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Influence of Personal, Motivational and Learning Environment Factors on Students' Attitudes toward Mathematic

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Abstract

This study uses the self-determination theory to explore how personal characteristics, motivation and learning environment influence students' attitudes toward the learning of mathematics. The study adopted a sequential mixed methods design, with 360 students from 24 schools, constituting the sample for the study. The results revealed that in general, students have positive attitudes toward the learning of mathematics, and this could be attributed to the utilitarian motive of mathematics and its importance in daily life. Pearson Moment Correlation and independent T-test analysis were used to ascertain if there is any relationship between students' attitudes toward mathematics and their academic performance and the relationship between performance and school location. Also, the results from the interviews revealed a direct relationship between personal characteristics, motivation, learning environment and students' attitudes toward mathematics, as motivated students, and experience positive learning environments performed better. Based on the findings, we recommend that teachers and educational authorities ought to be innovative in using creative approaches that will motivate students in developing a more positive attitude toward the learning of mathematics as this is very crucial in our quest for improving students' performance in mathematics.

Introduction

Providing sufficient opportunities for students to learn has over the years become the hallmark of most educational systems and reforms. In this era of globalisation and internationalisation and with the shift from traditional instructional practices to a learning paradigm that trains students to be creative thinkers, it has become generally accepted that understanding the way students learn has become a critical factor in our quest for educational improvement (Acharya, 2002). Mathematics plays a crucial role in our day-to-day lives and it is for this reason that it is a core component in the school curricula in most countries. As an engine to automobiles, so is mathematics the moving force to all the fields in the educational system, especially with regards to the sciences and this technological age. Acharya further added that to achieve the desired learning outcome; there is the need to provide teaching and learning counselling interventions that are compatible with students' learning styles and more especially motivating students to develop an interest in subjects like mathematics which continues to be the most abstract and challenging subject in the school curriculum. Students' achievement in mathematics is

undoubtedly a much-discussed and worrying subject to educators, governments, parents and other stakeholders all over the world of which Ghana (Poku, 2019, Ampadu & Danso, 2018) is no exception. Mathematics is perceived to be a difficult subject in Ghana like in most other countries and most students have often registered their dislike and disinterest in mathematics in the course of their education (Poku, 2019).

Sam (2002) postulates the daunting and incapable attitudes of many students concerning mathematical ideas and the learning of mathematics in general, and these kinds of perceptions do not only affect students learning experiences but also their academic performance as it affects their mathematical mindset. Such students normally see themselves as not mentally fit to do well in mathematics or solve mathematical problems. According to Aguilar et al. (2012), perception and beliefs in respect to students learning of mathematics can be traced back to the individual learner's existing events, experiences or knowledge as well as the societal perception of the subject. The teaching and learning of mathematics have been a major concern to the Ghanaian government and educators in the country at large. Anku (2008) posited how the government and educators had initiated policies to make the teaching and learning of mathematics more enjoyable to students by helping students develop the mathematical mindset needed to excel in mathematics.

It has therefore contributed to major reforms in the educational curriculum in September 2019, which places much concentration on literacy (English), Numeracy (Mathematics) and Technology. The government's quest to improve teaching and learning has contributed greatly in initiatives such as the upgrading of teacher training colleges offering Cert 'A' then to Collages of Education which offered diplomas and now offering degree programs, the infrastructural projects aimed at attaining no school under trees, capitation grants, and school feeding programme. Lamb and Fullarton (2002) attribute mathematics teaching and learning to three interrelated factors personal, home and school and classroom related factors. They further opined the personal factor to rely on students' beliefs and attitudes as well as the willingness and preparedness exhibited by the student to learn. Therefore, an improvement in mathematics performance aside from all other factors is very much dependent on students' attitudes toward the learning of mathematics as a subject (Anthony & Walshaw, 2007; Kele & Sharma, 2014). That is to say, despite the important role that the other related factors play in shaping students thinking and learning, the individual learner's personal factors have a greater impact on their mathematical mindset which affect their dispositions and attitudes toward mathematics.

