Asian Journal of Humanities and Social Studies (ISSN: 2321 – 2799)
Volume 01– Issue 01, April 2013

Impact of Effective Communication on Mathematics Education in Ghanaian Senior High Schools – Teacher's Role

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ABSTRACT– ***The study primarily dwells on the application of effective communicative techniques by Senior High School teachers in the classroom to foster understanding and practical application of mathematics as a subject. Using a non proportionate stratified random sampling technique, the researcher selected 25 Senior High School 1 and 2 (SHS1 and 2) mathematics teachers and 500 SHS1 and 2 mathematics students from five senior high schools in the Cape Coast metropolis of Ghana. With the aid of a 24-item self-developed questionnaire, the researcher conducted a descriptive survey based on the factors of effective communication. Data analysis revealed that i. mathematics teachers were effective in 60% of the factors identified from their opinion and from students' responses, the teachers were effective in 66.7% of the factors responsible for effective communication. ii. there was no significant relationship between teachers' and students' responses on the effective communication of teachers' in mathematics classroom. Findings of the study suggested that GES (Ghana Education Service) should use appropriate means to enhance mathematics teachers' teaching methods and students' interest in the subject.***

Keyword– Mathematics classroom, Mathematics teachers, Senior High School students, Ghana.

1. INTRODUCTION

"Mathematics ensures the efficiency of all things that we do especially science, engineering and technology that we need to develop our dear Ghana" stated [3]Anku (2010), in a speech delivered at a National Mathematics Day workshop in Koforidua, Ghana. He further stated: "it is also an international language and is essential in almost every field; handling money, measurements in fashion, angles in sports such as bowling and billiards, technology and economics." Corroboratively, [1]Okigbo and Okeke (2010) posit 'the level of science, technology and mathematics education (STME) of any nation has been widely accepted to be the index of measuring its socio-economic and geo-political development.' In fact, [2]Cangiano (2008) puts it this way, "mathematics is the queen of science and language of nature." Without mincing words, mathematics is a subject recognized as the mother of all learning, providing solid strata upon which other subjects in science and technology are deriving their concepts.

In his book, A History of Mathematics, [2]Baryelo (1987) economically described mathematic in the sense that it has borrowed to science its structure, syntax, grammar and logic while on the other hand, science has provided mathematics its physicality and dynamics thus making the two disciplines inseparable. Also, in his keynote address at the Millennium meeting entitled, "A Celebration of the Universality of Mathematical Thought, the brilliant mathematician, [3]Gomer (2000) stated "mathematics is cheap, and occasionally produces breakthroughs of enormous economic benefit, either directly, as in the case of public-key cryptography, or indirectly, as a result of providing the necessary theoretical underpinning for science.

In view of the foregoing, mathematics is an important 'constant' for rapid economic and social growth of any nation, hence teachers should effectively communicate its universal message with clarity and depth that its inculcation can enhance young ones ability to think critically in order to make intelligent decision and be responsible to the fast moving and dynamic world around them.

In his observational theory, [2]Bandura (1971) demonstrated that behaviors and skills are acquired by watching another (teacher, parent, mentor, and friend) that performs the behaviour. The model (teacher, parent, mentor, and friend) displays it and the learner observes and tries to imitate it. Teachers are, invariably, role models whose behaviours are easily copied by students. What teachers like or dislike, appreciate and how they feel about their teaching or studies could have a significant effect on their students. Unfortunately, however, many teachers seldom realize that how they teach ([1]Abimbade, 1999) … how they interact with students can be more paramount than what they teach. In a nutshell, teachers' communicative skills directly affect students' attitudes. Teachers' mode of teaching and skills are in turn, influenced by their culture and belief system ([1]Yara, 2009, p. 64).

Gangoli cited in [2]Igwe (2002) stipulates that for teaching and learning of Mathematics to be interesting and stimulating, there has to be motivation on the part of the teacher and by extension the learner so as to ensure academic achievement. It has been observed that teachers teach Mathematics in a way that merely requires the pupils to listen, read and regurgitate ([1]Yara, 2009 p. 365). Effective communication requires more than that, [1]Ogunniyi (1982) found that students' achievement in mathematics could be enhanced by the following teacher-related factors:

1. Teachers' enthusiasm,
2. Teachers' resourcefulness and helpful behaviour,
3. Teachers' thorough knowledge of the subject-matter and their making Mathematics quite interesting through effective communication (pp. 25-32).

From the above, we can say that the role of the teacher as facilitator of learning and the contributions to students' achievement is enormous. [1]Bajah (1999) was of the opinion that "the success of our Mathematics programme depends greatly on the classroom teacher as he or she is the one that translates all our thoughts into action."

Several research findings as enumerated below confirmed the hypothesis that teachers' plays a vital role in shaping the future of the students towards mathematical orientation. [2]Chako (1981) reported in a study of teacher and student characteristics as correlates of learning outcomes in mathematics that teachers' attitude towards teaching significantly predict students' attitude as well as achievement in mathematics. A common hypothesis with respect to the relationship between teachers' experience/attitude and student achievement is that students taught by more experienced teachers achieve at a higher level, because their teachers have mastered the content and acquired classroom management and communicative skills to deal with different types of classroom problems ([1]Slavin, 1987; [1]Evans, 1992; [1]Gibbons, 1997). Furthermore, more experienced teachers are considered to be more able to concentrate on the most appropriate way to teach particular topics to students who differ in their abilities, prior knowledge and backgrounds ([1]Raudenbush and Bryk, 1991; [1]Stringfield and Teddlie, 1991).

