Attitudes towards mathematics: A look at attitude to mathematics inquiry and enjoyment of mathematics lessons among Ghanaian students

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Abstract- Literature is clear about how individuals' capacity to solve real-world problem could be enhanced through mathematics learning. It is also suggested that advances in mathematics and sciences could be promoted by one's knowledge and skills in mathematics. Yet attitudes of students toward mathematics learning can affect and influence their mathematics results, which in turn can limit their access to taking advantage of opportunities offered by mathematics and sciences. Different dimensions of attitude to mathematics are known but there is the need to determine and nurture, early in students, those dimensions likely to groom them into inventiveness and problem-solving for development. Inspired by the country's aim at looking to produce students who would become citizens capable of solving societal problems, we used quantitative investigation to explore two of such dimensions: attitudes to mathematics inquiry and enjoyment of mathematics lessons. The sample involved 134 first-year senior high school students in Ghana. Data was collected through attitude survey. Overall, ANOVA differences were found at programme and gender levels regarding students' attitude to mathematics inquiry and how they enjoyed their mathematics lessons. Females were highly mathematically inquisitive than were their male counterparts, which is a good signal for investment in their mathematics education. Findings also revealed a strong and positive correlation between students' attitude to mathematics inquiry and their enjoyment of mathematics lessons. Conclusion and recommendations are offered based on the findings**.**

Index Terms- Attitude, attitude to mathematics inquiry, enjoyment, mathematics lessons, senior high school students

I. INTRODUCTION

Attitude, though intangible but observable construct, is an "individual's disposition to respond favourably or unfavourably to an object, person, or any other discriminable aspect of the individual's world" (Ajzen, 1989, p. 241). Mizra and Hussain (2018) referred to attitudes as "a state of mind and its tendency to respond to a certain situation or a person" (p. 11). Relating the issues of attitude to a popular Ghanaian adage, it might be possible to use the following catchphrase to depict it: 'attitude – like a person's character, or a pregnancy – cannot be hidden or suppressed forever. It will certainly show up!' This depiction signifies how critical attitude is to one's life, particularly as it can model individual's behaviour (Narayan, 2015). If this sense of attitude as being capable of modelling behaviour and that like a pregnancy – cannot be hidden – can be adopted, then it is significant for teachers to detect early and teach the attitudes and behaviours that maximise student's benefits – to enhance their "learning and success in later life" (Goss & Sonnemann, 2017, p. 7).

Narayan (2015) opined that students' attitude towards mathematics is a major influence on and determine their performance in the discipline. Several studies – for example, Cetin et al. (2005) – that have explored students' attitude to and performance in mathematics, have noted that a relationship exists between one's attitude to mathematics and mathematics performance. Authors, such as Anthony and Walshaw (2007) and Kele and Sharma (2014), have underscored the importance of attitudes in students' mathematics learning. Literature has shown that the process of mathematics learning does not entirely depend on one's thinking and reasoning alone. The aspect of learner's attitudes is also critical. For instance, attitudes entail cognitive (involving individual's thinking and belief about mathematics), affective (concerning general feelings and emotions expressed towards learning of mathematics) and behavioural (as regarding propensity to act in a certain manner towards learning mathematics) responses that are demonstrated by individuals towards an object or environment as results of one's feeling and interest (Han & Carpenter, 2014).

In line with the notion of Han and Carpenter (2014), Sanchal and Sharma (2017) noted that as the proportion of learners who likes mathematics increases, there is a corresponding increase in learners' enjoyment in mathematics lessons. This observation corroborates the findings of Zan and Di Martino (2007) that learners who find pleasure in learning mathematics lessons always enjoy same and are positively disposed towards the subject.

It is asserted that through mathematics learning, learners enhance their capacity to solve real world problems (Dewi & Kusumah, 2014) and that the advances in mathematics and sciences can be enhanced by one's mathematics knowledge and mathematical skills (Narayan, 2015). These asserted views suggest that mathematics lesson enjoyment and mathematics inquisitiveness are very consequential to developing problem-solving skills that can be useful in life. For instance, within the framework of developing effective, competent, and reflective citizens that can solve not only personal but confronting societal issues, Ghana's curriculum developers believe that learners should acquire positive outlook in life and attitude including values and psychological set of skills for participation in issues of national importance.

