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Positive attitudes toward mathematics among senior high school students in Cape Coast Metropolis

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ABSTRACT

The study involved 2,575 students selected through a combination of probability and non-probability sampling procedures. Explanatory sequential mixed methods design was used. Participants completed the Fennema-Sherman Mathematics Attitude Scales (FSMAS) to provide the quantitative data for the research. The qualitative data were gathered through interviews. The arithmetic mean from the survey data for each of the students was used to shortlist 140 students for focus group interviews. The findings revealed that some of the impetuses that drive the respondents' positive attitudes towards mathematics were mathematics as a compulsory subject, good teaching strategies by teachers, the utility of mathematics, career aspirations, and encouragement from parents, guardian or peers. The study recommended that stakeholders should encourage, enhance and promote these factors. Teachers, educators, and researchers are encouraged to dig deeper to unearth more of such factors.

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1. INTRODUCTION

The Ghanaian government has embraced technology, science, and mathematics as means for achieving national development [1], [2]. The fundamental goal of the Ghanaian mathematics curriculum is to allow all Ghanaian youth to acquire the mathematical abilities, insights, attitudes, and values that they will need to be successful in their chosen occupations and daily lives, which is a significant objective [1]. All children can learn mathematics, and all students need to study mathematics, is the underlying tenet of the programme. As a result, at the senior high school level, students are expected to acquire the necessary mathematical skills to apply their knowledge to solving practical problems and, secondly, to be well-prepared to pursue further education and related careers in mathematics, science, commerce, industry, and a variety of other professions.

The acquisition and use of fundamental mathematical knowledge and abilities are given a lot of attention in the curriculum. The mathematics curriculum is designed to give pupils the information, abilities, and attitudes necessary for success in this age of technological innovation [3]. Numbers and numeration, plane geometry, mensuration, algebra, statistics and probability, trigonometry, vectors, and transformation on a plane are the main topics covered in the senior high school mathematics curriculum. The curriculum has only recently been reviewed, and all Ghanaian students are expected to continue to place a high priority on learning mathematics. The new curriculum places a strong emphasis on a set of rigorous, globally benchmarked career and tertiary education requirements that students must master in order to pursue

postsecondary education, a career, or both [4]. This is due to the perception that mathematics achievement is essential for both personal and societal advancement.

However, stakeholders in the education sector have not been at ease in the last eleven years due to the fluctuations in performances of students at the West African Senior School Certificate Examination (WASSCE). A good number of students are unable to further their education due to their inability to obtain a credit pass in mathematics (where a credit pass means A_1 to C_6). Table 1 depicts the performance of students as reported by the General Resume of Chief Examiners' report (WAEC, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022).

Table 1. WASSCE results pass rate in mathematics from 2012 to 2021

Year	Results (%)
2012	49.9
2013	36.8
2014	32.4
2015	25.3
2016	32.8
2017	42.7
2018	38.3
2019	65.3
2020	65.7
2021	54.1
2022	61.4

Even though there has not been an excellent WASSCE results in mathematics in the last ten years, there is a need to ponder on what made it possible for those who recorded credit passes in those years. Some earlier studies have enumerated factors that challenge the teaching, learning, and outcomes in mathematics in senior high schools. These factors can be categorised as school-based, such as student/teacher ratio or class size and supervision; teacher factors, which include attitudes and beliefs, commitment, content knowledge, pedagogical knowledge, experience, and qualification; student factors, which include intelligence, interests, gender and early childhood learning; parental factors such as race, ethnicity, and social class; policy makers' factors, such as inadequacy or lack of textbooks, assessment practices, under staffing and curriculum [5]–[9]. There are also studies that have demonstrated that students' attitudes towards mathematics contribute to their mathematics performance, over and above personality and cognitive ability [10].

Hence, the testimonies of learners in particular can give crucial, first-hand evidence if the goal of any inquiry into learning outcomes is to improve learning [11], [12]. If students are to provide descriptions of their learning in any research, researchers should be more concerned about learners' perspectives regarding their experiences in classrooms and schools than just 'factual' testimony in the legal sense. Although these attitudes might not be considered acceptable proof in a court of law, they are an essential resource in an investigation aimed at enhancing learning. Moreover, educators and other math teachers [13] largely concur that students will perform better in mathematics if they enjoy it and that they will learn more successfully when they are enthusiastic in what they are learning. This assertion corroborated the position of [14] that a "positive attitude towards mathematics is thought to play an important role in causing students to learn mathematics" (p. 631). This might be the case because students' perceptions of mathematics and their participation in the subject are influenced by their attitude. When students were asked to rate their subjects in order of preference, the high achievers gave mathematics a much higher ranking than their peers, supporting [15] argument that they had a more positive attitude towards mathematics than underachievers. Additional research has shown that attitudes about mathematics are considerably and directly related to learners' achievement [10], [16]–[19]. Hence, for this study, positive attitudes of students were delved into to proffer evidence that are possibly responsible for these attitudes towards mathematics.

