The Phobia and Contentment for Mathematics. What Context Factors Can Do?

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Abstract

The enactment of Ghana's high school mathematics enjoins mathematics teachers to provide well-suited classroom instruction that engages students physically and cognitively. Since learners' context factors can compromise the instructional efforts of mathematics teachers in delivering the curriculum, this study sought to explore the associations between the levels of students' mathematics learning and mathematics anxiety with their gender, school type and learning styles. A descriptive survey involving the administration of questionnaires was used to gather data from 322 senior high school students in an educational directorate in Ghana. The data were analyzed with contingency tables, chi-square tests of associations, means and standard deviations. The results showed that mathematics learning and math anxiety levels were not statistically associated with students' gender, school type and learning style, although differences in the mean scores and frequencies were observed. Besides, the levels of mathematics learning were significantly associated with the levels of mathematics anxiety. Consequently, it was suggested that mathematics teachers include these contextual factors in preparing and implementing their classroom instruction to make instructional provisions compatible with learners.

Subject Areas

Mathematical Analysis

Keywords

Mathematics Anxiety, Mathematics Learning, Learning Style, Gender, School-Type

1. Introduction

The rationale for the common core curriculum for mathematics in Ghana ex-

pects teachers to provide quality mathematics education that is pivoted in learner-centered teaching approaches [1]. The common core curriculum further enjoins teachers to facilitate students' mathematics learning by engaging them physically and cognitively in a rich and rigorous inquiry-driven learning environment. To achieve this milestone, teaching interventions provided by teachers should be compatible with the students' context factors. This is because context factors can compromise learning outcomes [2]. There exist a plethora list of context factors [3], however, Lee *et al.* [4] summarized context factors into three groups—student experience, teacher experience, and school characteristics. Similarly, Qomariah as cited in [5] redefined the categorization of these context factors as internal factors, which refer to students' physical and mental conditions; external factors, which also refer to factors around students; and approaches to learning which deals with learning efforts including learning strategies and methods used in learning. Examples of these context factors are mathematics anxiety, learning styles/preferences, instructional quality, self-confidence, teacher beliefs, environment and school conditions, parental support, and gender [6].

Interestingly, Peker [7] corroborates earlier studies that concluded that mathematics anxiety, learning styles, and gender could affect students' mathematics learning. Peker [7], however, added that mathematics anxiety was the major influencing factor. More so, a search of published works in Google Scholar search engine for the years 2000 to 2021 using a combination of the keywords such as mathematics learning, mathematics anxiety, gender, school type, and mathematics learning style in Ghana showed a considerable bivariant enquiry into the relationship between gender and mathematics learning [8], mathematics learning and school type [8], mathematics learning and learning style [9], as well as mathematics learning, gender and mathematics anxiety [10]. Following earlier studies, we set up to explore senior high school students' mathematics learning and anxiety levels and to relate these variables (levels of mathematics learning and mathematics anxiety) with students' mathematics learning style, gender, and school type. Our study differs a little from previous studies in that unlike the studies identified earlier [8] [9] [10], we explored the association of gender, mathematics learning style, school type, and mathematics anxiety of students with their mathematics learning within a single study in the Ghanaian context. In line with the research objective, the following research questions were answered.

RQ1: How are students' levels of mathematics learning associated with their gender, school type and learning styles?

RQ2: How are students' levels of mathematics anxiety associated with their gender, school type and learning styles?

RQ3: How are students' levels of mathematics anxiety associated with their levels of mathematics learning?

In the sections that follow, we present a review of literature on mathematics learning, anxiety, and learning styles among high school students. Besides, the

research method we adopted for this study, the results obtained and the conclusions thereafter are presented in subsequent sections.

1.1. Mathematics Learning

According to Ambrose *et al.* [11], learning is a psychological trait that depicts a process, causes a change, is influenced by experience, is an agent for improved performance, and serves as a foundation for future learning. By extension, mathematics learning may be seen as a deliberate process undertaken to cause an improved performance in a person's experience. This process of acquiring new mathematics knowledge based on training and interaction with the learning environment should manifest changes in a person's cognition, affect and motor skills relative to quantity, space and structure Verschaffel *et al.* [12]. As explained by Verschaffel *et al.* [12], the goal for learning mathematics is the acquisition of mathematics competencies involving the organization of mathematics knowledge, development of problem-solving skills, metacognitive knowledge and appropriate disposition towards mathematics. Seen as an accumulative process and/or an active individual constructive process, measuring students' total mathematics learning experiences should be viewed with a unidimensional lens [12].

Nevertheless, teachers have mostly used students' performances in tests/quizzes/examinations to define the level of students' mathematics learning, and the scores obtained by students in using these assessment tools make people think that "not everyone can be good at mathematics" ([13] p. 731). To this end, researchers claim that male students outperform their female counterparts in mathematics learning [14] [15]. Other studies also show that some minimal level of mathematics anxiety promotes mathematics learning [16]. Meanwhile, the findings on levels of mathematics learning relating to students' learning styles remain inconclusive [5] [17].

1.2. Mathematics Learning Styles

Learning styles are a collection of cognitive, emotional, and psychological characteristics that serve as fairly consistent indicators of a learner's perceptions, interactions, and responses to the learning environment [18]. According to Dunn *et al.* [19], teachers' knowledge of students' learning styles is helpful to the extent individual needs relating to sound, light, temperature, mobility, concentration span, motivational interest, cooperative learning and the perseverance on tasks of students could be addressed through classroom arrangement. Besides, Mokmin and Masood [20] assert that when students' mathematics learning styles are identified and respective learning materials are developed per their learning preferences, mathematics learning achievement increases. As a result, the same teaching offered by a teacher is perceived differently by different students because of differences in the styles of learning which then implies that the effectiveness or otherwise of a teaching method to a group of students emanates from

the style of learning [19] [21].