Spurred largely by this requirement, the Ghanaian mathematics curriculum among other things seeks to develop attitudes and values through several pathways, including willingness to change one's opinion in the presence of plausible evidence; being reflective, necessitating acquisition of habit of critical reviews of ways and manners in which things are done; willingness to gather and use data for investigation, whiles at the same time, showing respect for data that others collect (National Council for Curriculum and Assessment (NaCCA), 2019). This attitude can come about and become fully developed in students as they develop their mathematics inquiry base and enjoy what they do in mathematics lessons. Taken together, whether a student would become interested or otherwise in any activity, including the learning of mathematics to develop critical skills and to solve future societal problems, is a function of one's attitude towards the object that relates it. Therefore, to produce students so that they can become problem-solving citizens and major players in a technological world, the key lies in early determination and characterisation of students' attitude towards mathematics learning and nurturing same in them towards the envisioned goal, in their schooling. This key necessitated the impetus to develop this study to explore the attitude to mathematics inquiry and enjoyment of mathematics lessons among different academic programme students who were in their first year at senior high school in Ghana.

Attitude to mathematics

The place of attitude in the teaching and learning of mathematics is recognised despite its multiple definitions. Earlier, some authors have attempted some definitions., for example, specified that attitude to mathematics is liking and disliking of mathematics. For Hart (1989), it is favourable and unfavourable disposition towards mathematics. Attitude is described to be cognitive, affective, and behavioural (Han & Carpenter, 2014; Maio & Haddock, 2010; Petty et al., 2003). Attitude, considered in the light of many definitions, indicates a lack of single defined meaning (Mullis et al., 2016). However, McLeod's (1992) definition indicates that "positive or negative feelings of moderate intensity and reasonable stability" constitute attitude which is different from all other facets of affect in mathematics.

Attitude can be considered multi-dimensional. For example, Fennema and Sherman (1976) considered nine dimensions of attitude in their study. These are success in mathematics, male domain, mother/father, teacher attitudes, mathematics anxiety, motivation, and usefulness. It is asserted that affect variables (eg attitude) affect one's effort exerted to learn mathematics and has excessive impact on selection of mathematics above secondary school level (Fennema & Sherman, 1976).

Wilkins and Ma (2003) clarified that people's disposition relating attitude towards mathematics is as vital for informed decision-making, regarding their willingness to use knowledge in everyday life, as content knowledge. Subsequently, Dede (2012) maintained that attitude (particularly, affect) influences students' use of mathematics as far as their future is concerned and how they learn mathematics in contexts. Two of such attitude dimensions include mathematics lessons enjoyment and mathematics inquiry (Chow, 2011), which are variables of interest in this study and are described next.

Attitude to mathematics inquiry

The coming together of "problem solving, communication, representation, connections and reasoning with content-based objectives" (as promoted by National Research Council (NRC) 1996 , p. 105) determine the approaches to effective inquiry in mathematics (Tyminski et al., 2013, p. 328). Mathematics inquiry involves developing people's understanding by investigating. This can be achieved by questions they ask, suitable methods they use, data they get to collect, and to formulate, communicate, and argue logically (NRC, 1996). In these approaches, learners are expected to be presented with opportunities so they can explore mathematics concepts being learnt prior to receiving any of formal explanations (Tyminski et al., 2013).

Inquiry mathematics attitude actively engages learners in their learning processes, affording them the "opportunity for both individual ownership and more collaboration with peers" and help learners enjoy their lessons more, which in turn, develop in them "more confidence in their abilities" (Riegle-Crumb et al., 2019, p. 3).

Tyminski et al. (2013, p. 326) argued that students are expected to be taught to "view mathematics as a coherent, sense-making endea[vour] and to use key mathematical processes" as a vehicle to learn the content of mathematics. This might endear students to mathematics learning as they may see mathematics lessons more practical and sensible venture, rather than as an abstract and teacher-dominated activity. This trend of mathematics teaching and learning was first promoted by the National Council of Teachers of Mathematics (NCTM, 1980). NCTM keeps stressing this in the standard documents, for example, of NCTM (2000) and Common Core State Standards Initiative (2010) as intimated by Tyminski et al. (p. 326). This continued emphasis suggests issues of concern with regard to the teaching and learning of mathematics lessons. This suggestion is given some credence by McGregor (2016), who mentioned that concerns about declining secondary school student interest and learning of mathematics lessons have been on the rise.

According to McGregor (2016, p. iii), this is a worldwide phenomenon, most experienced by students "in the senior years of high school and at university". To Explore how the beliefs and attitude of students can be influenced and re-shaped by inquiry-based mathematics lesson learning, the author discovered that secondary school students who have developed mathematics inquiry attitude were able to use several ways to solve, defend

alternative ways they chose, and were willing to seek more understanding of the problems they faced (McGregor, 2016). Students were reported to have taken intelligent risks and offered suggestions. Findings also showed that the students increasingly acquired mathematics inquiry attitude as they repeatedly engaged in ill-structured problems in their mathematics lessons.

