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A Correlation Analysis of Ghanaian Junior High School Pupils' Perception and Attitude Towards Mathematics

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Abstract

This study is aimed at exploring the correlation that exist between Ghanaian junior high school (JHS) students' perception and attitude towards mathematics, taking into account the influence of both attitude and perception in the teaching and learning of mathematics. An adaptation of the WIHIC and MAQ questionnaires, which is widely-used in mathematics related research, were used to obtain data from a sample of 320 JHS students from 18 public and private JHS in six circuits in the Cape Coast metropolis. The results of the study revealed that the JHS students in general had a positive attitude toward mathematics. The students' perception towards mathematics was also reported to be favourable as a result of which a positively weak correlation between the students' perception and attitude towards mathematics was also observed. Thus, the JHS students' perception of mathematics to a large extent does not depend on their attitude. Situated in context, are the implications as discussed.

Keywords: attitude; perception of affect, behavior; cognition

Introduction

A mathematically literate society is indispensable to the holistic development of a nation since the currency of today's technological advancement in this global community can be tied to one's appreciation and understanding of mathematics. Thus, there simply cannot be any meaningful development in virtually any areas of life without knowledge of science and mathematics (Yilmaz & Cavas, 2006). Due to the critical role mathematics plays in the lives of humans; the subject has become key in school curriculum. According to Ngussa and Mbuti (2017) mathematics curriculum is intended to provide students with knowledge and skills that are essential in the changing technological world. There has therefore never been a greater need to be mathematically literate than in the current rapidly expanding society and economy. In other countries such as Australia, mathematics results are used as a critical filter for higher education and future vocations signaling the great importance countries all over the world attach to the subject, that is, mathematics (Collis, 1987). In Ghana, a failure in mathematics papers at both basic education level (Basic Education Certificate Examinations) as well as secondary school level (Senior Secondary School Certificate Examinations [SSSCE] or the West African Senior Secondary School Certificate Examinations [WASSCE]) organized by the West African Examinations Council (WAEC) denies the candidate progression to the next level of his or her education.This explains the importance attached to the study of mathematics in Ghanaian schools. However,

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in recent times the continued trend of students' poor performance in mathematics raises concern about the teaching and learning of mathematics. In particular, the from the perspective of students at the JHS. A large-scale international comparative study, such as Trends in International Mathematics and Science Study (TIMSS) by the International Association for the Evaluation of Educational Achievement (IEA) reports that "Ghana's JHS2 students' performance in mathematics and science, though improved significantly since TIMSS 2003, remains among the lowest in Africa and the world." (TIMSS'2007; 2015) Again, Anamuah-Mensah & Mereku reported the abysmal performance of Ghanaian basic school pupils in mathematics both locally and internationally (Anamuah-Mensah & Mereku, 2005; WAEC, 2006).

In the discourse of these poor mathematics performance shown by students, the attitudes and perception of students have been identified to be a critical factor (Farooq & Shah, 2008; Asomah, Wilmot & Ntow, 2018; Asomah, Dennis, Alhassan, & Aseidu, 2018). These positive and negative perceptions as well as favourable and unfavourable attitudes about mathematics have a significant positive and negative impact on mathematics education. Negative attitudes about mathematics can be changed only as students become knowledgeable about mathematics and are prepared to become lifelong learners and users of mathematics (Asomah et. al., 2018). Borasi (1990) reported that the conceptions, attitudes and expectations of students regarding mathematics and teaching of mathematics are very significant factors underlying their school experience and subsequent achievement in the subject. Other studies (e.g., Fraser & Kahle 2007; Goh & Fraser, 1998; Asomah, R. K. Dennis, H Alhassan, M. N. & Aseidu, K. J. 2018), have found that mathematics classroom learning environments strongly influence students' attitudes towards mathematics. In particular, Asomah, Dennis, Alhassan, and Aseidu (2018) attributed the improvement of the junior high school pupil's performance in mathematics to their positive disposition towards mathematics. In the same vein, a number of studies conducted to understand this state of affairs have focused on the influence of learning environment on students' behaviour, as well as the teaching and learning process (e.g., Fraser, 1998, 2007, 2012; Taylor, 2004; Asomah, Wilmot, & Ntow, 2018). For instance, a study conducted by Asomah, Wilmot, and Ntow (2018) averred that how students perceive their mathematics classroom learning environment is an attributable factor to their understanding of the teaching and learning of mathematics.