Based on the learning styles theories of [18] [22] [23], among others, some reliable learning style inventory instruments were developed to measure the students' learning preference. Among these learning style instruments is the mathematics learning style inventory for secondary students designed by Silver *et al.* [24] for mathematics learning. Silver *et al.* [24] model categorizes each learner into four learning styles—mastery, understanding, self-expressive, and interpersonal. Among other things, Silver *et al.* [24] explain that mastery learners will want to learn practical information and procedures, like to solve problems using procedures and prior knowledge, and learn best when instruction emphasizes the modelling of new skills with adaptable feedback; understanding learners like mathematics tasks that challenge them to think and explain their thinking, mathematics tasks which requires them to prove and explain themselves so they can understand why the mathematics learned works; self-expressive learners are imaginative in exploring mathematics ideas and like to engage non-routine problem solving; and interpersonal learners want teacher attention, and they are used to dialogues, collaboration, working in teams to focus on the real application of mathematics. Whiles some students have a single learning preference, others have multiple styles [25] [26]. However, irrespective of a student's learning style, Dunn *et al.* [19] claim that no single learning style is better than the other.

Exploration studies on mathematics learning styles show revealing results. Palobo *et al.* [17] reported a moderate effect size of 13.4% that learning styles have on mathematics learning outcomes of 243 students in SMP Negeri Urumb, Merauke. Other studies show that students differed in their mathematics performance according to their learning styles [27]. For example, Camposana *et al.* [26] examined how in Los Baños, Laguna, 187 grade eight students' learning styles and performance in mathematics were related. Using the mathematics learning inventory [24] model, Camposana *et al.* [26] observed uneven distribution of students per their learning styles, with mastery students being the majority and interpersonal being the least represented. Besides, the result further indicated that students' learning styles were not related to their mathematics performance [26]. Additionally, a study conducted by Bosman and Schulze [25] using the Visual, Auditory, Read/Write and Kinesthetic (VARK) model explored the relationship between learning styles and mathematics performance on 240 grade 9 students in a school located in the North-West Province of South Africa found that it was admissible for learners to exhibit multi-preference since high mathematics achievers and group learning significantly correlated with multi-styles in mats learning. Furthermore, [5] analyzed the influence of VARK learning style on the achievement of 10th grade Indonesia students in mathematics and found a non-significant association.

1.3. Mathematics Anxiety

Mathematics anxiety relates to the feeling of anxiousness, tension and fear for

mathematics-related situations in academia and real life, which might lead to the eventual evasion of mathematics-related situations [28]. Aldrup [29] and Jatt [30] are among several researchers who believe that mathematics anxiety is not just a problem for many students or an obstacle that impedes mathematics achievement but can negatively affect students affect and cognition. Hence, Ashcraft and Kirk [31] agree that mathematics anxiety reduces memory capacity, thus interfering with cognitive processes. Mathematics anxiety can be seen as a multivariant variable [32] [33]. Plake and Parker [32] described the overall mathematics anxiety of students as a summation of their mathematics evaluation anxiety and learning mathematics anxiety. According to Plake and Parker [32], the learning mathematics anxiety component measured students' apprehension about mathematics class, such as walking into a mathematics class, buying mathematics textbooks, or starting to learn a new mathematics chapter. On the other hand, Mathematics evaluation relates to evaluation activities in mathematics such as taking an unannounced quiz, taking mathematics examination or thinking about a yet to write mathematics exam or even awaiting a mathematics result.

The study by Ma [34] shows that the prevalence of mathematics anxiety among secondary students. As an illustration, the 2012 PISA [35] results show that more than 50% of students are worried about anticipated poor mathematics performance and coping difficulties in mathematics lessons. Additionally, Ashcraft and Kirk [31] also reported an estimated 20% prevalence rate of mathematics anxiety among students. This means that at least a fifth of the high school students investigated had the propensity to avoid mathematics-related situations in academia and real-life situations. Academically, extant literature [29] [30] [34] [36] shows that mathematics anxiety negatively correlates with the mathematics achievement of students. For example, Namkung et al. [36] conducted a meta-analysis of 131 studies and found a significant negative correlation between mathematics anxiety and mathematics performance among secondary school students.

Interestingly, earlier studies show that the gender of students, the type of school attended by students and students' mathematics learning styles determine the levels of mathematics anxiety. Relating to the gender of students at the secondary school level, females are more mathematics anxious than male students [35] [37]. However, Homayouni et al. [14] found that female and male students were statistically not different in their overall mathematics anxiety. Regarding mathematics evaluation anxiety, Homayouni et al. [14] observed that male students were more anxious about mathematics evaluation than female students. From other reports, the variation in mathematics anxiety exists between students who attend single-sex schools and mixed-sex schools. As an illustration, Mann and Walshaw [37] observed that both female and male students in single-sex schools had a higher mathematics anxiety than their peers in mixed-sex schools.