Enjoyment of mathematics lessons

As a positive activating emotion – capable of affecting the possibility of students engagement or re-engagement in studying enjoyable content (Pekrun, 2006), 'enjoyment' has become one of the most commonly studied emotions in the classroom (Schukajlow, 2015), and especially within mathematics classrooms (e.g., Kupari & Nissinen, 2013; Firmender et al., 2017; Hidi, 2000). Enjoyment of mathematics lessons is viewed as the degree to which learners enjoy learning mathematics (Kupari & Nissinen, 2013). In mathematics lessons, enjoyment is enabled in varied ways. One of them is the comfortability and interactions among members of the classroom community (Firmender et al., 2017; Hidi, 2000). The chief aim is "mak[ing] students feel stress-free while [learning mathematics lessons and] writing their solution" Kaur and Prendergast (2021).

Literature attests to learners' enjoyment of mathematics lessons. In Bangrak, a study was conducted by Kumar and González (2021) to explore the attitudes of students to enjoying mathematics lessons (and self-confidence) after they have been exposed to a short writing intervention. Data, from their study, reported significant increase in the enjoyment of mathematics lessons mean scores of students. In another study, Mazana et al. (2019) investigated students' attitude to mathematics learning with Tanzanian students and the findings illustrated that the participating students highly enjoyed learning lessons in mathematics and that children in the primary school did enjoy learning mathematics lessons than their older counterparts. One-way ANOVA test confirmed a statistically significant study level (primary, secondary, and college) differences for enjoyment of mathematics lessons.

These findings suggest that students of all kinds enjoy lessons in mathematics differently and at different levels. Those who may find lessons enjoyable would perhaps endeavour to prevail and succeed whilst it might be possible for those on the other side of the spectrum to concede defeat and discontinue making any personal efforts. Enjoyment of mathematics lessons can also be increased to boosts students' confidence to learn mathematics (Capraro & Capraro, 2006; Haack, 2011).

The foregone literature review has identified the centrality of attitude in mathematics learning. Particularly, the review has indicated how students with mathematics inquiry attitude used different ways to solve, defend alternative ways used in their solutions to tasks, and how willing they sought to more understand the problems they encountered (McGregor, 2016). Students have also been found to enjoy mathematics lessons and that significant differences exist among study levels. However, not much is known about the constructs among Ghanaian high school students in their first years, and the association among the constructs as far as programme study level is concerned. It would therefore be interesting to see how the construct of mathematics lessons enjoyment and attitude to mathematics inquiry are experienced by same level students and among student in different programmes. This became the focus of research study upon which this manuscript is written.

II. RESEARCH QUESTIONS

1. What is the level of high school students' attitude towards mathematics as measured by TOMRA (Test of Mathematics-Related Attitude)?
2. Do the high school students studying different programmes have similar (or dissimilar) attitude to mathematics inquiry as measured by TOMRA?
3. Do the high school students studying different programmes express similar (or dissimilar) enjoyment of mathematics lessons as measured by TOMRA?
4. Is there a reasonable relationship between the attitude to mathematics inquiry and enjoyment of mathematics lessons as measured by TOMRA?

III. MATERIALS AND METHODS

Participants

In this study, a quantitative research design method was used. The study was conducted in Asare Bediako Memorial Senior High School, located in the Adansi North district in the Ashanti region of Ghana. A total of 134 first-year students participated in a self-reported survey. Of this sample, 46.3% was males and females constituted 53.7%. Before the survey was administered to the students, research permission was sought from the school administration. Student recruitment was made voluntary and those who expressed interest were allowed to participate in the study.

Instrument

The survey was developed by Chow (2011). It is a Test of Mathematics-Related Attitude (TOMRA), a revised form of a Test of Science-Related Attitudes (TORSA) by Fraser (1981). The TOMRA instrument contains two subscales of 10 items each. A half of the items for each sub-scale was negatively worded. The items were Likert type and were rated as: strongly agree – 5; agree – 4; not sure – 3; disagree – 2; and strongly disagree – 1. All negative statements were reversed scored. Chow reported, in his study, the Cronbach's alpha values for pre- and post-TOMRA subscales: Attitude to mathematics inquiry (AMI) (pre-test: $\alpha = 0.64$, post test: $\propto = 0.76$) and Enjoyment of mathematics lessons (EML) (pre-test: $\alpha = 0.93$, post test: $\propto = 0.86$).

However, contrary to the reported values of reliability, the scores (of the sample, n = 134, in this study) obtained from the instrument suffered low reliability: AMI ($\propto = .46$) and EML ($\propto = .35$). Nimon et al. (2012) have recommended that one or a few items that negatively impact the reliability of the observed scores can be omitted to enhance reliability. This position was earlier assumed by Dillon and Bearden (2001). To progress, the correlation matrix for the data was run, and all items found uncorrelated with other items with coefficients less than 0.30 were removed. Hence, items 15 (The material covered in mathematics lesson is uninteresting); 11(Mathematics lessons are a waste of time); 3 (I dislike mathematics lessons) and 7 (Mathematics lessons bore me) were removed from AMI subscale.