Problem Statement

Students' poor performance in mathematics in both national and international assessments has been a major concern globally, but most notably in Ghana judging from performances recorded in recent times locally and internationally. For example, the United Nations Childrens' Fund (UNICEF) and Ghana government collaborated National Education Assessment 2013 results revealed a lagged in grade expectation in mathematics performance of as low as 20% proficiency in mathematics for basics 2, 3 and 6 (Ministry of Education, 2013) and a similar performance in 2016 National Education Assessment (Ministry of Education, 2016). Also, in the BECE 2008 and 2010, students, poor performance was evident as over thirty-eight public schools recorded a zero percent pass rate. Poor performance in mathematics was again unearthed in the 2011 BECE (Chief Examiners Report, 2011).

Internationally, Trends in International Mathematics and Science Studies (TIMSS) equally graded Ghana poorly in terms of performance (Anamoah-Mensah & Mereku, 2005; Anamuah-Mensah, et al., 2008; Butakor, Ampadu, & Cole, 2017). For example, TIMSS 2011 results indicated that the performance of Ghanaian students was among the lowest. The substantive issues remain as to what has resulted in the poor performance of students in mathematics at both the national and international levels. Literature has identified various interrelated variables ranging from personal factors, teacher-teaching factors, school and home environment factors, peers' factors among many others as significantly influencing students' attitude in the study of mathematics (Mohamed & Waheed, 2011; Fraser & Kahle, 2007; Singh et al., 2002). However, as discussed above, the individual learner's mathematical mindset and personal characteristics as well as how they perceive the learning environment can have a greater impact on their attitudes and achievement. The present study, therefore, seeks to ascertain the kind of attitudes that students have toward the learning of mathematics, with emphasis on how personal, motivational and the learning environment influence students' attitudes, learning experiences and performance in mathematics.

Research Questions

As highlighted above, the purpose of this study is to examine how students' personal, motivational and learning environment factors influence their attitudes toward mathematics and learning experiences. It also seeks to investigate how students' attitudes influence their mathematics performance and if there is any difference between school location and students' performance. The following research questions guide the present study;

1. What characterises students' attitudes toward the learning of mathematics?
2. What is the relationship between students' attitudes toward the learning of mathematics and their achievement?
3. How do students' personal, motivation, and learning environment affect their attitudes toward mathematics?

Rationale for Study

The results from the study will provide first-hand information to assist educators in understanding how the perception of their students' attitudes have influenced their teaching in the classroom and the performance of the students. The results from the study will also assist managers and planners of educational institutions in putting up measures and methods to improve teaching and learning in general for better results. Again, the research will serve as reference material or document for teachers, students, government, other stakeholders and the general public in any other study which will fall under the domain of this particular study.

Theoretical Framework and Empirical Studies

Attitudes and Mathematics Achievement

There are a plethora of different educational challenges, more especially in the learning of mathematics, as evidenced in the literature. These challenges have been categorized into personal, home, school, and curriculum-related factors, and students face one or many of these challenges in their learning process. Despite the many

challenges that most students go through when learning mathematics, the individual student's attitude, mindset and motivation have been seen to have a greater impact on students' achievements in mathematics and their educational achievements in general. According to Dowker et al. (2019) review of relevant literature show that "mathematical ability is dependent not only on cognitive abilities such as IQ and working memory but also on emotional factors and attitudes toward mathematics" (p. 212). The concept of attitudes has been defined from different perspectives. For example, according to Kibrislioglu (2015) attitudes toward mathematics can be considered as the individual student's like or dislike of the subject or his/her willingness to engage or not to engage in mathematical activities. Kibrislioglu added that the individual student's attitudes toward mathematics could be considered as the belief that one is good or bad at mathematics. Tahar et al. (2010) on their part also defined attitude as the learner developing a positive or negative emotional disposition towards mathematics based on their mathematical mindsets, societal perceptions and dispositions.

It is evident from the literature that there is a direct relationship between students' attitudes and their performance in mathematics. For example, Singh et al. (2002) examined mathematics and science achievement among 8th-grade students and established that students' experiences, motivation and engagement in mathematics classrooms have a significant relationship with their interest, which also influences their achievement in mathematics. They further argued that "attitudinal and affective variables such as self-concepts, confidence in learning mathematics…interests and motivation have emerged as salient predictors of achievement in mathematics" (p. 324). Similarly, Mensah, Okyere and Kuranchie (2013) in their study, examined students' attitudes toward mathematics and their performance in Ghana and established a significant positive correlation between students' attitudes and performance. However, Krinzinger, Kaufmann, and Willmes (2009) and Dowker, Bennett, and Smith (2012) in their studies found no statistical difference between students' attitudes and performance in mathematics.