Moreover, the review of literature also shows that learning styles affect stu-

dents' mathematics anxiety [38] [39]. For example, Banaga [40] used Kolb's learning style inventory to explore 495 students of Calawis National High School grades 7 - 12 students and related the results with their mathematics anxiety. The study showed a mixed statistical association between mathematics anxiety levels and learning styles—grade 8 - 10 students had their mathematics anxiety levels significantly related to their learning styles, whiles a non-significant relationship was established for grades 7, 11 - 12 students. However, the overall data showed that none of the four learning styles (convergent, divergent, assimilative, and accommodative) was a predictor of mathematics anxiety. The study [40] also revealed an uneven distribution of students according to their learning styles and mathematics anxiety levels, with the majority of the students having low mathematics anxiety, yet the anxiety rate in male students (79.3%) was higher than the female students (69%). Esa and Mohamed [41] inquired how 175 Kerian students in Form Four mathematics anxiety was related to their learning styles. Using the Grasha's Learning Styles Inventory which categorizes students into six learners—independent, avoidant, collaborative, dependent, participant, and competitive, Esa and Mohamed (2017) found that students' overall mathematics anxiety was moderate, and based on gender, there was a significant difference in the learning styles. The test of association also showed a statistically weak negative significant correlation between students' learning styles and their mathematics anxiety [41]. Finally, Anggoro *et al.* [39] suggest that audio learners have high mathematics anxiety, kinesthetic learners are related to moderate mathematics anxiety, while visual learners are accustomed to low mathematics anxiety.

1.4. Conceptual Framework

Biggs [42] developed the 3P cyclic model for evaluating teaching and learning. In the 3P model, Biggs [42] identified the interacting events of student characteristics and teaching context in the learning process culminating in students' learning outcomes. Based on the 3P model, Tran [43] derived three approaches (student presage focused, teaching-focused, and learning-focused) for evaluating teaching and learning. The student presages focused approach [43] provided a conceptual framework for this study. Deducing from the student presage focused approach, differences in students' learning outcomes were attributable to their characteristics such as students' motivation [44] and learning preferences Biggs [42]. Hence, exonerating the efforts of teachers and teaching context in the learning process, it is possible to understand students' learning outcomes using their context factors [2] [7].

2. Research Method

This study was situated within a positivist paradigm in which quantitative data was collected through a descriptive cross-sectional survey that involved closed-ended questionnaires in answering the research questions [45]. This study en-

sued after the Mampong municipal educational directorate has granted ethical clearance for the study. A multi-stage random sampling technique [46] was used to sample 322 students from three senior high schools within the educational directorate. The 322 students included 93 males and 229 females attending either a same-sex (N = 112) high school or a mixed-sex (N = 210) high school.

Three existing questionnaires were used to gather data for the study. Firstly, Plake and Parker [32] 24-item Mathematics Anxiety Rating Scale (MARS) was used to estimate students' level of mathematics anxiety. The 5-point Likert scale MARS has responses from 1 (no anxiety) to 5 (high anxiety). Previous validation by Plake and Parker [32] showed that the MARS is a reliable measure (Cronbach alpha = 0.98) of students' mathematics anxiety. Besides, MARS is a dual-dimensional scale of learning mathematics anxiety (LMA) and mathematics evaluation anxiety (MEA). Secondly, Frymier and Houser [47] 7-item revised learning indicators scale (RLIS) was slightly modified to measure mathematics learning. The RLIS is a 5-point Likert scale with responses ranging from 0 (never learned mathematics) to 4 (very often learned mathematics). Frymier and Houser [47] have already proved that the RLIS is a valid and reliable measure of learning (reliability alpha of 0.85). The RLIS was modified to make the items more mathematics-related. For example, the original item "I feel I have learned a lot in this class" was modified to read "I feel I have learned much mathematics this semester". Thirdly, Silver *et al.* [24] mathematics learning style inventory (MLSI) was used to identify the students' preferred learning style. The MLSI is a set of 22 questions with four alternatives each. Each question on the MLSI demands a student to assign a different number of points (5, 3, 1, 0) to each of the four alternatives. The three questionnaires—MARS, RLIS and MLSI were simultaneously answered by the 322 sampled senior high school students. In this study, the Cronbach alpha (α) of the MARS (α = 0.867) and RLIS (α = 0.532) were within the acceptable range, which indicates that the instruments were reliable and conclusions based on the data valid [48].

Furthermore, the range of scores in the survey shows that the total mathematics anxiety (TMA) scores ranged from 21 to 95 (M = 54.13, SD = 15.34) but, the learning mathematics anxiety (LMA) scores ranged from 13 to 57 (M = 30.49, SD = 9.72) whiles the mathematics evaluation anxiety (MEA) scores from ranged from 8 to 40 (M = 23.64, SD = 7.36). The total mathematics learning (TML) scores also ranged from 1 to 24 (M = 13.5, SD = 4.36). Regarding the students' TMA levels, the most inducing scenario was the item "Being given an 'unannounced' test in a mathematics class makes me feel …" (M = 3.40, SD = 1.43), and the least inducing scenario was the item "Buying a mathematics textbook makes me feel…" (M = 1.88, SD = 1.33). Relating to students' TML experiences, the most inducing scenario was the item "I see connections between the mathematics content and my career goals" (M = 2.43, SD = 1.34), and the least inducing scenario was the item "I like to talk about what I am doing in this mathematics class with friends and family" (M = 2.05, SD = 1.35).

Based on the students' overall mean and standard deviation statistics, the students were categorised empirically into three groups (low, medium, high) of TMA, LMA, MEA and TML. Low TMA/LMA/MEA/TML scores were at least 1 standard deviation below the overall sample mean; High TMA/LMA/MEA/TML scores were at least 1 standard deviation above the overall sample mean; and medium TMA/LMA/MEA/TML scores were within 1 standard deviation (exclusive) below and above the overall sample mean [31] [37]. Furthermore, in using Silver, *et al.*'s (2003) formula for identifying students' mathematics learning styles, 315 students were uniquely identified whiles seven students were unspecified because they had two leaning styles. The distribution of the 322 students are as follows: mastery (N = 167, min = 53, max = 97, M = 65.61), understanding (N = 61, min = 53, max = 84, M = 62.24), self-expressive (N = 27, min = 52, max = 74, M = 62.43), interpersonal (N = 20, min = 53, max = 80, M = 64.43) and unspecified learning styles (N = 7, min = 51, max = 65, M = 58.5).