Similarly, items 4 (Doing mathematics problems is not as good as finding out from teachers), 8 (I would rather agree with other people than to do mathematics problem to find out for myself), 10 (I would prefer to do my own mathematics problems than to find out information from a teacher), 12 (I would rather find out about things by asking an expert than by doing a mathematics problem), 16 (It is better to ask the teacher than to find it out by doing a mathematics problem), and 20 (It is better to told mathematics fact than to find them out from doing a mathematics problem) were removed from the EML subscale.

Chow (2011), who amended the TOSRA scale to create TOMRA scale, adopted in this current study, derived validation for its use from Fraser (2011) and his endorsement. Since the phenomenon investigated in this study focused on SHS students' attitude to mathematics lesson inquiry and their attitude to enjoyment of mathematics lessons and the TOMRA items purported to measure such constructs, the 10 items used can be seen as measuring what they were meant to do. In addition, due to the reduced items used in this study, the researchers collectively agreed to the use of the items after having rated the items, individually. It was further endorsed by other colleagues in the field of mathematics education who reviewed the items for face validity.

Subsequently, further analysis on the reliability was then performed. The resulting reliability for each subscale is: AMI ($\propto = 0.84$) and EML ($\propto = 0.60$). The Cronachs' alpha estimate of the internal consistency reliability for the entire scale was 0.84.

The new reliability values suggest the items on each subscale can be trusted to reasonably measure the same underlying construct for which they were intended, thus, internal consistency among items of each subscale is okay. Based on this, we judged that the scores are reliable to be used for further analysis. Table 1 lists the various items that made for each subscale which generated data used for the results in this study upon which this manuscript is written. The bold figures indicate their serial numbers.

Table 1 Items for the study

Attitude to mathematics lesson inquiry
1. I would prefer to find out why something happens by solving a mathematics problem than by being told (**2**)
2. I would prefer to do mathematics problems than read about them (**6**).
3. I would rather solve a problem by doing mathematics than to be told the answer (**14**).
4. I would prefer to do a mathematics problem on a topic than to read about it in a mathematics magazine (**8**).
Attitude to enjoyment of mathematics lessons
1. Math lessons are fun (**1**)
2. Schools should have more math lessons each week (**5**)
3. Mathematics is one of the most interesting school subjects (**9**)
4. I really enjoy going to mathematics lessons (**13**)
5. I look forward to mathematics lessons. (**17**)
6. I would enjoy school more if there were mathematics lessons. (**19**)

We categorised and maintained a mean score of 3.0 (overall score divided by number of items) as criterion for the TOMRA, AMI, and EML. Thus, any dimension of attitude with items-mean of more than 3.0 is an indication that students possess a high and positive attitude. Otherwise, students were deemed to have low and negative attitude of that particular dimension. The overall score for TOMRA ranged from 10 to 50; for AMI, 4 to 20; and for EML, 6 to 30.

IV. DATA ANALYSIS

The descriptive statistics were used to report the mean scores of students' overall attitude and the subscales by academic programme of study and gender. Students' attitude to mathematics inquiry as well as enjoyment of mathematics lessons were analysed to investigate academic programme-level (Home economics, Business, Science, Agricultural science, and Arts) differences and gender-level (males and females) differences. A One-way between-groups analysis of variance (ANOVA) was used. A pairwise post hoc test with Bonferroni for multiple comparisons was performed if ANOVA result confirmed a statistically significant difference. The level of significance was set at 0.05 for all. Pearson product-moment correlation analysis was conducted to investigate the relationship between attitude to mathematics inquiry and enjoyment of mathematics lessons.

V. RESULTS

High school students' attitude towards mathematics

We present the results of high school students' attitude towards mathematics as was assessed by TOMRA. We do this by listing the mean and standard deviation scores for the items (Table 2); the entire participants (Table 3); and further, looking at academic programme-level (Table 4) and gender-level (Table 5) across the whole scale and the factor levels of the scale.