Ampofo (2019) examined the relationship between pre-service teachers' mathematics self-efficacy and their mathematics achievement in Ghana, also established a strong positive correlation between the pre-service teachers' self-efficacy in mathematics and their achievement in mathematics. Peteros et al. (2019) in their study also established that students' attitudes toward mathematics have a more significant impact on affecting their academic achievement. From the above discussions despite the works of Krinzinger et al. (2009) and Dowker et al. (2012) finding no relationship between students' attitudes and performance, the majority of the literature under review have established a positive correlation. However, studies like Krinzinger et al. (2009) suggests that in most cases primary school children's attitudes to mathematics tend to be positive, but that they deteriorate with age during childhood and adolescence. It is therefore imperative that in our quest for improving students' performance in mathematics and encouraging students' active participation in mathematics and science-related subjects, the issue of students' attitudes toward mathematics should be paramount.

Mathematics Learning Environments and Attitudes

The term learning environment has been explored from different perspectives. According to Afari et al. (2013) learning environments are the "psychological or emotional conditions of the classroom as well as the social and

cultural influences that are present" (p. 132). Akey (2006) established a series of elements of the school environment (teacher support, student interaction and student expectations) that are primarily related to students' attitudes, behaviour and achievement in mathematics and learning in general. The classroom learning environment plays a critical role in enhancing teaching and learning. Since students have different learning styles and ability levels, so does their learning environment preferences differ? According to Seidel (2006) "students with high knowledge, interest and self-concept of ability might be more likely to perceive a given learning environment as more supportive than students with more 'challenging' characteristics" (p. 254). Teachers' ability to promote an enabling learning atmosphere continues to be a significant challenge in most classrooms, even though such an environment is desirable for effective teaching and learning (Horsman, 2004).

Afari et al. (2013) in their analysis of classroom environment and students' achievement established that there is a direct relationship between the quality of the classroom environment and individual students' learning experiences and mathematics achievement. For the current study, the classroom learning environment is considered as the prevailing circumstances of a classroom which is shaped by teacher-student and student-student relationships, actions and inactions. Together with the need for positive attitudes toward mathematics in schools, the importance of an enabling learning environment for changing attitudes toward mathematics and improving students' achievements has gained attention in recent years (e.g., Akey, 2006; Maat and Zakaria, 2010; Vandecandelaere, Speybroeck, Vanlaar, De Fraine, and Van Damme, 2012).

Vandecandelaere, et al. (2012) in examining the association between students' perception of the learning environment and their mathematics attitude established that the learning environment plays a significant role in the enjoyment of students' attitudes toward mathematics. Similarly, a study by Maat and Zakaria (2010) also revealed a strong correlation between the classroom learning environment and students' attitudes toward mathematics. Fraser and Kahle (2007) in their research also established that the learning environment at home, school and classroom accounted for a significant variance in students' attitudes which also influence their performance and interest in pursuing mathematics. In all these studies, the authors established that students who are more in tune with the learning environment and whose teachers are more optimistic tend to adopt a more positive attitude toward mathematics. There was also a strong correlation between such students' academic achievement and the learning environment and attitudes toward mathematics.

Motivation on Attitudes toward Mathematics

Motivation is a critical element that influences students' attitudes, interests and academic success. Many studies have established that motivation related variables are the main predictors of attitudes toward mathematics (e.g., Mata et al., 2012; Singh et al., 2002; Oyedeji, 2017). According to Oyedeii (ibid) "motivation has been shown consistently to strengthen the ability to concentrate on schoolwork and consequently with achievement, while their absence is associated with disengagement from learning behaviours and failure in schoolwork" (p.278). Students are motivated intrinsically and extrinsically, and students need both forms of motivation to engage in schoolwork and excel in their academic endeavours. Intrinsically motivated students have an inner force that motivates them to learn because they are interested in learning, and they enjoy the learning process (Adamma et

al., 2018). Extrinsically motivated students engage in learning for external rewards, such as teacher and peer approval and good grades, and this kind of motivation is good to help students who have not yet developed the intrinsic motivation needed for the learning of a particular concept (Mueller et al., 2011).