According to Hart [20], it takes a multidisciplinary approach to attitudes toward mathematics and characterises a person's attitudes toward mathematics as a more complicated reality, characterized by the feelings they have for mathematics, the ideas they have about it, and the way they act toward it. The learned propensity of a person to react favourably or unfavourably to a thing, situation, idea, or another person is referred to as attitude [21]. The definition by Hart [20] is more appealing for this study because it encompasses the students' emotional, cognitive, and behavioural aspects. Howe and Krosnick have assigned strength to attitudes [22]. These authors believe that the strength of one's attitude varies. The importance of attitudes in moulding thinking and action in different settings is measured by their strength. Some people have strong attitudes, while others have weak ones. Strong attitudes are those that have the greatest impact on

a person's ideas, intentions, and actions. Easy-to-change attitudes are weak and unlikely to influence behaviour. The attitudes that have the greatest influence on behaviour are the most difficult to alter.

Additionally, Kahveci [23] and other researchers have developed many instruments that they have used to gauge attitudes. Ajzen [24] suggests three behaviour-based measures. Personal commitment to the behaviour, self-reported behaviour, and observable acts taken by the individuals and noted by the investigator are some of them. Self-reported behaviour was used in this study since research [25], [26] has shown that common scaling methods like the Likert scale can be used to obtain congruence between attitudes and behaviour measurements. Hence, Kahveci's [23] adaptation of the Modified Fennema-Sherman Mathematics Attitude Scales (FSMAS) was used in this study.

Due to the problems researchers have in this relatively new field of study, including theories that are not yet fully formed, terminology that is employed inconsistently and differently, and a variety of research tools [27], [28], there are also numerous classifications of the sub-constructs of attitude. For instance, [22] suggested that three main groups of factors—self-interest, social identity, and values—generally impact individual attitudes. Confidence, beliefs in the value of mathematics and its practical application, and mathematical anxiety, according to Ashby [29], are additional factors that affect attitudes toward mathematics. On the other hand, according to Lim and Chapman [30], attitudes toward mathematics can be divided into three sub-constructs: i) Enjoyment of mathematics; ii) Self-confidence in mathematics; and iii) Value of mathematics.

The first sub-construct, enjoyment of mathematics, refers to the emotions, passions, and feelings that come with learning mathematics. Thus, enjoyment of mathematics refers to how much students love doing and learning mathematics [31]. This means that students who like mathematics are likely to spend more time with the subject. Consequently, they are likely to learn better, thereby recording higher performance. The second sub-construct, self-confidence, is based on students' conviction in their abilities to learn the subject [32]. Thus, when students are prepared to face mathematical obstacles, it boosts their academic performance. Meanwhile, students with low self-esteem easily give up the hope of achieving success when confronted with some challenges in computing numerical tasks; thus, resulting in low performance. The final sub-construct, value, refers to perceived usefulness of mathematics. This has to do with students' opinions of the importance of mathematics in real life, either currently or in the future, or both [32]. In the study conducted by Guy *et al*. [33], they discovered that the perceived usefulness of mathematics was a positive predictor of success in the subject. The ability to see how useful the subject is to the participants of their study (both then and in the future) may have played some role in the output they produced in the subject.

Furthermore, there are eight sub-constructs of attitude, according to the modified Fennema-Sherman Mathematics Attitude Scales. These are interest, social influence, value, perseverance, confidence, gender, enjoyment, and perceived personal ability. Six of the sub-constructs will converge into the three sub-constructs identified by Lim and Chapman [30], with the exception of the social influence and gender. The perceived personal ability and confidence will converge into self-confidence, enjoyment, interest, and perseverance will converge into the enjoyment of mathematics, and value is a stand-alone sub-construct. The three thematic categories of attitudes must be present before we can declare that an attitude exists. The belief that mathematics is easy to learn (that is, confidence or cognition), the desire to learn more mathematics (that is, value or behaviour), and a positive emotion (affective), such as feeling joyful in a mathematics classroom. This is otherwise known as the ABC model.