Table 2 means and standard deviation scores for items

Attitude to mathematics lesson inquiry	**Mean**	**SD**
1. I would prefer to find out why something happens by solving a mathematics problem than by being told (**2**).	3.66	1.238
2. I would prefer to do mathematics problems than read about them (**6**).	4.31	1.035
3, I would rather solve a problem by doing mathematics than to be told the answer (**14**).	3.96	1.241
4. I would prefer to do a mathematics problem on a topic than to read about it in a mathematics magazine (**8**).	3.77	1.286
Attitude to enjoyment of mathematics lessons		
1. Math lessons are fun (**1**).	4.07	1.119
2. Schools should have more math lessons each week (**5**).	3.58	1.483
2. Mathematics is one of the most interesting school subjects (**9**).	3.75	1.336

4. I really enjoy going to mathematics lessons (**13**).	3.67	1.336
5. I look forward to mathematics lessons (**17**)	3.84	1.190
6. I would enjoy school more if there were mathematics lessons (**19**).	3.21	1.371

Data reveals high and positive mean scores were obtained for individual items on both subscales. Regarding the overall attitude of students towards mathematics, a high and positive level of attitude was expressed towards mathematics (M = 3.78, SD = 0.3), generally. Males (M = 37.94, SD = 8.66) appeared to have expressed higher and positive attitude as compared to their female counterparts (M = 37.71, SD = 7.79), even though both expressed a high attitude to mathematics. By programme-wise, the results showed that students of Business (M = 41.88, SD = 6.32), Science (M = 40.0, SD = 6.84) , Agricultural science (M = 39.18, SD = 6.12), and Home economics (M = 39.11, SD = 6.163) – in order of magnitude of their mean scores – expressed a high level of attitude to mathematics. However, Arts students (M = 29.17, SD = 10.23) held a moderate attitude.

Again, the results of the analysis showed that students, overall, held high and positive attitude to mathematics inquiry (M = 3.93, SD = 0.29). Analysis by gender revealed that both females (M = 16.42, SD = 3.139) and males (M = 14.87, SD = 3.21) held a high attitude to mathematics inquiry, with the former leading the latter. Further, the results revealed that students of Home economics (M = 17.34, SD = 2.50), Business (M = 16.65, SD = 2.34), Science (M = 15.76, SD = 3.03), and Agricultural science (M = 15.11, SD = 2.25) (in order of magnitude of their mean scores) held a high attitude to mathematics inquiry. A moderate attitude to mathematics inquiry was, however, observed with Arts students (M = 13.33, SD = 4.60).

Regarding the overall students' enjoyment of mathematics lessons, a high and positive level was observed among students (M = 3.69, SD = 0.29), generally. Males (M = 23.06, SD = 6.13) appeared to have enjoyed mathematics lessons more than females (M = 21.29, SD = 5.47), even though both held a high level of enjoying lessons in mathematics. By programme-wise, the data revealed that students of Business (M = 25.24, SD = 4.60), Science (M = 24.24 SD = 4.80), Agricultural science (M = 24.08, SD = 4.40), and Home economics (M = 21.76, SD = 4.30) (in order of magnitude of their mean scores) enjoyed mathematics lessons highly. Arts students (M = 15.83, SD = 6.80) moderately enjoyed mathematics lessons.

Table 3 Students' mean ratings of attitude (n =134)

	Mean	SD	Max	Min	Range
AMI	3.93	0.29	4.31	3.66	0.64
EML	3.69	0.29	4.07	3.21	0.89
TOMRA	3.78	0.30	4.01	3.21	1.10

Table 4 Students' ratings of attitude by programme (n =134)

	H Econs		Business		Agric		Arts		Science	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
AMI	17.34	2.50	16.65	2.34	15.11	2.25	13.33	4.60	15.76	3.03
EML	21.76	4.30	25.24	4.60	24.08	4.40	15.83	6.73	24.24	4.80
TOMRA	39.11	6.16	41.88	6.32	39.18	6.11	29.17	10.23	40.00	6.84

Table 5 Students' mean ratings of attitude by gender (n =134)

	Males		Females	
	Mean	SD	Mean	SD
AMI	14.87	3.20	16.42	3.14
EML	23.06	6.13	21.29	5.47
TOMRA	37.94	8.66	37.71	7.78

Students' differences in attitude to mathematics inquiry

To answer this question, one-way between-groups analysis of variance was performed to explore the differences in the mean scores for students' ratings for mathematics inquiry (as measured by TOMRA) across their programmes of study. The results revealed a statistically significant difference at the $p < .05$ level in scores for the various programmes studied by the students, $F(4,129) = 7.513$, $p = .0001$.

Table 6 Students' attitude to mathematics inquiry by academic programme

Gender	n	Mean±SD	F value	*p* value	interpretation
H Econs	38	17.34±2.50.	7.513	0.000	sig
Business	17	16.65 ± 2.34			
Agric	38	15.11 ± 2.25			
Arts	21	13.33 ± 4.60			
Science	17	15.76 ± 3.03			

Post hoc tests for multiple comparisons, with Bonferroni, determined that Home Economics (M = 17.34, SD = 2.50) differed from Arts (M = 13.33, SD = 4.60) and Agriculture Science (M = 15.11, SD = 2.25). Business (M = 16.65, SD =2.34) differed from Arts (M = 13.33, SD = 4.60). All others appeared to have similar attitude towards mathematics inquiry as shown:

- Home economics and Business (p = 1.0)
- Home economics and Science (p = .714)
- Business and Agriculture Science (p = .779)
- Business and Science (p = 1.0)
- Agriculture Science and Arts (p = .239)
- Science and Arts (p =0 .110)

When the impact of gender was investigated, the independent t-test revealed a statistically significant difference between the scores of males and females (t value = -2.814, p value = .000). The summary of results (in Table 5) indicates that the scores of attitudes to mathematics inquiry for the females is higher than their male counterparts.