To this end, literature establishing the correlation between the JHS students' perception and attitude toward mathematics seems rare particularly at the level Basic school (Junior High School) in the Ghanaian context. We contend that such lines of studies are important because the relationship between students' perception towards mathematics and their attitude have the potential of affecting the teaching and learning of mathematics at the Basic level. Furthermore, inferring from the studies conducted in these areas of attitudes and perceptions, it can be argued that any strong weak positive and negative correlation between students' attitudes towards mathematics and perception of their mathematics classroom context would in turn have favourable or unfavourable impact on the teaching and learning of mathematics particularly at the junior high school level. The foregoing points to a strong indication that an exploration of students' perception and their attitude towards mathematics have a vital role to play as far as students' outcomes such as achievement in mathematics are concerned. The way the classroom environment is organised and how it is perceived, therefore, plays a crucial role in the determination of students' achievement or performance (Taylor, 2004).

Frazer (1996; 2012) had earlier made this point when they pointed to investigations into possible connection between attitude towards mathematics and students' perception of their learning environments as a future research concern. Attitude refers to a learned tendency of a person to respond positively or negatively towards an object, situation, concept or another person (Sarmah & Puri, 2014). In measuring the JHS students' attitude towards mathematics, the study employed the ABC Attitude Model. It served as a useful theoretical framework for the development of JHS students' attitude towards mathematics. The ABC Model of Attitude is anchored on a Hierarchical Model described in Ajzen (1993) who conceptualises an attitude as an amalgam of three separate measurable components: affect (A), behaviour (B) and cognition (C). Affect is the emotional component consisting of feelings and emotions that are associated with an attitude object (in our study mathematics). The behaviour is the action component consisting of predispositions to act in a particular way towards the attitude object. Cognition is a mental component that consists of belief and perceptions people hold about the attitude object. These three components must be present before we say that an attitude exists. A particular attitude may consist a positive emotion that is, feeling happy in a mathematics classroom (affect), intend to learn more mathematics (behaviour) and belief that mathematics is easy to learn (cognition). Mohamed and Waheed (2011) explored attitudes and its impact on students' development. Consequently, three groups of factors were identified: students related factors (e.g., mathematical achievement, anxiety, self-efficacy and self-concept, motivation, and experiences at school); school, teacher, and teaching-related factors (e.g., teaching materials, classroom management, teacher knowledge, attitudes towards maths, guidance, beliefs), and home environment and social factors (e.g., educational background, parental expectations). Students may form a favourable or an unfavourable attitude towards mathematics. Such a call by Taylor (2004); Frazer (1996; 2012) is important for Ghanaian researchers considering how the low levels of achievement currently observed in the nation's basic schools has led to a number of concerns.

These factors among others have all been hypothesised as the impediment to the teaching and learning of mathematics as far as students under achievement in mathematics is concerned. These influences in classroom practices may form a particular Ghanaian mathematics classroom culture which may in turn cause Ghanaian students to perceive their mathematics classroom learning environment differently and as such develop a biased attitudinal characteristic if not checked since "culture shapes mind" (Bruner, 1996 p.x). There is lack of research into how insiders, such as Ghanaian students particularly junior high school (JHS) pupils who actually experience act as a main part to build the classroom learning environment in relation to their attitude and perception; as many previous studies have found, it as a major determinant of students' cognitive and effective outcome (Fraser, 2007; 2012).

In view of the research gap and the importance of an exploration of students' perception and attitude towards mathematics in affecting the teaching and learning of mathematics at the basic level of the educational enterprise in Ghana, this study with the involvement of students from both public and private schools, explores the correlation between students' perception and their attitude towards mathematics among JHS students in the Cape Coast metropolis.

Research Questions

The study focused on the following three research questions:

1. What are the JHS pupils' attitudes towards mathematics?
2. What are the JHS students' perceptions towards mathematics?

3. What is the relationship between the JHS pupils' perception and attitude towards mathematics?

Procedure

The descriptive survey design was adopted for the study. The study had a target population of all Junior Secondary School (JHS), both public and private in the Cape Coast Metropolis of Ghana. The study used six circuits, and the researcher adopted them to serve as strata for the study. A purposive sampling technique was, however, used to select 3 schools each from strata to make a total of 18 schools from the accessible population of 85 JHS in the Cape Coast Metropolis. The total participants were 320 comprising of 190 males and 130 females. A semi-structured questionnaire was administered to the students. The semi-structured questionnaire was in two parts. The first and second parts were used to elicit demographic information and views from the participants respectively. The age distribution of the respondents ranged from 11 to 19 years with an average age of 14.05 years and a standard deviation of 1.05. Table 1 summarises these characteristics of the sample used for the study.