The ABC model of attitudes suggests that attitude has three components: affect, behaviour, and cognition. The three elements denote the verbs 'feel, do, and think'. The term 'affect' refers to a person's emotions and feelings about an attitude object. The term 'behaviour' denotes intentions, vocal declarations related to behaviour, and actual action. The term 'cognition' has to do with knowledge and beliefs. These three elements interact closely with one another and influence an individual's attitude toward an object. Thus, 'affect' is represented by eagerness, trust, and belief. The 'behaviour' is said to be an experience or value. Finally, 'cognition' is represented by knowledge, competence, or skill. This study, which follows the ABC paradigm, focuses on attitude factors such as students' self-confidence in their mathematical aptitude, mathematics enjoyment, and perceptions of mathematics' usefulness.

There have been differences in opinions among researchers regarding which of those sub-constructs is the core of attitude. Some researchers, for example, Bandura [34] opined that self-confidence of the individual to have a breakthrough in an activity will energise them to forge ahead despite all odds. Meanwhile, other researchers, for example, Elliot [35] indicate that self-confidence will generate no engagement with the task if the individuals do not value the activity. Nonetheless, the study of Lim and Chapman [36] discovered that within the construct of attitudes, self-confidence was the strongest correlate of achievement. This is in line with past findings [37] and suggested the importance of self-confidence in obtaining better mathematics results, both in the short and longer terms. It is not surprising that the government of Ghana has recently given recognition to the importance of attitude to learning in general, by

indicating the percentage of attitude that learners are expected to demonstrate as a result of their cumulative learning experiences in school [3].

Although there have been many studies that have investigated the attitudes of students to learning in general and to mathematics in particular [5]–[8], many of these studies did well in focusing on attitudes of students in general and concluded that negatvie attitudes were responsible for poor performances of students in mathematics. However, there is a need to think outside the box and unearth the reasons behind those students who possess positive attitudes towards the learning of mathematics, notwithsatnding the numerous challenges confronting their adventures. Hence, the purpose of this study is to investigate the secrets behind positive attitudes of senior high school students towards mathematics in the Cape Coast Metropolis. While affirming positive practices that promote mathematics teaching and learning, the results might provide insights on how to promote and incite positive changes in the attitudes of students in schools where there are negative attitudes towards the teaching and learning of mathematics. Furthermore, the lingering problem of not knowing exactly what can be done to improve the learning of mathematics may be brought at bay because knowing the secret of positive attitudes towards the learning of mathematics, from [11], [38] would mean opening rooms for more research into the characteristics of those positive attitudes. Invariably, once a positive attitude is formed, students' learning can be improved [17].

The following research question was formulated to guide the study: What are the secrets behind positive attitudes of eleventh graders towards the learning of mathematics? However, to answer this question, the following sub-questions were formulated: i) What are students' understanding of attitudes in relation to the learning of mathematics?; ii) How do students describe their experience with mathematics?; iii) How much do students like or dislike mathematics?; and iv) Why do student like or dislike mathematics?

2. RESEARCH METHOD

A sequential explanatory mixed methods research design was adopted in this study. That is, both quantitative (first to be used) and qualitative (as a follow-up) data were sequentially collected and analyzed. This is because attitudes are primarily measured by attitude scales that show whether attitudes are positive or negative. However, finding information about the attitudes of Ghanaian students, on the other hand, necessitates qualitative methodologies [39] which allow for self-reporting. This will give room for the research community to draw their own conclusions beyond what the researcher of this paper can produce. Thus, this paper will report mainly qualitative data. Nonetheless, the quantitative part of the design that was used for the survey helped to shortlist interviewees with positive attitudes for the qualitative data collection exercise.

Focus group interviews were employed to collect the data for the qualitative component of this study. Over 70% of the learners, 68% of whom were male and 32% of whom were female, were between the ages of 16 and 18. All of the traditional programmes, including general science, business, general arts, technical, home economics, and visual arts, were represented in the study with science and general arts having the highest representations (28% and 24%, respectively), while technical had the lowest presence (2%).