Table 7 Attitude to mathematics inquiry by gender (n=134)

Gender	n	Mean±SD	*t* value	*p* value	interpretation

Males	62	14.87±3.21	-2.814	0.006	sig
Female	72	16.42 ± 3.14			

Students' differences in enjoyment of mathematics lessons

One-way between-groups analysis of variance was performed to explore the differences in the mean scores for students' ratings for enjoyment of mathematics lessons (as measured by TOMRA) across their programmes of study. The test confirmed a statistically significant difference at the p < .05 level, existing between the five ratings (F (4,129) = 13.587, p = .0001). Post hoc test for multiple comparisons, with Bonferroni, determined that Arts (M = 15.83, SD = 6.73) differed statistically significantly (p < .05) from: Home Economics (M = 21.76, SD = 4.40); Business (M = 25.24, SD = 4.60); Agriculture science (M = 24.08, SD = 4.30); and Science (M = 24.24, SD = 4.80).

Table 8 Students' enjoyment of mathematics lessons by academic programme

Gender	n	Mean±SD	F value	*p* value	interpretation
H Econs	38	21.76±4.40.	13.587	0.000	sig
Business	17	25.24 ± 4.60			
Agric	38	24.08 ± 4.40			
Arts	21	15.83 ± 6.73			
Science	17	24.24 ± 4.80			

However, students of the following academic programmes appeared to have similar attitude towards enjoyment of mathematics lessons:

- Home economics and Business (p = 0.180)
- Home economics and Science (p = 0.904)
- Home economics and Agriculture Science (p = 0.441)
- Business and Agriculture Science (p = 1.0)
- Business and Science (p =1.0)
- Agriculture Science and Science (p = 1.0)

When the impact of gender was investigated, the independent t-test revealed a statistically significant difference between the scores of males (M = 23.06, SD = 6.13) and females (M = 21.29, SD = 5.47). Table 7 indicates that the score of enjoyment of mathematics lessons for the males is higher than their female counterparts.

Table 9 Enjoyment of mathematics lessons

Gender	n	Mean±SD	*t* value	*p* value	interpretation
Males	62	23.06±6.12	-2.814	0.006	sig
Female	72	21.29 ± 5.47			

Relationship between attitude to mathematics inquiry and enjoyment of mathematics lessons

To answer this question, the relationship between attitude to mathematics inquiry and enjoyment of mathematics lessons was examined with Pearson product-moment correlation coefficient. All preliminary analyses (tests of normality, linearity, and homoscedascity) were performed, which revealed no violation of any of the assumptions. The test confirmed that there was a strong, positive correlation between attitude to mathematics inquiry and enjoyment of mathematics lessons: $r = .584, n = 134, p < .000$, indicating a high level of mathematics inquiry (inquisitiveness) is associated with corresponding high level of enjoyment of mathematics lessons. It is revealed that attitude to mathematics inquiry accounted for 34.1 % of variance in students' enjoyment of mathematics lessons.

VI. DISCUSSIONS

As a critical variable determining how individuals respond to objects, people, subjects, and places (Ajzen, 1989), attitude of senior high school students to mathematics is essential to be determined. Determining students attitude to mathematics is important on some counts: first, it shows if a person is interested in mathematics or not; second, it influences their mathematics performance (Hattie, 2009); third, mathematics is said to filter students into STEM programmes (Blotnicky et al., 2018; Seo et al., 2019); and lastly, for teachers to action appropriate interventions. The overarching objective can then be to direct their attitude positively for their learning.

This study is quantitative method-oriented, focussing on high school students' attitude to mathematics inquiry and enjoyment of mathematics lessons, with reference to whether different academic programme students have similar or dissimilar attitude. Further, the study investigated the relationship between the two dimensions to attitude. The study reveals diverse results.