Oyedeji (2017) examining the impact of students' motivational elements on their attitudes toward mathematics, it was discovered that intrinsic motivation had a stronger and more positive association with students' attitudes toward mathematics. His research also discovered that intrinsic drive had the greatest impact on predicting students' attitudes. This suggests that developing both intrinsic and extrinsic motivation does not only have a positive impact on student's attitudes toward the learning of the subject but also go a long way to support their learning experiences and achievement. It is for this reason that Oyedeji argued that helping students develop both intrinsic and extrinsic motivation should be paramount in the classroom and every teacher should make a deliberate attempt to motivate his/her students. Singh et al. (2002) examined the impact of attitude, motivation, and academic engagement on the academic performance of mathematics and science students in the eighth grade. The results showed strong influences of motivation, positive behaviour and commitment to research work to succeed in mathematics and science.

Singh et al. (2002) concluded that although the cognitive abilities of the students and other factors like home backgrounds are essential predictors of achievement, affective variables such as motivation has emerged as salient factors affecting students' success and persistence in mathematics and science subject areas. Mueller et al. (2011) in their analysis of sensemaking as motivation in doing mathematics from two studies established that students' dispositions coupled with intrinsic motivation helped the students to develop the self-confidence that they desired to find solutions to the mathematical problems they were presented with. That is, pupils will acquire positive attitudes and enthusiasm in the subject if they have this intrinsic motivation and understand the utilitarian rationale behind the mathematical principles they are studying. By implication, students with higher confidence levels in mathematics tend to have a flair for mathematics with consequential higher academic performances. Motivation is, therefore, one of the most excellent tools that mathematics teachers and practitioners can employ to influence students' attitudes toward mathematics which will help improve their academic performances.

Theoretical Underpinning

To investigate the influence of personal, motivational and learning environment factors on students' attitudes toward mathematics, this research is framed within the self-determination theory propounded by Deci and Ryan (1985). The theory is underpinned by the principles that the construction of new knowledge is underpinned by three interrelated assumptions; autonomy, competency, and relatedness. Niemiec and Ryan (2009) defined autonomy as "experiences of a behaviour as volitional and reflectively self-endorsed" (p. 135). That is the ability to "act in accord with one's self, it means to feel free and volitional of one's actions" (Deci, 1995, p. 2). In this study, one may ask how the learning experiences of these students have been guided by their own will or chosen and endorsed by themselves because they know the importance of the concepts they are learning for immediate usage and long-term usage? Competency on the other hand has to do with doing something effectively.

According to Deci (1995), an individual will feel competent when he/she "takes on and, in his view meeting optimal challenges" (p. 66). The individual student's level of competency could be influenced by his or her level of autonomy, as when the individual is guided by his/her own volitional and self-endorsement of the concept, it is likely that he/she will exhibit a high level of competency as there is a direct relationship between self-endorsement and competency (Niemiec & Ryan, 2009). The third component relatedness is defined by Van den Broeck et al. (2010) as "an individual's inherent propensity to feel connected to others" (p. 982). The student's relationship with the group (i.e the teacher and the other students) is crucial in their learning experiences. A learning environment that is free from intimidation and unfairness will encourage students' high-level intellectual discussions and effective collaborative learning among peers.

This theory has been applied to motivation theory by several researchers (e.g Eccles & Wigfield, 2002; Liu, et al., 2009; Karabenick & Conley, 2011) where they try to measure students or teachers' intrinsic and extrinsic motivation. In relating this to students learning experiences, Deci and Ryan (1985) posit that student intrinsic motivation behaviours are more adaptive as they see these activities as enjoyable and self-regulated by the individual learner. They further added that extrinsically motivated behaviours are controlled by external factors as a means to an end. Ryan and Deci (2000) in examining human needs and self-determination of behaviour argued that for learners to be intrinsically motivated, the activity must be enjoyable, interesting and have a utilitarian value to the learner. That is without such intrinsic motivation it will be difficult for the learner to change their behaviours and accommodate new information. It is for this reason that Ryan and Deci posit that for the learner to be intrinsically motivated, the three basic needs underpinning the self-determination theory, autonomy, competence, and relatedness should be met. It is worth noting that despite the importance of extrinsic motivation, overreliance on it will limit the individual learner's intrinsic motivation and self-determination (Ryan & Deci, 2000).