Four core subjects and four elective subjects are offered in all programmes. In addition to offering four elective subjects each, the core disciplines are core mathematics, English language, social studies, and integrated science. The optional combinations are different to accommodate the students' various future needs as well as chosen university programmes and national objectives. For instance, the general science programmes offer elective mathematics as well as physics, biology, and chemistry. The general arts programme provides either government, history, christian religious studies, economics, literature, and government as elective topics, or government, economics, French, or Twi (Ghanaian language). The business programme offers options in financial accounting, cost accounting, economics, business management, elective mathematics, economics, economics, and French. It also offers options in financial accounting, cost accounting, economics, and business management. General knowledge in arts, sculpture, ceramics, pottery, basketry, graphic design, textile/picture making, general knowledge in arts options, or leather works/jewelry, general knowledge in arts, graphic design, and picture making/economics are the elective subjects available for the visual arts programme. Home economics includes topics like food and nutrition, biology, living arrangements, and general knowledge of the arts, as well as topics like clothes, biology, living arrangements, and general knowledge of the arts. The technical programme also offers a variety of elective math courses and other courses in metal, car mechanics, welding, electricals, and other fields.

2.1. Instruments, samples and sampling techniques

A sample size of 3,342 students were randomly selected from among the ten participating schools, according to the table of sample sizes for research activities [40]. The researchers collected the sample frame

from each of the 10 schools, which was a list of the population from which students were chosen as the study's units. According to their class classification, which was based on the programme the students offered, the form two learners were selected. Different schools used different letters (A1, B4, S2) to represent the classroom groupings or categorization according to the programme or specialization of the student. For example, School I (SchI) used 2S1, 2S2, 2S3, 2S4, and 2S5 to represent her five general science classes, with 37 students in each of the classes. School G (SchG) uses 2Aa and 2Ac, comprising 54 and 57 students, respectively, to represent her two general art classes. To make selection in each of the schools, the representations (2A1, 2S2, 2Ac) of form two for each school were put together, and the required number of classes that added up to the sample size based on the recommendation of [40] were randomly selected.

Although, intact classes were chosen to prevent interfering with the students' academic schedules, the response rate of the participants was 77% (that is, 2575 students). The Fennema-Sherman Mathematics Attitude Scales (FSMAS) with high reliability ($.777 \leq \alpha \leq .942$) was used to collect the quantitative data. Participants were assigned to complete the FSMAS. The arithmetic mean from the survey data for each of the students was arranged in ascending order, and 250 students from the higher end of the continuum [21] were shortlisted for the interview (i.e. 250 students from the upper bounds). These represent those with a strong positive attitude towards the learning of mathematics. Volunteers were solicited from among the 250 students. Consequently, 170 students volunteered to be interviewed, but only 140 (79% males and 21% females) participated in the interview. The interview guides contained four items, namely: i) What is your understanding of attitudes in relation to the learning of mathematics?; ii) How would you describe your experience with mathematics?; iii) Do you like mathematics?; and iv) Why do you like mathematics? The instruments were made available to four senior mathematics education scholars and were pilot-tested.

2.2. Pilot testing of the instruments

Two instruments were used in this study. They were an interview guide, and a questionnaire. There were three graduates who just completed their service year at the researcher's department were specially trained and financially compensated to assist with data collection (while they were waiting to be posted by the government to teach at senior high schools).

The semi-structured focus group interviews took place on three occasions. Each attempt was an improvement over the previous attempt and took place in three different senior high schools, which were outside of the Cape Coast Metropolis. The first and second attempts engaged 30 and 25 students, respectively. The last attempt engaged 20 students, and the interview lasted for 60 minutes. During the interview, the lead interviewer raised the questions, and while voices were tape recorded, both interviewers noted important points in the code books. After each interview, the researchers compared notes and reconcile outstanding ideas. The information gathered in answer to the interview questions was qualitatively analysed utilizing recurrent themes. Despite the author's intentions, several preset codes were discovered while conducting a data analysis [41]. This led to the usage of both developing and predefined codes.

The analysis was performed manually and was divided into stages. The initial step was familiarization with the data, which required transcribing the data so that textual information was documented as accurately as possible. The transcriptions were then read aloud several times as the writers made notes about the noteworthy details. The second stage involved coding the data and identifying the verbal statements that fit each code. The third stage required gathering all pertinent data extracts inside the determined topics, which were organized using a table, and categorizing various codes into the developing themes. The themes were examined in the fourth step to determine how they related to the data set. The topics are categorized into several subjects in the fifth step using the interview questions as a guide. The final step entails the extraction of verbal expressions to support the determined attitudes-related components [41]. The coding of the data was done by four coders. As a result, there was an inter-coder agreement wherein three or four coders concurred on the codes to be applied to the same text passages. The majority opinion was used when there was a disagreement over how a particular section should be coded.