Table 1: Background Characteristics of the Participants

	Number of Pupils		
Form	Private school	Public school	Total
JHS 2	40	70	110
JHS 3	80	130	210
Total	120	200	320

Instrument

Data for the study was collected using two sets of five-point Likert scale type questionnaire to measure the JHS pupils' perception and their attitude towards mathematics. The *What Is Happening In This Class* instrument (abbreviated in this report as WIHIC) originally adapted by (Ntow, 2009; Asomah, Wilmot, & Ntow, 2018) was used in this study. Since the items on the WIHIC scale were developed based on a culturally different context of the respective countries, some of the items on it were modified to reflect the Ghanaian cultural context purposed to make the items more contextually meaningful to the respondents. The finial modified version of the questionnaire was constructed using a five-point Likert-type response scale to indicate the degree to which students agreed with each statement: (1) Never; (2) seldom; (3) Sometimes; (4) Often; (5) Always. A detailed description of the five modified WIHIC Subscales are presented in Table 2.

Table 3. Description of the scale items and sample items

Aspect	Attitude	Description (Sample statement)
Affect	Self-confidence	"I am able to do mathematics in a way I can learn understand"
	Mathematics Anxiety	"I get worried in studying mathematics"

Table 2: Description and Sample Item for Each Subscale Scale in the Modified WIHIC

Subscale	Sample Item
Pupil Cohesiveness	I am friend to members in my mathematics class.
Teacher Support	My mathematics teacher listens to and accepts my comments on how he/she teaches
Involvement	My ideas and suggestions are used during mathematics classroom discussions
Co-operation	In my mathematics class there is high competition among us which leads to selfishness.
Equity	My mathematics teacher treats me the same way he/she treat other pupils in this class.

The second instrument which is in accordance with Syyeda (2016) attitude has three main components: *affect*, *cognition* and *behaviour*. The components are interrelated and involve several aspects contributing to the overall attitude towards learning mathematics. The current study draws from the ABC (Affective, Behavioural and Cognitive) model (Ajzen, 1993) to investigate the JHS students' attitude towards mathematics. In line with the ABC model, the study focuses on attitudinal characteristics, including: students' self-confidence in their mathematics ability, mathematics anxiety, mathematics enjoyment, perception about the usefulness of mathematics and intrinsic motivation. Thus, primary instrument for collecting data in this study was the Mathematics Attitude Questionnaire (MAQ). A description of each aspect, and a corresponding sample statement have been detailed in Table 3. All statements composing attitude aspects were scored on a 5-point scale ranging from 5 = strongly agree to 1 = strongly disagree.

Validity

The two instruments WIHIC and MAQ were subjected to review by two seasoned examiners from the WAEC with decades of experiences in the teaching and learning of mathematics at the Basic level. The feedback was used to improve the quality of the items adopted to be reflective in the Ghanaian context. Following the review and final draft, the instrument was piloted in two schools (one public and one private) in a nearby district with similar characteristics as those that were used for the actual study. The Cronbach's Alpha reliability scores for the MAQ in five attitudinal subscales was adequate as it ranged between 0.58 and 0.87. These reliability estimates were considered appropriate since Hinton, McMurray, and Brownlow (2014) argue that Cronbach's alpha reliability estimates of 0.5-0.75 is moderately reliable for the conduct of a study. Moreover, in determining the extent to which items in the various subscales was related to each other, reliability estimates using Cronbach's alpha, was calculated for each subscale (WIHIC instrument). The Cronbach's alpha reliability coefficients for the subscales ranged from 0.50 to 0.71. These values were taken to be good since they showed that within each subscale, the items had shared covariance and fairly measured the same underlying concept.

Data Analysis

A quantitative method was used to analyse the survey. Using Statistical Package for Social Sciences (SPSS 16.0) descriptive analysis in particular means and standard deviations as well as correlation analysis were performed. Data obtained from closed-ended items were coded and entered in the SPSS computer programme. At this point, negative items were scored in the reverse order. Mean scores were calculated for each statement of attitude aspect to get variables (MAQ and WIHIC) which were used in subsequent analysis. The first and second research questions of the study required to establish the students' attitude and perception towards mathematics. Towards this end, descriptive statistics such as mean and standard deviation were used where mean values of all attitude aspects and perception subscales were averaged to get the overall attitude and perception. Correlation analysis was used to establish the relationship existing between the attitudes and perception. In particular, the relationship that exists, if any, between JHS school pupils' perception and attitude towards mathematics were premised on research hypothesis one and two. To test these research hypotheses, Spearman Rank Correlation tests was conducted, the results from the correlation tests were corrected for type one error using Bonferroni correction procedure.