3. Results

The data on TML showed that during the semester, 52, 208, and 62 students respectively experienced low, medium and high mathematics learning to suggest that about 65% of the students experienced medium mathematics learning. Besides, the TMA data also showed that 56, 214, and 52 students respectively experienced low, medium and high mathematics anxiety during the semester. Similarly, 62, 207, and 53 students, respectively, experienced low, medium and high in LMA, while 68, 191, and 63 students experienced low, medium and high MEA during the semester. The data on students' anxiety pointed out that about 60% of the students experienced medium mathematics anxiety. Although less than a fifth of the students (16.1%) experienced high TMA, the data showed that about 20% of the students experienced high MEA, with a little below 17% experiencing high LMA The distribution of the students' TML, TMA, LMA and MEA scores with their gender, learning styles and type of school are presented in Table 1.

The distribution in Table 1 shows that female students had more TML (M = 13.75, SD = 4.48) than male students. However, the female students were more anxious in TMA (M = 54.23, SD = 15.29) and in MEA (M = 23.98, SD = 7.35) although their LMA (M = 30.25, SD = 9.76) was slightly lower than the scores for the male students. Hence, the data depicts that although female students were more anxious about mathematics, they had more mathematics learning experiences than male students. Regarding school type, students in single-sex schools had more mathematics learning (M = 14.53, SD = 4.30) than students in mixed-sex schools (M = 12.95, SD = 4.30). Conversely, students in mixed-sex schools were more anxious about mathematics in TMA, LMA and MEA (Table 1). Remarkably, in mixed-sex schools, female students had more TMA (M = 56.50, SD = 14.95) than male students (M = 53.89, SD = 15.53). Nonetheless, the TMA for female students in mixed-sex schools (M = 56.50, SD = 14.95) was

Table 1. Mean variation in students' mathematics anxiety and mathematics learning (N = 322).

		TML			TMA		LMA		MEA	
		N	M	SD	M	SD	M	SD	M	SD
Gender	Male	93	12.87	4.00	53.89	15.53	31.09	9.62	22.81	7.36
	Female	229	13.75	4.48	54.23	15.29	30.25	9.76	23.98	7.35
School type	Single-sex	112	14.53	4.30	51.86	15.36	28.82	9.86	23.04	7.24
	Mixed-sex	210	12.95	4.30	55.35	15.23	31.39	9.54	23.96	7.42
Mathematics learning style	Mastery	167	13.36	4.54	53.91	14.85	30.00	9.57	23.91	7.25
	Understanding	61	14.03	4.05	51.66	15.96	29.46	10.67	22.20	6.56
	Self-expressive	27	13.70	3.47	56.96	16.68	31.70	10.51	25.26	7.95
	Interpersonal	60	12.93	4.37	55.63	14.64	31.95	8.49	23.68	7.57
	Unspecified	7	16.14	5.08	57.29	22.17	34.14	11.35	23.14	11.74

		TML				TMA		
		N	M	SD		N	M	SD
TMA	low TMA	56	14.02	4.73	low TML	52	54.00	14.65
	medium TMA	214	13.21	4.02	medium TML	208	54.02	14.14
	high TMA	52	14.10	5.20	high TML	62	54.61	19.50
LMA	low LMA	62	14.08	4.62	low LMA	62	34.63	7.30
	medium LMA	207	13.14	4.08	medium LMA	207	54.40	9.92
	high LMA	53	14.23	4.96	high LMA	53	75.92	7.89
MEA	low MEA	68	13.68	4.96	low MEA	68	35.26	7.38
	medium MEA	191	13.38	4.00	medium MEA	191	55.20	10.90
	high MEA	63	13.65	4.76	high MEA	63	71.25	10.16

higher than the TMA for female students in single-sex school (M = 51.86, SD = 15.36). Additionally, in mixed-sex schools, female students had more TML (M = 13.01, SD = 4.53) than male students (M = 12.87, SD = 4.00). Nonetheless, the TML for female students in mixed-sex schools (M = 13.01, SD = 4.53) was lower than the TML for female students in single-sex school (M = 14.53, SD = 4.30).

Relating to the four-mathematics learning styles (Table 1), students with understanding learning style had more mathematics learning experiences (M = 14.03, SD = 4.05) whiles students with interpersonal learning style had the least mathematics learning experiences (M = 12.93, SD = 4.37). Besides, students with self-expressive learning style were more anxious in TMA (M = 56.96, SD = 16.68) and MEA (M = 25.26, SD = 7.95) whiles students with understanding learning style were less anxious in TMA (M = 51.66, SD = 15.96), LMA (M = 29.46, SD = 10.67) and in MEA (M = 22.20, SD = 6.56). Moreover, Table 1 shows that students with understanding learning style had low mathematics anxiety (TAM, LMA, and MEA) and more mathematics learning experience (TML). However, the data as presented in Table 1 could not establish whether interper-