Method

Research Design and Sample

Based on the purpose of the study and the research questions guiding it, the study employed a sequential mixed methods design where the qualitative results were used to clarify or expand on the quantitative findings from the first phase (Ivankova et al., 2006). The study's target population was all Ghanaian junior secondary schools (JHS), including public and private. The accessible population, on the other hand, consisted of 24 schools in the Asunafo South District JHS (1-3) students and a total of 360 pupils (216 males and 144 female) who participated in the study. The eight circuits served as strata and out of it, three schools were purposively selected. 15 students (three students each from JHS 1, JHS 2 and JHS 3) were randomly selected for the first phase of the study. In the second phase, ten students (five each from rural and urban schools) were purposively selected and interviewed to understand their rationale for the quantitative data.

Instrumentation

This study's instrument was designed with cognizance to the three needs underpinning the self-determination

theory; that is autonomy, competence and relatedness. Two instruments, a semi-structured questionnaire and semi-structured interviews were used to collect data. The questionnaire was in two parts, and the first part was used to collect personal data information, whereas the second part had three sections. Section A had 9 items asking questions about how students like and view mathematics in their development agenda. Section B consisted of eight items and gathered information relating to how students feel in math class and in the process of performing mathematical tasks. Lastly, section C, with three items inquired about students' approach towards mathematics as a subject. The reliability of the instrument was tested using the Cronbach Alpha, and a reliability result of 0.79 was achieved. The interview schedule had two parts. The first part was used to collect the background data of the participants and the second part had 10 questions and the second part was tailored at garnering information on why they like mathematics or not and how they think their learning experiences had been influenced by their learning environment. The questionnaire was used to measure students' autonomy, and this was compared with their competencies in solving mathematical problems. The interview was used to measure the students' relatedness and how this influences their performance and learning experiences.

The questionnaire after scrutinising for correctness and completeness were entered into the SPSS version 16.0 and analysed using descriptive and inferential while the interview data were analysed thematically to generate themes and make meaning of the responses from the participants. Two main ethical considerations, anonymity and confidentiality were adhered to throughout the research process. To maintain participant anonymity, fictional names were given to them to obscure their identities and statements in the study.

Results

RQ 1: What characterises Students' attitudes toward mathematics?

To answer the first research question, the respondents were asked to rate how much they agreed or disagreed with nine items, and the results are shown in Table 1.

Table 1. Students' Attitudes toward Mathematics

Variable	SA	A	D	SD	Mean	Std. Dev
1. The mathematics we learn in school can be applied to a variety of areas.	58.1	26.1	6.6	9.2	1.67	.95
2. I like studying Mathematics because it will help me in future	29.7	46.7	15.0	8.6	2.02	.89
3. I look forward to doing mathematics in future	47.2	23.6	16.1	13.1	1.95	1.08
4. I find Mathematics difficult	46.4	23.3	23.6	6.7	1.91	1.08
5. Mathematics is relevant to life in today's world	76.4	16.4	2.2	5.0	1.36	.76
6. I enjoy studying Mathematics	38.1	32.2	19.2	10.6	2.02	.99
7. Mathematics is boring	19.4	20.8	25.3	34.4	2.75	1.13
8. I find Mathematics interesting and challenging	41.4	35.0	13.3	10.3	1.93	.98
9. Even when it gets hard, can do our Mathematics work	23.6	31.9	37.8	6.7	2.28	.89

*Strongly Agree = SA, Agree = A, Disagree = D, Strongly Disagree = SD

Therefore, these results demonstrate the significance of autonomy in students learning of mathematics and this is consistent with the underpinning principles of self-determination theory as argued by Deci (1995). From this, it can be argued that the majority of these students could be able to develop the competency that they need to solve mathematical problems as their learning of the subject has been informed by their acceptance of the utilitarian motive behind the learning of the subject as compared to acting without a sense of personal endorsement. However, despite the overwhelming majority having a positive attitude toward mathematics, 69.7% of the respondents indicated that mathematics is a very difficult subject. Students developing this kind of perception about the subject could influence the level of competence as they may not feel effective in solving mathematical problems. This, therefore, calls for creative approaches to helping students develop an interest in mathematics as well as making mathematics learning easier and fun.