Results

JHS Students Overall Attitude Towards mathematics

In responding to research question one thus, "What are JHS students' attitude towards mathematics". The students were to indicate the extent to which they agree or disagree to the items on the MAQ instrument. The mean scores were obtained by dividing the subscale mean score by the number of items in each subscale. The average item mean provides a meaningful basis for comparing subscales that contain different items on the questionnaire. Table 5 summarizes the mean scores for each subscale. Possible responses to the items on the five-subscale questionnaire were on a scale ranging from strongly disagree (1) to strongly agree (5). Thus, for the subscales, a score below and above 3 depicts positive and negative opinions of the respondents. Table 4 shows the results of students' attitude towards mathematics.

Table 4. Descriptive statistics for the overall students' attitude towards mathematics

Aspect	Attitude	Mean	Std. Deviation
Affect	Self-confidence	4.12	0.75
	Mathematics Anxiety	4.29	0.87
	Enjoyment of Mathematics	4.30	0.64
Behavior	Intrinsic motivation	4.48	0.46
Cognition	Perceived Usefulness	3.78	0.67

As presented in Table 4, the attitude scores vary between 3.78 and 4.48 for the various subscales in the study. It can be inferred from the table that students exhibited high levels of intrinsic motivation toward mathematics as depicted by their mean score (mean= 4.48). whereas their disposition towards mathematics in relation to their self-confidence, anxiety in mathematics and the manner they enjoy mathematics were also reported to be positive. However, they seemed uncertain going forward into the future about the usefulness of learning mathematics to secure job-related opportunities although it was found to be positive. Generally, the results show that students had confidence, did enjoy mathematics lessons, they were motivated and found it useful.

JHS Students' Perception Towards Mathematics

Research question two was purposed to elicit from the perspective of the students their views towards their mathematics classroom learning environment. Thus, "what are the JHS students' perception towards mathematics". The mean scores were obtained by dividing the subscale mean score by the number of items in each subscale. The average item mean provides a meaningful basis for comparing subscales that contain different items on the questionnaire. Table 5 summarizes the mean scores for each subscale. Possible responses to the items on the five-subscale questionnaire were on a scale ranging from strongly disagree (1) to strongly agree (5). Thus, for the subscales, a score below and above 3 depicts favourable and unfavourable opinions of the respondents.

These mean scores range from 3.15 to 4.84, indicating that, for all subscales surveyed, the JHS pupils did not perceive mathematics as "always" favourable. However, the item means scores for the various subscales indicate that students' opinions were favourable.

Thus, it could be inferred that, the JHS students involved themselves in the various mathematics teaching and learning processes.

Again, they cooperated with their colleagues during group work activities on mathematics related courses. In relation to their teachers' behaviour towards them during the teaching and learning processes, they posited that there was equity in the distribution of mathematics related questions, task and most importantly, received an even support during teaching and learning of mathematics as depicted by the respective mean ratings.

The Correlation Between JHS Students' Perception and Attitude Towards Mathematics

In order to test the correlation between the JHS students' perception and attitude towards mathematics, the following hypothesis were formulated: There is no significant relationship between the JHS students' perception and attitude towards mathematics. There is significant relationship between the JHS students' perception and the attitude towards mathematics. A Spearman's Rank correlation test was conducted to determine the possible correlation if any, between the JHS students' perception and attitudes towards mathematics. As presented in Table 6.

Table 5: Junior High School Pupils' Perception towards Mathematics

Aspects	Mean	Std. Deviation
Equity	4.84	0.79
Teacher support	4.29	0.51
Cohesiveness	4.21	0.54
Involvement	3.54	0.83
Cooperation	3.15	0.61

***Table* 6**: A Correlation of JHS students' Perception and Attitude Towards Mathematics

		Attitude	Perception
Attitude	Pearson Correlation	1	.276**
	Sig. (2-tailed)		.000
Perception	Pearson Correlation	.276**	1
	Sig. (2-tailed)	.000	

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

From the table, the sample size is 420. The Pearson value of 0.276 indicates that there is a weak positive correlation between the JHS students' perception and attitude towards mathematics. Thus, as students' perception towards mathematics appreciates, their attitude towards mathematics also appreciates and vice versa. Again, alpha (α) =0.05 and Sig. value is 0.000 was also recorded (as shown in Table 6). Since the Sig. value of 0.000 is less than the alpha (α) value of 0.05 ($p < 0.005$) there is enough evidence to reject the null hypothesis thus, "there is no significant relationship between the pupils' perception and attitude towards mathematics. Hence, a relationship between the JHS students' perception and attitude towards mathematics has been established in the current study.