sonal learners were more anxious about mathematics given that they experienced low mathematics learning. Nonetheless, further analysis shows that within mastery learners, females had more TML (M = 13.59, SD = 4.66) and less of TMA (M = 53.73, SD = 14.32) compared to male students with less TML (M = 12.67, SD = 4.12) and high TMA (M = 54.55, SD = 16.52). Among understanding learners, females had less TML (M = 13.96, SD = 4.17) and high of TMA (M = 52.83, SD = 16.24) compared to male students with high TML (M = 14.27, SD = 3.79) and less TMA (M = 48.07, SD = 15.02). For self-expressive learners, females had less TML (M = 13.68, SD = 4.00) and less of TMA (M = 54.63, SD = 17.83) compared to male students with high TML (M = 13.75, SD = 1.91) and high TMA (M = 62.50, SD = 12.88). Lastly, among interpersonal learners, females had more TML (M = 13.32, SD = 4.40) and high of TMA (M = 56.50, SD = 14.95) compared to male students with less TML (M = 12.42, SD = 4.36) and less TMA (M = 55.04, SD = 13.70). Thus, whiles the highest TMA was with male self-expressive learners, male understanding learners achieved the highest TML.

Table 1 further shows that among the groups of TMA, LMA and MEA, medium anxiety level students had the least TML, whiles the high TMA, high LMA and low MEA students had more TML, respectively. This indicates that students with high mathematics anxiety take to experiencing more mathematics learning. Besides, students with low TML also had low TMA (M = 54.00, SD = 14.65) whiles students with high TML experienced high TMA (M = 54.61, SD = 19.50). Expectedly, students with low LMA and low MEA tended to experience low TMA and vice-versa.

To appreciate how students' mathematics learning and mathematics anxiety are associated with their gender, school type and learning style, a Chi-square test of the association at 95% confidence level was used to ascertain the statistical significance of the associations. The result is presented in Table 2.

The analysis, as shown in Table 2, revealed that the Pearson Chi-Square test of independence produced no evidence of a statistical association between the

Table 2. Association of students' mathematics learning and mathematics anxiety with to their background information (N = 322).

		Gender	School type	Mathematics learning style	TMA	LMA	MEA
TML	Chi-square (df)	2.341 (2)	4.477 (2)	13.479 (8)	11.457 (4)	10.580 (4)	6.459 (4)
	Sig.	0.310	0.107	0.096	0.022	0.032	0.167
TMA	Chi-square (df)	0.132 (2)	1.315 (2)	9.614 (8)		342.180 (4)	214.401 (4)
	Sig.	0.936	0.518	0.298		0.000	0.000
LMA	Chi-square (df)	0.605 (2)	2.785 (2)	11.116 (8)			76.410 (4)
	Sig.	0.739	0.248	0.195			0.000
MEA	Chi-square (df)	0.772 (2)	1.805 (2)	7.798 (8)			
	Sig.	0.680	0.405	0.453			

levels of TML and gender (χ^2 (2) = 0.772, p = 0.680). Besides, the Nominal-by-Nominal Cramer's V statistic (0.085, p = 0.310) showed that the gender of students was not likely to identify with students' mathematics learning. More so, the Pearson Chi-Squared test of independence gave no evidence of a statistical association between the levels of TML and school type (χ^2 (2) = 1.805, p = 0.405). The Nominal-by-Cramer's V statistic (0.118, p = 0.107) showed that school type was not likely to identify with students' mathematics learning. In addition, the Pearson Chi-squared test of independence presented no evidence of a statistical association between the levels of TML and mathematics learning styles (χ^2 (8) = 7.798, p = 0.453). Besides, the Nominal-by-Nominal Cramer's V statistic (0.145, p = 0.096) showed that students' learning style was not likely to identify with students' mathematics learning.

Table 2 further show that the Pearson Chi-Square test of independence produced no evidence of an association between the levels of TMA and gender (χ^2 (2) = 0.132, p = 0.936). Besides, the Nominal-by-Nominal Cramer's V statistic (0.020, p = 0.936) showed that the gender of students was not likely to identify with students' overall mathematics anxiety. More so, the Pearson Chi-Squared test of independence gave no evidence of an association between the levels of TMA and school type (χ^2 (2) = 1.315, p = 0.518). The Nominal-by-Cramer's V statistic (0.064, p = 0.518) showed that school type was not likely to identify with students' overall mathematics anxiety. In addition, the Pearson Chi-squared test of independence presented no evidence of an association between the levels of TMA and mathematics learning styles (χ^2 (8) = 9.614, p = 0.298). Besides, the Nominal-by-Nominal Cramer's V statistic (0.122, p = 0.293) showed that students' learning style was not likely to identify with students' overall mathematics anxiety. Similar conclusions of no statistical association between the levels of LMA and MEA with students' gender, school type, and mathematics learning styles.

That notwithstanding, except for the Pearson Chi-Square association between TML and MEA (χ^2 (4) = 6.459, p = 0.167), there were statistical association among the levels of TML, TMA, MLA, and MEA. That is, the Pearson Chi-Square test of independence between the levels of TML and levels of TMA (χ^2 (4) = 11.457, p = 0.022); between the levels of TML and levels of LMA (χ^2 (4) = 10.580, p = 0.032); between the levels of TMA and levels of LMA (χ^2 (4) = 342.180, p = 0.000); between the levels of TMA and levels of MEA (χ^2 (4) = 214.401, p = 0.000); between the levels of LMA and levels of MEA (χ^2 (4) = 76.410, p = 0.000) produced evidence of association. Besides, the Nominal-by-Nominal Cramer's V statistic confirmed that the levels of TML was likely identify with TMA (0.133, p = 0.022); the levels of TML was likely identify with LMA (0.128, p = 0.032); the levels of TMA was likely identified with LMA (0.729, p = 0.000); the levels of TMA was likely identified with MEA (0.577, p = 0.000); the levels of LMA was likely identify with MEA (0.134, p = 0.000).