RQ 2: Relationship between Students' Attitudes and Mathematics Achievement

To find answers to this research question, the Pearson correlation was used to determine the type and degree of the link between the two variables of attitude and achievement, and an independent T-test was used to determine the differences in means and standard deviations between urban and rural school students' results in mathematics test. Tables 2 and 3 summarize the findings. For easy analysis, students who scored 50% and above were classed as above average, while those who scored less than 50% were labelled as below average.

Table 2. Students' Attitudes and Mathematics Achievement

Attitude *Achievements	N	Mean	SD	df	t	p
Above average score	341	3.259	1.07	358	1.662	0.006
Below average score	19	2.842	.89			

$p < 0.05$

From the results, one's attitude towards mathematics can have an impact on one's mathematical performance. This is consistent with the underlining principles of self-determination theory which suggest that intrinsically motivated behaviours are more likely to exhibit a high level of autonomy and competency through seeking challenges and discovering new ways of solving problems (Deci, 1997). It can be argued that, together with other positive interrelated factors such as motivation, learning environment, and curriculum, positive attitudes toward mathematics can lead to an improvement in students' achievement and learning experiences. With a significance value of 0.006, the findings suggest that there is a significant relationship between attitudes toward mathematics and students' achievement. It is therefore imperative for teachers, parents and other educational authorities to put in supporting strategies to help students develop positive attitudes toward mathematics as this will go a long way to influence their achievement in the subject.

Table 3 above shows that students from urban schools (M = 2.03, SD = .68) have higher Mathematics achievement scores than their counterparts from rural schools (M = 2.0, SD = .61), [$t_{(358)} = .47$, $p = 0.002$]. A p-value of 0.002 also indicates a wide difference in terms of attitudes and achievements and this could be attributed to the variations in interest levels of urban and rural students, availability of resources and motivation among these students.

Table 3. Mathematics Achievement and School Location

School Location	N	Mean	SD	df	t	p
Urban	90	2.03	.68	358	.47	.002
Rural	270	2.0	.61			

$p < 0.05$

RQ 3: Effects of personal, motivation, and learning environment on attitudes toward mathematics

This research question was answered qualitatively using interviews as students were asked to describe how different factors (i.e personal, motivation and learning environment) influence their attitudes toward mathematics. The analysis of the interview results shows that these factors in one way or the other influence individual student's attitudes toward mathematics. For example, similar to the findings from the quantitative results where the majority of the students ascribed positively to show their like for the subject the majority of the students interviewed indicated that they like mathematics because of their interest and motivation (intrinsic) to learn the subject.

As highlighted in Table 1, from the quantitative results, the majority of the students indicated that they like or study mathematics because of the utilitarian motive and the application of the knowledge acquired in other jurisdictions. Similarly, the analysis of the qualitative data shows some similar trends as students described the different reasons that they like or learn mathematics. For example, one student stated that she likes mathematics because "*it is interesting for me",* another student was of the view that "*I like mathematics because mathematics is a way of thinking logically".* Similarly, another student indicated that "*I like mathematics because in this modern world if you want to do anything it involves mathematics*". It was also interesting to note the kind of value some of these students attached to mathematics as the gateway to other disciplines and a requirement for getting admission into institutions of higher learning. One student indicated that "*I like to study it every day because I don't want to fail during mathematics exams".* Similarly, another student indicated that "*I learn mathematics every day because like what I said before, everything you do involves mathematics and I want to overcome it".*

Concerning how the learning environment influence students' attitudes and learning experiences, the analysis of the data has established that the learning environment and the actions and inactions of students and teachers influence individual students' attitudes toward mathematics. For example, a student indicated that her interest in mathematics is normally affected by the feedback or response from her peers. One student indicated that her learning of mathematics is influenced by the actions and inactions of her friends and teachers "*Most of my friends laugh at me and my teacher shut them up and encourages me to do it".* Another student also indicated how his learning of mathematics has been motivated by the teacher "*My teacher motivates me that I should go and study".* Similarly, another student indicated that "*Oh when I gave a wrong answer, my teacher congratulates me to continue with that because I was on the way to the correct answer so I shouldn't give up".*