2.3. Interview

After the analysis of the pilot test of the instrument a checklist based on the common themes was prepared, and it was used together with an interview guide. All the interviews were recorded. Hence, when the lead interviewer asks a question, the companion ticks the checklist based on the response given by the student. Consequently, for the main study, an interview guide, a checklist, a tape recorder, and a code book for a backup were used. The interviews took place in each of the ten selected schools with an average of 14 students in a school. In addition, both the interviewers and the interviewees sat in circles. The seats were coded for easy identification of the students' programmes of study. Nonetheless, the analysis was combined for ease of reporting. The frequency of the responses was counted, giving rise to frequency counts and percentages. However, because the respondents gave multiple responses the sum or percentage sum is

meaningless. Each interview took 60 minutes on average and was managed by two interviewers. Each individual school was assigned an alphabet (A to J), and each student was numbered St_1, St_2, St_3, …, for example, the code, StC_2, means 'student 2 from school C'.

3. RESULTS AND DISCUSSION

3.1. Students' understanding of attitudes

The students were asked about their understanding of attitudes in relation to the learning of mathematics. As many as 100 (71%) of the 140 students interviewed saw it to be about their responses, dispositions, or reactions to mathematics, 106 (76%) of them saw it as the importance they attached to mathematics, 12 (9%) of the students saw it as being about their opinions or behaviour towards mathematics. About 50 (36%) of the respondents indicated that attitude has to do with the level of their confidence in mathematics as well as the value they attach to mathematics. From their responses, it could be established that the students were aware of their attitudes towards mathematics as well as the implications of such attitudes. For example, one student (StB_1) said, "*attitude is how I behave towards somebody or something or subject e.g., math, …like whether in good way or bad way*". The lead interviewer probed further how the respondent behaves towards mathematics and whether it is in a good way or a bad way; StB_1 "*in a good way…except that I smile nicely at my teacher whenever I sense I am 'in trouble' of being called to answer question in class. This helps to make him move his attention to someone else*". "*Why do you do that*," the interviewer asked, StB_1 responded, "*I just do not want to be embarrassed openly in the class, but I work very hard on my own*". Student (StC_2) declared "*my attitude is determined by my classroom environment. I try to be friendly with the teacher so that I can have good relationship with math. 'I also attend extra lessons with the teacher to catch up*". Another student (StD_1) claimed, "*attitude is how disposed I am to math. I can say I am well disposed*". The submission of student (StC_2) shows that good teacher-student relationship could promote good attitude to learning. This may eventually result in good academic achievement. This submission is in line with the findings of [42], [43] that established in their studies that teacher-student relationships positively predict the academic achievement of students. Hence, teachers should be approachable to facilitate easy access to them by their students. In addition, they should not be deceived by pleasant countenance from students as evident in StB_1 submission.

3.2. Experiences of students with mathematics

The students were asked to describe their experiences with mathematics. Their responses were grouped into three major themes: average experiences such as 'fine' 'somehow', 'not bad' 'no choice', 'no idea'; positive experiences such as 'interesting', 'awesome', 'great', 'stimulating', 'fascinating'; negative experiences such as 'difficult', 'confusing', 'bad' 'nasty', 'discouraging'. About 20 students (14%) have positive experiences, 119 (85%) have average experiences, while one (1%) have negative experience. These responses revealed that most of the students have had good experiences with mathematics, with the exception of a few students whose experiences could neither be classified as good nor bad. For example, Student (StF_3) declared "*I have no choice but to learn math*". The interviewer interrupted, by asking the student, "*How do you mean?*", (StF_3) responded, "*Because I see math as a problem, I always attend extra lessons in the subject. I always need to work hard in the subject…although I always do well, the success in math for me comes with tears. Because I am afraid of failing math, I forced myself to learn math against my wish. I am determined to make A1 (credit) in math*".

Although student (StF_3) was able to manage their fears of learning mathematics with the determination to succeed, researchers [44], [45] discovered that fear of failure could cripple some students from attempting to learn mathematics or lead to learned helplessness. Thus, as teachers and educators, in agreement with [46] we should create an environment that helps to undermine students' fear of failure. Furthermore, student (StB_1) declared, "*My experience is discouraging. I work hard following steps in textbooks ...my teacher should mark my work and indicate what I did wrong, instead of crossing out only my answer . . . my efforts should count*". The position of student (StB_1) calls for analytic rubric marking instead of a holistic rubric. According to Burkhardt and Swan [47] analytic rubric marking increases openness and objectivity. Furthermore, some researchers believe that engaging students in self-assessment can boost their confidence in their own abilities [48], [49]. Hence, teachers may need to use comments to accompany their marking for their assessment to be effective.