High school students' attitude towards mathematics

Consistent with earlier research results (e.g., Blackwier, 2016), this study results indicate, overall, that students hold attitude towards mathematics, but then it is moderate. This study found that males expressed relatively higher level of attitude to mathematics than the females, though both expressed a high attitude to mathematics. The students of some different academic programmes showed more attitude to mathematics than did others. The findings echoed with Blackwier's study that found the attitudes of boys of all ages more positive towards mathematics than the girls. Somewhat not assessed in this current study, Balckweir found that girls in Years 11 and 12 held more negative attitude towards mathematics. Blackweir developed an online instrument to assess the attitude of Australian secondary students towards mathematics, in two suburbs in Perth. Our findings also lend support to that of Etsey and Snetzler (1998). In their meta-analysis of 96 studies (n = 30490), a key conclusion drawn illustrates that gender differences exist in attitudes of students toward mathematics but are small; and that, males are more positive in terms of their attitudes to mathematics.

Literature has been quite inconsistent with the attitudes of males and females towards mathematics learning. For example, quite contrary to the above findings, Elçi (2017) – who compared males' attitude to mathematics with that of the females' – found a statistically significant difference between them (using a t-test) in favour of females. Thus, statistically, females' scores were higher than their male counterparts. Elçi's finding supports that of Guzel (2004), that illustrates that the attitude of female students towards mathematics is rather more positive than their male counterparts. Some other studies (e.g.: Mohamed & Waheed, 2011; Olufemi & James, 2014) reveal otherwise. They claimed that attitude towards mathematics of students is not dependent on gender – connoting that male students' attitudes to mathematics do not differ from that of the female students.

Regarding programme-level differences, our study found that students of Business, Science, Agricultural science, and Home economics (in order of magnitude in mean scores) expressed a high level of attitude to mathematics, except Arts students whose attitude was moderate. This finding is consistent with the finding of Kumar and González (2021). Their study, conducted in Bangrak–Thailand with 142 upper secondary students, confirmed differences in the programme-levels. Math-Science programme students were reported to have enjoyed a high level of mathematics lessons. However, Math-English students neither enjoyed a high nor low level of mathematics lessons. In Elçi's (2017) study, the ANOVA results revealed a statistically significant difference in the mean scores of students' attitudes to mathematics among the three programmes (mathematics, Science and Turkish). A pairwise comparison with Sidak multiple adjustment, confirmed that Science and mathematics differed.

We recognise that, students do show attitude to mathematics learning; gender-level differences as well as programme-level differences exist; and that we agree with Langat (2015) that teachers should determine carefully and support student interaction and style of instruction to enable fruitful knowledge transfer within the classroom. This can reduce, if not eliminating, the tendency of students to skive off mathematics lessons.

Differences in attitude to mathematics inquiry

The results revealed a statistically significant difference at the $p < .05$ level in scores for the various programmes studied by the students ($F(4,129) = 7.513$, $p = .0001$). This finding indicates that the attitude to mathematics inquiry held by the participating students, learning different programmes, was significantly different for some at least two academic programmes.

Added findings identified that the Home Economics students differed highly from Agricultural Science and Arts students in their attitude to mathematics inquiry. The students of Business studies tended to hold higher attitude to mathematics inquiry than their counterparts in Arts programme. There was evidence to suggest that the average programme-level effect is similar for the following programmes: Home economics and Business; Home economics and Science; Business and Agriculture Science; Business and Science; Agriculture Science and Arts; and Science and Arts.

The data also showed, by the independent t-test analysis, that the scores of the males and females were statistically significantly different (t value = -2.814, p value = .000), in favour of females. Thus, statistically, the scores proved that the females were somewhat highly mathematically inquisitive than their male counterparts. s to attitude. The study reveals diverse results.

Differences in enjoyment of mathematics lessons

The results obtained reveal that students of some academic programmes enjoyed mathematics lessons differently, as indicated by their ratings. This was confirmed by ANOVA test which resulted in a statistically significant difference ($F(4,129) = 13.587$, $p = .0001$), existing between the five academic programmes. Post hoc test, with Bonferroni, determined that Arts students differed statistically significantly ($p < .05$) from students of: Home Economics (mean = 21.76, sd = 4.40); Business (mean = 25.24, sd = 4.603); Agriculture science (mean = 24.08, sd = 4.40); and Science (mean = 24.24, sd = 4.80). The students who studied Home economics enjoyed mathematics lessons similarly as those who studied Business ($p = 0.180$), Science ($p = .904$), and Agriculture Science ($p = 0.441$). Similarly, Business and Agriculture Science students also enjoyed mathematics lessons in a similar manner ($p = 1.0$). Further, it was found that Business and Science students did not differ in their enjoyment of mathematics lessons ($p = 1.0$) and so did the students of Agricultural Science and Science ($p = 1.0$). The above findings, somehow, corroborate the findings of Kumar and González's (2021) study that found that the Upper Secondary Math-Science students differed significantly from their Math-English counterparts regarding their enjoyment of mathematics lessons.