Figure 1: presents the scatter plot obtained from the correlation between perception and attitudes of JHS pupils towards mathematics.

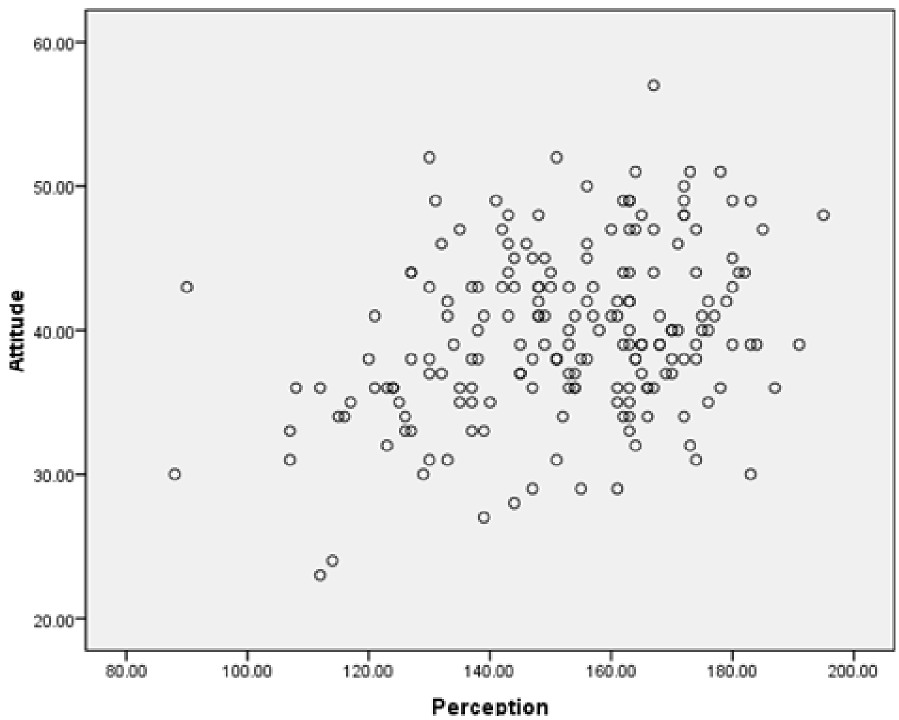

Figure 1 **Scatter plot for the correlation between perception and attitudes towards mathematics**

Discussion

This study focused on investigating how JHS students' perception their mathematics and attitude towards mathematics, using a modified, WIHIC and MAQ to collect information on their experiences in the mathematics lessons context. The findings in this study suggest that, generally speaking, mathematic as a subject of study perceived by JHS students are positive. Again, the positive perception towards mathematics was reported on all of the five Subscales in the current study. This confirms the findings of Koul and Fisher (2005); Taylor (2004); Asomah, (2018). Further, the attitude of JHS pupils as reported in the current is consistent with the studies of (Mohamed & Waheed, 2011; Asomah et.al., 2018) who found in their studies that attitude influences students in the learning of mathematics. Moreover, other studies (e.g., Fraser & Kahle 2007; Goh & Fraser, 1998), have found that mathematics classroom learning environments strongly influence students' attitudes towards mathematics and mathematics learning. However, this contradicts the current study's Spearman rank correlation tests which showed that there existed a positively weak correlations between the junior high school students' perception and their attitude towards mathematics. Thus, the participants in this study's attitude towards mathematics to a large extent is not influenced by their perception.

Conclusion and Recommendation

Findings like this suggest that, for the purposes of promoting effective teaching and learning of mathematics, JHS mathematics teachers need to appreciate that although the scope of the JHS mathematics curriculum is broad and deals with inter-related concept which may appear difficult superficially, the tendency for the students to understand is cannot be under-estimated since the current study reveals of a positive disposition in terms of the students affect, behaviour and cognition as well as a favourable towards mathematics. Again, there is the need to prioritize students' attitude towards mathematics as independent of their perception of the classroom context. This is as a result of the weak correlation established between the students' attitude and their perception. Hence the need to introduce into mathematics classroom learning environment, readily available mathematics teaching and learning materials (TLMs), activity-based classroom activities devoid of intimidation and mockery so as to reinforce the students' appetite for mathematics related courses at the basic level. The study further advocates that mathematics educators build on the students' attitudes and perception as two separate conditions pre-requisite to the improvement of the students' achievement in mathematics. This is affirmed by the current study's findings.

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