Student (StA_3) stated "*my experience is awesome*"; Interviewer: Can you please explain what made your experience awesome? (StA_3) responded "*my teacher acknowledged my contributions in class, he said he had learnt from me. He made photocopy of some of the reading materials from my long vacation lessons and went through my lesson exercise book to see what I was taught. I was happy he identified with my learning*". A further probe into (StA_3) experiences revealed that the teacher devoted some of their time to finding out

how their students' vacation was spent, and particular attention was paid to the mathematics content taught by vacation teachers with the intention of integrating some of the approaches where applicable to ensure continuity. (StD_1) indicated that their experience is stimulating "*…I already learnt most of the topics during the long vacation, prior to our resumption and I helped my friends as well while in school*".

Although there were complaints from some of the respondents based on the shared experiences, these group of students were seen to be making effort to learn mathematics. The outstanding contributions the extract from the interviews is making is constant practicing by the students promote the right attitude and confidence in learning. For example, attending vacation lessons increase the length of time spent by the students in the learning of mathematics.

However, the school mathematics teacher may need to show interest in what their students learnt during vacations as a way of authenticating the work done or encouraging the students. Where possible, integrating some of the approaches or methods used by the lesson teachers might help ensure continuity of their students' learning. In addition, reviewing students' work or exercises (StB_1), step by step, might help mathematics teachers identify errors and misconceptions and proffer solution.

3.3. Liking or disliking mathematics

The respondents were asked to indicate whether they like or dislike mathematics. Although this may not look like a good interview question, nonetheless, the item helped to make a connection between the survey results and the focus group interviews. Their responses were clarified under the two themes of 'yes' or 'no'. About 136 (97%) answered in the affirmative that they like mathematics while four (3%) indicated that although they do not dislike mathematics, they have some challenges that make it difficult for them to declare their stand on mathematics. For example, (StH_1) submitted, "*I feared to think that I will one day write WASSCE (national examination) because whenever I see any WAEC past questions (Essay section) I wonder what it was all about*". The second student (StH_6) stated, "*Learning math bring joy if you succeed but pains if you don't…great joy within me whenever I succeeded in math… unfortunately my teacher wouldn't acknowledge me because I always score less than half of the total marks…*". Another student, (StD_5), indicated, "*I like math but I wish it is more practical like Visual Arts, Home Economics, etc*". Furthermore, (StG_6), said, "*I like math but it is too abstract unlike my Geography that is about my environment*". About 30 (out of the 136) students that claimed they 'like' mathematics expressed that the subject is too abstract. They wish for practical ways of delivery and assessment from their teachers.

The submissions by the students (i.e., StH_1 and StH_6) revealed that although the students had a strong positive attitude (from the survey), fear of examinations and lack of motivation hinder them from experiencing the joy that comes from the learning of Mathematics. This may indicate that absence of fear and/or presence of motivation may help to promote positive attitude towards the learning of mathematics [44]. Therefore, there is need for teachers to be more practical in their teaching and to continuously encourage their students, irrespective of whether they are smart or not in mathematics. The fact that they are present in mathematics class and made some efforts means that some learning must have taken place. Seeking for immediate observable behavioural change in students may exclude slow learners who genuinely have the talent to learning mathematics. Furthermore, school management in collaboration with mathematics teachers should identify and counsel students who have phobia for examinations.

3.4. Reasons for liking or disliking mathematics

Subsequently, the students were asked to state reasons for liking or disliking mathematics. The responses from those who like mathematics were varied. They range from the utility of mathematics, desire to pass the national examination (which will help higher learning, useful for future career aspirations), through personal satisfaction, encouragement from parents, guardian or peers, inspiration from role models, good teaching strategies by teachers, study group support, the feeling of being exceptional, to the feeling of having no choice, since the subject is compulsory among other students. One of the interviewees (StH_5) asked "*What is life, without mathematics? Mathematics is used in our daily life... Mathematics is used in the preparation of even our food. I like math, but learning it is the problem…*". The responses were put into five themes and discussed. Table 2 presents the five themes as depicted by the participants' responses.