From the above discussions, it is clear that the individual student's attitudes toward mathematics are influenced by his/her characteristics, motivation (intrinsic and extrinsic) and the nature of the classroom environment. The results from the interview attest to the fact that the third component of Deci and Ryan (1985) self-determination

theory is critical in helping students in their learning process. That is to say, the individual student's relatedness is influenced by the kindly of feedback that they receive from their peers and teacher and these students could be able to engage in cooperative learning and high-intellectual discussion if the learning environment is friendly and free from intimidation. This, therefore, calls for the creation of enabling environment free from fear and intimidation to help motivate students to play an active role in the teaching and learning process.

Discussion and Implications

As highlighted above the purpose of this research was to examine how students' personal, motivational and learning environment characteristics affect their attitudes and the learning of mathematics. Using the self-determination theory, the authors critically examined how individual students' personal, motivational and learning environment characteristics influences their attitudes toward mathematics and their achievement in the subject. The results from the study show that the majority of respondents have favourable views toward mathematics and said that learning mathematics serves a practical purpose in their pursuit of further education or the application of mathematics to real-world situations.

The findings from the study are consistent with the findings from Singh, Granville, and Dika, (2002), Mensah and Kurrancie (2013) who have established that students' experiences, motivation and classroom environments have a significant relationship with their learning and attitudes toward mathematics. Despite these overall positive attitudes toward mathematics, the results also established that 69.7% of the participants indicated that mathematics is a difficult subject and 40.2% indicated that mathematics is boring. From this, one can say that despite students' positive attitudes toward mathematics, teachers and educators have to look for creative ways of making the subject less boring and reducing the abstract nature of the subject in our teaching and learning process.

Similar to the findings of Mensah, Okyere and Kuranchie (2013) and contrary to that of Krinzinger et al. (2009) and Dowker et al. (2012) the results from the study found a positive relationship between students' attitudes and achievement in mathematics. Individual students' positive attitudes toward mathematics are reflected in their performance in mathematics. This can be attributed to the significant value that students attached to mathematics because of the utilitarian motive of mathematics. That is, students may have positive attitudes toward mathematics because they know that mathematics is an important subject in the school curriculum. This suggests that as we encourage students to develop positive attitudes toward mathematics, there is a need for setting higher expectations and targets for all students to achieve.

A plethora of different researches (e.g., Vandecandelaere, et al., 2012; Mata et al., 2012; Singh et al., 2002) has shown that there is a positive relationship between the learning environment and students' attitudes toward mathematics. The findings from the study have established that the actions and in-actions of students and their teachers play a significant role in the enjoyment and students' attitudes toward mathematics. Similarly, to the findings from Maat and Zakaria (2010), the results from the study revealed that there is a positive relationship between the classroom learning environment and students' attitudes toward mathematics. Teachers and educators

ought to find ways of creating an enabling learning environment where individual students' differences will be appreciated and respected to motivate students' active participation and engagement.

Conclusion

Mathematics plays a critical role in our day-to-day activities and training students who can think critically and have higher-order thinking skills has become the hallmark of most educational reforms and school curricula. Understanding students' attitudes toward the learning of mathematics and their achievements have been examined from different perspectives by different researchers. In this current study, relying on the self-determination theory, we have established that despite the important role that other factors such as school-related, curriculum-related, resources, in shaping students' attitudes and achievement, the influence of personal, motivational and the learning environment could not be underestimated in our quest for providing a holistic picture of the situation under consideration. That is students learning experiences could not be understood from just examining a few related factors but there is the need for critical analysis of the different factors. It is for this reason that the authors argue that there is the need for further studies to examine the different factors influencing students learning at the different levels of the educational system to help understand how to design innovative lessons and provide the needed support for students at different levels. Although some of the issues identified here may be applicable in other contexts, we think conducting a need analysis at different school levels, school location (i.e rural, semi-urban, urban), school type (public and private) is crucial.

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