Again, the independent t-test conducted in this present study revealed a statistically significant difference between the scores of males (mean = 23.06, sd = 6.13) and females (mean = 21.29, sd = 5.47). The score of enjoyment of mathematics lessons for the males was higher than their female counterparts. This finding, however, does not support the findings of Kaur and Prendergast (2021) that the scores of the males were not statistically significantly different from that of their female counterparts in terms of enjoying mathematics lessons. In spite of their results, the authors opined that the reflections of students, such as, "I like it", "It was enjoyable" and "I like my math class as this" (p. 10) confirmed that participants enjoyed mathematics lessons. Their work involved Indian students in a co-educational secondary school. The study explored the students' attitudes to enjoyment of mathematics and self-confidence, after they have been exposed to a short writing intervention. The students increased in their enjoyment of mathematics lessons (initial mean score = 34.79, final mean score = 39.82).

In another Australian study with the 8th graders, Narayan (2015) reported that more boys, as compared to girls, disagree that mathematics is boring. It has been reported in another study by Langat (2015, p. 37) that, a high percent of 83 were found to have enjoyed mathematics lessons (as against 11% who never enjoyed), 77% looked forward to mathematics lessons, 16% somewhat felt mathematics was boring as against a whopping 75% who felt otherwise.

Relationship between the attitude to mathematics inquiry and enjoyment of mathematics lessons

This study found a strong and positive correlation between attitude to mathematics inquiry and enjoyment of mathematics lessons: $r = .584, n = 134,\ p < .0001$. This indicates that a high level of mathematics inquiry is linked with corresponding high level of enjoying mathematics lessons. It is revealed that attitudes to mathematics inquiry explains 34.1% of variance in students' enjoyment of mathematics lessons. This finding connotes that if individuals are mathematically inquisitive, they will continue to enjoy their mathematics lessons. This finding supports Putwain et al's. (2018) findings that explored the give-and-take relationship that exist between academic enjoyment, boredom, and achievement of English primary school students (selected from 65 classrooms within 25 schools). These authors found that a higher mathematics lesson enjoyment and lower boredom predict larger consequent achievement and vice versa.

Parallel to the finding of this study, and that of Putwain et al. (2018), Langat (2015, p. 37) asserted that a student would always

enjoy learning mathematics lessons if he/she continues to like it and would all the time expect mathematics lessons. This finding echoed Schreiber (2000) and Hannula (2002) for whom good performance is always linked with positive attitude, and that, positive attitude would predict better student mathematics performance. Other researchers, such as Ma and Kishor (1997), opined that as long as students continue to like what they learn, their learning becomes effective and would perform better. It has been hypothesised that if individuals enjoy their subjects, it could help them to understand better, motivate them to learn, and become proficient in their subjects (Nyacomba, 2017).

Summary and conclusions

This study reports on an investigation into the attitude of first year senior high school students in Ghanaian context to determine their attitude to mathematics inquiry and enjoyment of mathematics lessons at academic programme levels. This was necessitated by the country's aim at looking to produce students who will become citizens capable of solving societal problems. The adequate sample size of 134 participating students in this investigation has offered a pretty good support base for effective evaluation of students' attitude. Descriptive analysis, one-way between group analysis of variance (ANOVA) and correlation analysis were conducted

Based on the following results obtained, we reckon that this study contributes to literature in first-year students' attitude to mathematics inquiry and enjoyment of mathematics lessons, in Ghanaian context. Specifically, they showed attitude to mathematics learning, generally; males expressed higher level of attitude to mathematics learning than did the females though both expressed high level of the construct; whilst some programme students have similar attitude, in terms of their mathematics inquisitiveness and mathematics lesson enjoyment, other students differ in these constructs at programme level. Data suggests female students were more mathematically inquisitive than were their male counterparts. The reverse results hold true for enjoying lessons in mathematics; that is, in favour of the males. Finally, their attitude to mathematics inquiry strongly and positively correlated their enjoying mathematics lessons. We agree, then, with Langat (2015) that teachers should determine carefully and support student interaction and style of instruction to enable fruitful knowledge transfer within the classroom. This can reduce, if not eliminating, the tendency of students to skive off mathematics lessons.

We recommend that the existence of high level of attitude to mathematics learning among the sampled first-year Ghanaian senior high school students, both at gender and programme levels, is a recipe for effective mathematical preparation of students to become problems solvers in society. Senior high school mathematics teachers need to be encouraged to use interactive inquiry-based mathematics instructions in their teaching practices to increase students' rate of enjoying lessons in mathematics. Particularly, their female students should be engaged more to develop fully their inquisitive attitude in mathematics. This, when ensured would not only get more of our female students' attention into male-dominated STEM (Science, technology, engineering, and mathematics) programmes and their related field of work, would also develop their aptitude to problem-solve.

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