Table 2. Reasons for the 'like' of mathematics by the participants

Themes	Samples
Mathematics is a compulsory subject	Mathematics as a compulsory subject
	Mathematics relatedness to other field of study
	Gain admission
Career aspirations	Further career in mathematics related programme
	Management of resources
	Banking negotiations
	Billing customers in business proposals
Good teaching strategies by teachers	Giving students room to express their views
	Patient from mathematics teachers
Utility of the subject	Day-to-day application of mathematics
	Time management
	Critical thinking
Encouragement from parents, guardians, or peers	Encouragement from loved ones
	Support from peers
	Group work
	Teacher-student relationship
	Role models' inspiration

3.4.1. Mathematics is a compulsory subject

Science and business students believe mathematics helps them in other subjects like physics, chemistry, and accounting, while technical students claim that without mathematics, there would be nothing like technical drawing. A student (StA_1) said, "*it is a compulsory subject. I have to learn math, whether I like it or not…*". Student (StA_1) was questioned further, if mathematics was not to be a compulsory subject, would you have offered the subject? The student responded, "*yes I would but my math teacher should be a lot more practical and more patient*". The demand by students (StA_1) for their teachers to be more practical when teaching mathematics supports [50] position that educational institutions can only respond to labour market needs by integrating science, technology, engineering, and mathematics (STEM). Unfortunately, there is hardly any practical advice to teachers on how these capabilities can be promoted. Another student (StE_3) claimed, "*I have no option than to learn math for me to gain admission into university for a programme of my choice. I must have A1 (credit) in math…*".

Student StI_1 claimed, "*I just must do well in mathematics to make my parents proud. It is compulsory in my family to pass math*". Another student, (StA_4), said, "*I always learn math because no math means no admission to university*". When the same question was posed to other students, 30 out of the 140 students, despite their strong positive attitudes to mathematics declined to have any relationship with mathematics if it were not a compulsory subject. This suggests that some of the students '*like*' mathematics because they felt obliged to do so. That may explain their struggle with the subject. They do not enjoy learning the subject, rather, the value of mathematics and their ego propel them to learn the subject.

3.4.2. Career aspirations

With regards to future endeavours, some participants believe that their achievement in mathematics is linked to their career aspirations. For example, (StD_5) stated that "*It will help me to further my career in mathematics-related programmes as well as gain admission into university*". Meanwhile, (StH_5) responded: "*Mathematics would be useful for me in the future as it will help me with the management of resources, like calculating how many wedding cakes I can bake from 25kg of flour,…., in banking negotiations*". Another student (StC_4) claimed "*it would help me with business activities like calculating profit and adding it to the cost of materials before billing customers in a business proposal*". Thus, teachers could take advantage of the future aspirations of students while teaching mathematics by making links between the two.

3.4.3. Good teaching strategies by teachers

Lessons are more engaging when the teacher teaches for understanding. This is critical for students' participation in mathematics. Listening to the students, (StI_3) expressed that, "*the opportunity to convey my views in class helps me to retain knowledge gained or improve my level of learning, helps to correct misconceptions, helps to remember things learnt while writing examinations*". Another student claimed, "*I enjoy math because our teacher is patient and understanding*". In addition, a student (StF_4) said, "*... Our 'master' teaches well...*,". Again, another student retorted, "*I love math since we have a nice teacher, she allows me explain how I understand what she teaches and also allows me to ask questions when I do not understand*". This means that teachers who use effective teaching methods coupled with an excellent demeanor are likely to promote learning [43].

3.4.4. Utility of the subject

Some interviewees indicated they liked mathematics because it could be utilized in real-life situations. They claimed that the majority of their daily activities were centred on mathematics. For example, a student (StI_1) stated "*Irrespective of the challenges I face in mathematics, it is useful to me in my day-to-day activities. These include helping our illiterate parents run their day-to-day businesses. It also helps me to understand other subjects…*". Other students (StH_2) stated that *"Mathematics helps me think very quickly when buying things in the market*", and (StG_1) indicated that "*it helps me manage my time well when writing an examination because I share the time among the questions to be answered*", and (StB_2) that "*I am able to organize my daily activities well using math because I give proportional time to each activity depending on the importance of the activity*". Likewise, StA_1 said "*I use math a lot. It saves me time and embarrassment when I go to shopping mall. I always estimate the sum of the cost of items that I pick before going to the counter to pay. I also compare the weight (gram) of the items before making my choice. I learnt this from a movie that I watched*".