Further analysis showed that at a low-level TML, the Continuity Correction Chi-Square association was statistically significant between gender and school

type (χ^2 (1) = 6.653, p = 0.010), the Nominal-by-Nominal phi (−0.405, p = 0.004) but the Pearson Chi-Square association was neither statistically significant between gender and learning style (χ^2 (4) = 7.421, p = 0.115) nor between school type and learning style (χ^2 (4) = 1.670, p = 0.796). Also, at medium TML level, the Continuity Correction Chi-Square association was statistically significant between gender and school type (χ^2 (1) = 44.740, p = 0.000), the Nominal-by-Nominal phi (−0.475, p = 0.000) but the Pearson Chi-Square association was neither statistically significant between gender and learning style (χ^2 (4) = 3.998, p = 0.406) nor between school type and learning style (χ^2 (4) = 7.376, p = 0.117). Then at the high TML level, the Continuity Correction Chi-Square association was statistically significant between gender and school type (χ^2 (1) = 11.337, p = 0.000), the Nominal-by-Nominal phi (−0.467, p = 0.000) but the Pearson Chi-Square association was neither statistically significant between gender and learning style (χ^2 (4) = 5.689, p = 0.224) nor between school type and learning style (χ^2 (4) = 7.339, p = 0.119).

Regarding levels of anxiety, the analysis showed that at low MTA level, the Continuity Correction Chi-Square association was statistically significant between gender and school type (χ^2 (1) = 12.280, p = 0.000), the Nominal-by-Nominal phi (−0.509, p = 0.000) but the Pearson Chi-Square association was neither statistically significant between gender and learning style (χ^2 (4) = 4.459, p = 0.347) nor between school type and learning style (χ^2 (4) = 5.527, p = 0.237). Also, at medium MTA level, the Continuity Correction Chi-Square association was statistically significant between gender and school type (χ^2 (1) = 46.018, p = 0.000), the Nominal-by-Nominal phi (−0.474, p = 0.000) and the Pearson Chi-Square association was equally statistically significant between gender and learning style (χ^2 (4) = 10.365, p = 0.035), the Nominal-by-Nominal Crammer's V (0.220, p = 0.035) but the association between school type and learning style (χ^2 (4) = 6.546, p = 0.162) was not statistically significant. In addition, at high MTA level, the Continuity Correction Chi-Square association was statistically significant between gender and school type (χ^2 (1) = 5.963, p = 0.015), the Nominal-by-Nominal phi (−0.386, p = 0.015) but the Pearson Chi-Square association was neither statistically significant between gender and learning style (χ^2 (4) = 3.186, p = 0.527) nor between school type and learning style (χ^2 (4) = 6.274, p = 0.180).

As a consequence of the statistically non-significant associations of the levels of mathematics learning and mathematics anxiety with students' gender, school type and learning styles, a contingency table (Table 3) was used to describe the distribution of students' responses.

Despite the statistically non-significant associations between the level of TML and student's gender, school type and mathematics learning style, the data (Table 3) show that concerning gender, at least 62.9% of both male and female students experienced medium TML. However, for male students, the net difference between high and low TML was −3.2%, indicating that the number of male

Table 3. Distribution of students based on students' mathematics learning and mathematics anxiety (N = 322).

| | | Gender | | School type | | | Mathematics learning style | | | |
		Male	Female	S/S	M/S	Mas	Und	Selfp	Int	Unsp
TM L	Low	16 (17.2%)	36 (15.7%)	14 (12.5%)	38 (18.1%)	31 (18.6%)	6 (9.8%)	3 (11.1%)	11 (18.3%)	1 (14.3%)
	Medium	64 (68.8%)	144 (62.9%)	70 (62.5%)	138 (65.7%)	102 (61.1%)	43 (70.5%)	22 (81.5%)	39 (65.0%)	2 (28.6%)
	High	13 (14.0%)	49 (21.4%)	28 (25.0%)	34 (16.2%)	34 (20.4%)	12 (19.7%)	2 (7.4%)	10 (16.7%)	4 (57.1%)
TM A	Low	16 (17.2%)	40 (17.5%)	22 (19.6%)	34 (16.2%)	27 (16.2%)	15 (24.6%)	4 (14.8%)	9 (15.0%)	1 (14.3%)
	Medium	63 (67.7%)	151 (65.9%)	75 (67.0%)	139 (66.2%)	119 (71.3%)	35 (57.4%)	17 (63.0%)	40 (66.7%)	3 (42.9%)
	High	14 (15.1%)	38 (16.6%)	15 (13.4%)	37 (17.6%)	21 (12.6%)	11 (18.0%)	6 (22.2%)	11 (18.3%)	3 (42.9%)
LM A	Low	18 (19.4%)	44 (19.2%)	27 (24.1%)	35 (16.7%)	35 (21.0%)	16 (26.2%)	4 (14.8%)	6 (10.0%)	1 (14.3%)
	Medium	62 (66.7%)	145 (63.3%)	69 (61.6%)	138 (65.7%)	108 (64.7%)	31 (50.8%)	18 (66.7%)	46 (76.7%)	4 (57.1%)
	High	13 (14.0%)	40 (17.5%)	16 (14.3%)	37 (17.6%)	24 (14.4%)	14 (23.0%)	5 (18.5%)	8 (13.3%)	2 (28.6%)
ME A	Low	22 (23.7%)	46 (20.1%)	27 (24.1%)	41 (19.5%)	32 (19.2%)	16 (26.2%)	3 (11.1%)	14 (23.3%)	3 (42.9%)
	Medium	55 (59.1%)	136 (59.4%)	67 (59.8%)	124 (59.0%)	102 (61.1%)	37 (60.7%)	17 (63.0%)	33 (55.0%)	2 (28.6%)
	High	16 (17.2%)	47 (20.5%)	18 (16.1%)	45 (21.4%)	33 (19.8%)	8 (13.1%)	7 (25.9%)	13 (21.7%)	2 (28.6%)

