussier, R. N., & Achua, C. F. (2007). *Leadership, theory application, skill development*. (3rd ed.). Thomson South-Western.

Mann, L. C., & Walshaw, M. (2019). Mathematics anxiety in secondary school female students: Issues, influences and implications. *New Zealand Journal of Educational Studies*, *54*(1), 101–120. https://doi.org/10.1007/s40841-019-00126-3

Ministry of Education [MoE]. (2020). *Mathematics curriculum for B7- B10 (Common core programme)*. National Council for Curriculum and Assessment (NaCCA).

Mullis, I. V., Martin, M. O., Foy, P., & Arora, A. (2012). *TIMSS 2011 international results in mathematics*. International Association for the Evaluation of Educational Achievement. Herengracht 487, Amsterdam, 1017 BT, The Netherlands.

Murphy, P. E. (2017). Student approaches to learning, conceptions of mathematics, and successful outcomes in learning mathematics. *Success in Higher Education: Transitions to, within and from University*, 75-93. https://doi.org/10.1007/978-981-10-2791-8_5

Nagi, M. S., & Maruthachalam, M. A. (2017). Achievement motivation among the University post graduation students. *Imperial Journal of Interdisciplinary Research*, *3*(9), 303–310.

Onwuegbuzie, A. J. (2004). Academic procrastination and statistics anxiety. *Assessment & Evaluation in Higher Education*, *29*(1), 3–19. https://doi.org/10.1080/0260293042000160384

Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2008). Learning styles: Concepts and evidence. *Psychological Science in the Public Interest*, *9*(3), 105–119. https://doi.org/10.1111/j.1539-6053.2009.01038.x

Pawar, S. (2017). A study of academic achievement motivation among secondary school students. *Scholarly Research Journal for Interdisciplinary Studies*, *36*(4), 6646–6651. https://doi.org/10.21922/srjis.v4i36.10009

Pintrich, P. R., & Schunk, D. H. (1996). *Motivation in education: theory, research, and applications*. Merrill.

Pizon, M. G., & Ytoc, S. T. (2021). A path model to infer mathematics performance: The interrelated impact of motivation, attitude, learning style and teaching strategies variables. *East Asian Journal of Multidisciplinary Research*, *1*(3), 315–330. https://doi.org/10.55927/eajmr.v1i3.104

Plake, B. S., & Parker, C. S. (1982). The development and validation of a revised version of the mathematics anxiety rating scale. *Educational and Psychological Measurement*, *42*, 551–557. https://doi.org/10.1177/001316448204200218

Pradeep, R. (2011). *A study of mathematics anxiety amongst primary pre-service teachers enrolled in a Dutch Teacher Training program* [Master's Thesis, Universiteit Van Amsterdam].

Putra, D. M., Ardana, I. M., & Astawa, I. W. (2019). Contribution of mathematics anxiety, achievement motivation, and academic potential to problem solving ability. *Jurnal Pendidikan Dan Pengajaran*, *52*(1), 15–25.

Rehman, A. A., & Alharthi, K. (2016). An introduction to research paradigms. *International Journal of Educational Investigations*, *3*(8), 51–59.

Richardson, M., & Abraham, C. (2009). Conscientiousness and achievement motivation predict performance. *European Journal of Personality*, *23*(7), 589–605. https://doi.org/10.1002/per.732

Rogers, K. S., Thomas, C., & Holmes, H. (2024). Encouraging student participation in mathematical activities in synchronous online tuition. *Open Learning: The Journal of Open, Distance and e-Learning*, 39(3), 241–257. https://doi.org/10.1080/02680513.2021.1938523

Sabti, A. A., Rashid, S., Nimehchisalem, V., & Darmi, R. (2019). The Impact of writing anxiety, writing achievement motivation, and writing self-efficacy on writing performance: A correlational study of Iraqi tertiary EFL learners. *SAGE Open*, *9*(4). https://doi.org/10.1177/2158244019894289

Sachdeva, S., & Eggen, P.-O. (2021). Learners' critical thinking about learning mathematics. *International Electronic Journal of Mathematics Education*, *16*(3), Article em0644. https://doi.org/10.29333/iejme/11003

Seven, M. A. (2020). Motivation in language learning and teaching. *African Educational Research Journal*, *8*, 62–71.

Silver, F. H., Thomas, J. E., & Perini, J. M. (2003). *Math learning style inventory for secondary students grade 6 - 12*. Thoughtful Education Press, LLC.

Singh, B. (2018). High school students' academic achievement in relation to their achievement motivation and intelligence. *Journal of Advances and Scholarly Researches in Allied Education*, *15*(4), 212–217. https://doi.org/10.29070/15/57500

Szczygiel, M. (2020). Gender, general anxiety, math anxiety and math achievement in early school-age children. *Issues in Educational Research*, *30*(3), 1126–1142.

Taley, I. B. (2022a). Teacher and student views of mathematics word problem-solving task at senior high school level. *Faculty of Natural and Applied Sciences Journal of Mathematics, and Science Education*, *3*(2), 33–43.

Taley, I. B. (2022b). Do students like us because we teach well? The popularity of high school mathematics teachers. *Asian Journal for Mathematics Education*. https://doi.org/10.1177/27527263221142906

Taley, I. B., & Ndamenenu, D. K. (2022). The phobia and contentment for mathematics. What context factors can do?. *Open Access Library Journal*, *9*, Article e8636. https://doi.org/10.4236/oalib.1108636

Usher, A., & Kober, N. (2012). Student motivation: An overlooked piece of school reform. *The Education Digest*, *78*(5), 9.

Werdhiastutie, A., Suhariadi, F., & Partiwi, S. G. (2020). Achievement motivation as antecedents of quality improvement of organizational human resources. *Budapest International Research and Critics Institute*, *3*, 747–752. https://doi.org/10.33258/birci.v3i2.886

Wigfield, A., & Eccles, J. S. (2002). The development of competence beliefs, expectancies for success, and achievement values from childhood through adolescence. In A. Wigfield & J. S. Eccles (Eds.), *Educational Psychology, Development of Achievement Motivation* (pp. 91-120). Academic Press. https://doi.org/10.1016/B978-012750053-9/50006-1

Willingham, D. T., Hughes, E. M., & Dobolyi, D. G. (2015). The scientific status of learning styles theories. *Teaching of Psychology*, *42*(3), 266–271. https://doi.org/10.1177/0098628315589505

Yazici, K. (2017). The relationship between learning style, test anxiety and academic achievement. *Universal Journal of Educational Research*, *5*(1), 61–71. https://doi.org/10.13189/ujer.2017.050108

Zhao, X., Jia, L., & Maes, J. H. (2018). Effect of achievement motivation on cognitive control adaptations. *Journal of Cognitive Psychology*, *30*(4), 453–465. https://doi.org/10.1080/20445911.2018.1467915