Thus, the usefulness of mathematics on a daily basis forms the basis of students' likeness of the subject. This confirmed the position of [51] that the benefit attributed to an object predisposes an individual to take further action in favour of the object. Consequently, teachers could establish a relationship between mathematics and its utility while teaching.

3.4.5. Encouragement from parents, guardian, or peers

The participants stated that they enjoy mathematics because of the encouragement and assistance they have gotten from their peers, educators, and parents. Students require assistance when they are having trouble answering a mathematical problem. Some resolve to work in groups, thereby helping one another. For example, one student (StE4), expressed their situation "*I cannot learn math all by myself. I always have to consult someone while learning, but it stays after all*". This student's (StE_4) experience supports [52] who argues that group work or peer learning promotes cognitive restructuring that leads to learning. Another student claimed that "*my teachers and parents always say that mathematics demands more time than other subjects, hence I should devote myself to it. Now, I spend more time learning math than before. I score higher nowi*". This narration gives support to some of the studies [53], [54] on the influence of parents, teachers, and role models on the learning of children or students. This means that it is everyone's responsibility to support the learning of the future leaders. (StI_1) claimed, "*My interaction with my teacher promotes my learning in several ways. The teacher gets to know my weaknesses...This boosts my confidence level. Consulting with teachers outside the lesson periods also help me better*".

Other students stated that they liked mathematics because of their role models' inspiration, the feeling of being exceptional among their peers when they do well in the subject, and personal satisfaction or enjoyment of the subject. For example, (StA_3) "*My role models play a significant role in motivating me to learning mathematics as I always want to excel like them. This goes a long way to make me love mathematics*". Lastly, (StJ_4) claimed, "*since I joined a mathematics study group, I have improved,…, my teacher rush through solution all the time but working in group help me to go at my pace and to seek for help immediately. I am one of the best students in math in my class, at the moment*". Student (StJ_6), indicated, "*I used to fall asleep when solving math, or abandon difficult math problems but working in group help me to remain focus, because I see others working and they help me when I am stuck*". This implies that teachers, parents, role models, and peers are crucial in building students' positive attitudes towards mathematics [52]–[54].

4. CONCLUSION

The study lends support to the mixed methods explanatory sequential approach. The clarity produced during the interviews (e.g., the data items from StH_1 and StH_6) would have been lost if only survey was used. Secondly, it was revealed that although the students in this study have strong positive attitude towards the learning of mathematics, they are faced with some challenges. Nonetheless, they persisted in their learning of the subject because they valued mathematics for the utility of the subject, their career aspirations, or admission into higher institutions of learning. This is in line with the theory of planned behaviour, which indicates how hard people are willing to sacrifice to perform activities they believe will bring desirable outcomes. Thirdly, the closeness or proximity of some of the students to mathematics, evident in their vacation extra lessons, seems to boost their confidence. Consequently, since attitude is a predictor of success, the students are likely to achieve better results in mathematics. Fourthly, the findings also affirm the findings of some earlier studies on the beliefs of students about the relevance of mathematics in real life. If students thought that mathematics might be used in their future life, this might change their appreciation of mathematics and their commitment to mathematical tasks. Furthermore, reliance on national examination results continue to constitute obstacles to the enjoyment associated with the learning of mathematics. The

data items from some of the students (e.g., StD_5, StG_6) in this study confirmed the earlier findings of some researchers that the way the subject is assessed through time-written examination with no connections between classroom mathematics and real-life applications hinders the attainment of high-quality mathematics education as stipulated in the mathematics curriculum. Finally, study groups afford students the opportunity to discuss mathematics, ask each other questions about the material at hand, encourage the weary ones among them and provide feedback where necessary without intimidation. This is in line with the finding of some studies that friendship is necessary for academic success.

Each school, classroom, or set of students is unique. Thus, teachers should endeavour to find out how students in their classroom use mathematics and promote such adventures while teaching. Promoting classroom collaboration may help students at their level to open up and receive help where necessary from one another. Sampling the opinions of students at the beginning of every academic year before teaching mathematics could create an opportunity for teachers to come to terms with their students' expectations and maneuver their teachings to meet those expectations. Intermittently, the use of an "add comment" box in the classroom for students to drop anonymous notes could help the teacher gather information and consequently design helpful strategies. Furthermore, it may be interesting to find out in future research, the percentage of junior high students that may be interested in learning mathematics at the senior high level if mathematics is no longer compulsory for admissions into higher institutions of learning.

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