Mas = Mastery, Und = Understanding, Selfp = Self-expressive, Int = Interpersonal, Uns = Unspecified S/S = single-sex, M/S = mixed-sex.

students in the low TML category was 3.2% more than the male students in the high TML category. Contrasting with female students, the net difference between high and low TML was 5.7%, indicating that the number of female students in the high TML category was 5.7% more than the female students in the low TML category. Comparatively, female students in the high TML category were more than male students by 7.4% points. Also, at least 65.9% of both male and female students experienced medium TMA. However, the net difference between high and low TMA for male students was −2.1%, indicating that the number of male students in the low TMA category was 2.1% more than the male students in the high TMA category. Contrasting with female students, the net difference between high and low TMA was −0.9%, indicating that the number of female students in the low TMA category was 0.9% more than the female stu-

dents in the high TMA category. Comparatively, female students in the high TMA category were more than male students by 1.5% points. A similar analysis shows that the number of female students in the high LMA category was more than male students by 3.5%, whereas the number of female students in the high MEA category was more than male students by 3.3% points.

Regarding school type, at least 62.5% of both single-sex and mixed-sex students experienced medium TML. However, for single-sex students, the net difference between high and low TML was 12.5%, indicating that the number of male students in the high TML category was 12.5% more than the single-sex SHS students in the low TML category. Contrasting with mixed-sex SHS students, the net difference between high and low TML was −1.9%, indicating that the number of mixed-sex SHS students in the low TML category was 1.9% more than the mixed-sex SHS students in the high TML category. Comparatively, the number of single-sex SHS students in the high TML category was more than mixed-sex students by 8.8% points. Also, at least 66.2% of both single-sex SHS and mixed-sex SHS students experienced medium TMA. However, for single-sex SHS students, the net difference between high and low TMA was −6.2%, indicating that the number of single-sex SHS students in the low TMA category was 6.2% more than the mixed-sex SHS students in the high TMA category. Contrasting with mixed-sex SHS students, the net difference between high and low TMA was 1.4%, indicating that the number of mixed-sex SHS students in the high TMA category was 1.4% more than the mixed-sex SHS students in the high TMA category. Comparatively, the number of mixed-sex SHS students in the high TMA category was more than mixed-sex SHS students by 4.2% points. Analogous analysis shows that the number of mixed-sex SHS students in the high LMA category was more than single-sex SHS students by 3.3%, whereas the number of mixed-sex SHS students in the high MEA category was more than single-sex SHS students by 5.3% points.

Relating to the mathematics learning style of students, at least 61.1% of all four learning styles experienced medium TML. However, for mastery students, the net difference between high and low TML was 1.8%, indicating that mastery learners in the high TML category were 1.8% more than mastery learners in the low TML category. With understanding learners, the net difference between high and low TML was 9.9%, indicating that the number of understanding learners in the high TML category was 9.9% more than the understanding learners in the low TML category. For self-expressive learners, the net difference between high and low TML was −3.7%, indicating that the number of understanding learners in the low TML category was 3.7% more than the self-expressive learners in the high TML category. Similarly, the net difference between high and low TML was −1.6% among the interpersonal learners, indicating that the number of interpersonal learners in the low TML category was 1.6% more than the interpersonal learners in the high TML category.

Furthermore, at least 57.4% of all four learning styles experienced medium

TMA. However, the net difference between high and low TMA was −3.6% for mastery students, indicating that the number of mastery learners in the high TMA category was 3.6% less than the mastery learners in the low TML category. With understanding learners, the net difference between high and low TMA was −6.6%, indicating that the number of understanding learners in the high TMA category was 6.6% less than the understanding learners in the low TMA category. For self-expressive learners, the net difference between high and low TML was 7.4%, indicating that the number of understanding learners in the high TMA category was 7.4% more than the self-expressive learners in the low TMA category. Similarly, the net difference between high and low TMA was 3.3% among the interpersonal learners, indicating that the number of interpersonal learners in the high TMA category was 3.3% more than the interpersonal learners in the low TMA category.

4. Discussion

This study purposed to explore the associations between the levels of students' mathematics learning and mathematics anxiety vis-a-vis students' gender, school type and learning styles. The data for the study was collected from 322 Ghanaian high school students. The findings of the analysis are herein discussed.

The results showed that about 84% of the students had at least medium to high mathematics learning experiences. This shows that about 84% of the students were expected to achieve optimum mathematics performance based on the claims of Taleb *et al.* [49], which indicates that improved mathematics learning leads to enhanced performance. Inversely, about 16% of the students also experienced low mathematics learning, and by implication, these students were likely to produce low mathematics performance. The result came as no surprise since not every student can be good at mathematics [13]. Regarding school type, the results pointed out that students in single-sex schools had more mathematics learning than students in mixed-sex schools. Comparing the female students in both school types, the results indicated that female students in the mixed-sex school lagged the female students in the single-sex schools in relation to the mathematics learned. Also, within mixed-sex schools, female students learned more mathematics than male students. Unlike the findings of Szczgiel [15] and Homayouni *et al.* [14], which indicated that male students outperformed their female counterparts, this study rather suggested that female students in this study had more learning of mathematics than male students and, by extension, female students were likely to outperform their male colleagues in mathematics. Although the cause for this finding was not investigated, it is hypothesized that instructional opportunities offered to the students favored female students and this was reflected in the learning styles as female students outlearned their male students in all four learning styles.

Similar to findings in previous studies [27], students' distribution and learning preferences varied, with most students being mastery learners (52%). Thus, most

students like to learn practical information and procedures, solve problems using procedures and prior knowledge, and learn best when instruction emphasizes new skills with adaptable feedback. Nonetheless, the findings of Camposano *et al.* [26], whose presentation suggested that mastery learners were the highest mathematics achievers, could not be confirmed in this present study since understanding learning styles had the highest mathematics learning. Regarding the significance of the relationships, this study has revealed that students' mathematics learning was not related to their gender, school type and learning style. Thus, the levels at which the students learned mathematics (will perform in mathematics) during the semester was not related to their gender, school type nor learning style. This finding was inconsistent with previous findings [14] that established an association between mathematics learning and gender but, the finding was consistent with previous findings [5] [26] that found no association between mathematics learning and learning styles.

The results also showed that the prevalence of mathematics anxiety was high. About 83% of the students had at least medium to high levels of mathematics anxiety. This means that less than 20% of the students were likely to confront mathematics-related activities both academically and in real-life situations. Besides, the percentage of mathematics anxious students was greater than the 78% reported by Marshall *et al.* [50] and the reported percentages in literature [31], [35] but less than the 85% reported by [51]. It stands to reason that the 83% rate of mathematics anxiety, as explained by Marshall *et al.* [50], may have a negative learning experience on students' mathematics learning. Gender wise, female students were more anxious mathematically than male students. This result corroborates with the findings of Mann and Walshaw [37], who found that at the secondary school level, females are more mathematics anxious than male students.

Regarding school type, the results pointed out that students in mixed-sex schools were more mathematics anxious than students in single-sex schools. Although this result contradicts the findings of Mann and Walshaw [37], it was assumed that in single-sex schools, the absence of male students reduced the mathematics anxiety in the female students. This assumption was anchored on the findings, which indicated that female students in the mixed-sex school were more anxious than female students in the single-sex schools, and within mixed-sex schools, female students were more anxious than male students. The finding that female students tended to be more anxious within the mixed-sex schools further corroborates Mendick's [52] admonition that female students trained in single-sex schools have high self-esteem necessary to reduce mathematics anxiety. For mathematics learning styles, students with self-expressive learning styles were more mathematics anxious, whiles students with understanding learning styles were least mathematics anxious.

Despite these revealing results, the findings of this study indicated that students' mathematics anxiety was not related to their gender, school type and learn-

ing style. Thus, the levels at which the students were anxious with mathematics during the semester was neither related to their gender, school type, nor learning style. This finding was consistent with previous findings [14] that established no association between mathematics anxiety and gender. This finding also reflected the findings of Banaga [40], who found that mathematics anxiety was not associated with students' learning styles.

Nevertheless, except at the medium level of anxiety, the study has shown that students' levels of mathematics learning were related to their levels of mathematics anxiety. The level of association was moderate and positive. This means increasing levels of mathematics anxiety accompanied increasing levels of mathematics learning. Perhaps, the level of mathematics anxiety was a motivating factor for the students to learn more mathematics. Although this finding was consistent with existing literature [29] [30] [34] [36] in which the relationship between students' mathematics achievement and their levels of mathematics anxiety was significant, a negative association was reported by [30]. While this study could not establish causality between students' mathematics anxiety and mathematics learning, the result showed that just as there were more mathematics anxious students (83%), so was more mathematics learned (84%). Another important result was that students with high mathematics anxiety levels, on average, had high levels of mathematics learning than those with medium and low anxiety. This corroborated the findings of Ashcraft [16] which indicated that some level of mathematics anxiety is associated with mathematics learning.

5. Conclusion

In conclusion, this study explored how the levels of mathematics learning and mathematics anxiety were associated with students' gender, school type and learning style. The results have provided empirical literature necessary for planning mathematics instruction within the research population. As an illustration, it was found that understanding learning styles were the least anxious, but they experienced more learning (and will experience optimum mathematics performance). This means that students who are challenged to think and explain their thinking; tasked to prove and explain why the mathematics works are likely to produce optimum performance in mathematics. Furthermore, the results suggest that some level of mathematics anxiety is necessary for high mathematics learning. Indeed, the results of this study have added to existing literature the need for mathematics instructors to appreciate the relationship between mathematics anxiety and mathematics learning among senior high students. Though the study has shown that the levels of mathematics learning and mathematics anxiety were not statistically associated with students' gender, school type and learning style, the understanding that these contextual factors are natal, developmental or coincidental properties implies that teachers should not underestimate their impact on students' mathematics learning. This is because when mathematics teachers include these contextual factors in preparing and imple-

menting their classroom instruction, the instructional provisions will be compatible with learners. Hence, students will be physically and cognitively engaged in a rich and rigorous inquiry-driven learning environment as the common core curriculum is enjoined.

6. Limitations and Recommendation

Relating to the gender and school type, the data used in this study was skewed, favoring females and mixed-sex schools, respectively. Therefore, any inferences made on the conclusion arrived in this study should be measured. Consequently, it is recommended that the study be replicated on a large sample to verify its results.

Conflicts of Interest

The authors declare no conflicts of interest.

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