As shown above, communication is a fundamental part of the career of any mathematician. [2]Mefalopulos (2008) clarifying ambiguity defines communication as a two-way process not used exclusively to send message or pass information, but to explore, discover and generate knowledge and understanding. Also, going by the semantic root of the word communication it is the same as in communion and community and it is about sharing. Based on this information, [2]Barry and Rhoda (1996) suggested a model for effective communication, by indicating that it is a two-way process consisting three basic elements, a sender, a receiver, and an understood message culminating in sharing. The connecting ring between the students and the teachers in the achievement of the stated objective of education is communication. Hence, the teacher being the originator (sender) must convey his or her thoughts to the students (receiver) in such a way that the students, based on their prior or present experience can decipher or understand the message conveyed to them, in turn knowledge is generated and thoughts are shared.

Constitutive factors for effective classroom communication ranges from language, attitude of the sender (teacher), material, channels, feedback, students ability, attitude of students, class size, to school environment ([2]Dynamic, 2007). Explicating the implication of effective communication in mathematics education, [1]Lindquist and Elliot (1996) affirms that we all need to communicate mathematically to fulfill the societal goals of a mathematically literate workforce, lifelong learning, opportunities for all, and an informed electorate. This will also assists students to organize, consolidate and explain their mathematical thinking coherently and clearly to peers, teachers and others.

The importance of getting students involved in the teaching process cannot be overemphasized, [1]Rika, (1996) indicated that an important aspect of learning is for students to be able to communicate what they know, or think they know. Teachers should encourage communication from all students through lively and stimulating classroom discussion or small group works. [2]Andrius (2012) summarized teacher role in effective communication as follows:

1. Initiate and sustain effective communication systems and techniques so as to establish and maintain group cohesion and on-task behavior.
2. Develop communication skills of teacher and students to facilitate the management of classroom activities, both behavioral and instructional.
3. Maximize the exchange of information within the classroom and with other sections of the school and its community, so as to develop common understandings.
4. Devise effective communication strategies for overcoming classroom management issues.

2. STATEMENT OF THE PROBLEM

The Ghana Mathematics Society (GMS), in her recent meeting, expressed concern about the persistent poor performance of students in mathematics locally, especially in Senior High Schools. [3]Anku (2010) related this persistent poor performance to several teachers lacking proper communicative skills thereby spawning fear and trauma in many students. Most importantly, is the persistent drop in students' grade in mathematics WASSCE as presented below in Table 1.

Table 1: Performance of candidates in Core Mathematics

Year	A1 to B3 (%)	C4 to C6 (%)	D7&E8 (%)	Fail (F9) (%)
2006	10.9	20.4	33.6	33.9
2007	9.4	15.9	27.8	46.2
2008	10.2	15.9	28.8	44.8

Source: [1]African Echo Magazine, 2012.

Though it is consoling that the performance improved a little in 2012 with the national average of 20.04%, yet, it is still on the low side because it is like catching 20 balls out of 100. This dismal failure at WASSCE is an indicator that the performance of students in the senior high schools level is poor. To forestall this problem, the communicative skills of teachers should be investigated perhaps it is due to the ineffective use of communication skills by mathematics teachers that may have contributed to lack of interest and underachievement of mathematics students. It would be pleasing therefore to determine the extent to which teacher's role as an effective communicator has affected students' achievement in mathematics.

3. PURPOSE OF THE STUDY

The present study seeks to examine the extent effective communication by mathematics teachers affects teaching and learning of mathematics in senior high school. The study shall attempt to:

a. Examine the extent to which the teachers communicate effectively in mathematics classroom.
b. Determine the relationship between the teachers' and students' responses on the effectiveness of the mathematics teachers' communication in the classroom.

4. RESEARCH QUESTIONS

a. To what extent do mathematics teachers communicate effectively in mathematics classroom?
b. Is there any significant relationship between the teachers' and students' responses on the effectiveness of teachers' communication in the mathematics classroom?

5. RESEARCH HYPOTHESIS

There is no significant relationship between the teachers' and students' responses on the effectiveness of teachers' communication in the mathematics classroom.

6. RESEARCH DESIGN

The study is rooted in survey research paradigm. The choice of this research design was informed by its appropriateness and suitability. [2]Mizner (2008) indicated that a survey research provide a high level of general capability in representing a large population. Due to the usual huge number of people who answers survey, the data being gathered possess a better description of the relative characteristics of the general population involved in the study. As compared to other methods of data gathering, surveys are able to extract data that are near to the exact attributes of the larger population. Moreover, [1]Okigbo and Okeke (2010) employed it in a recent research similar to the present research with appreciable results.

7. POPULATION AND SAMPLE

The population comprised SHS1&2 Mathematics students and SHS1&2 Mathematics teachers from Ghana National College, Mfantsipim School, Adisadel College, St Augustine's College and University Practice Senior High School. Using a non proportionate stratified random sampling technique, a total of five hundred (500) students consisting of two-hundred and fifty (250) SHS1 and two hundred and fifty (250) SHS 2 Mathematics students were sampled. The figure consisted of fifty (50) SHS 1 and fifty (50) SHS 2 students from each school. Thus hundred students were selected from each school. In addition, a total of twenty five (25) Mathematics teachers, five from each school were also sampled for the study.

8. INSTRUMENT AND VALIDATION

The instrument used for the study was structured questionnaire. Basically, there were two sets of questionnaire, the first tagged Mathematics Teachers' Questionnaire (MTQ) and the second Mathematics Students Questionnaire (MSQ) contained the same information but the former was directed to the teachers while the later was directed to the students. Questionnaire was used because it gives a quick way of collecting data. It is also known to be quite valid and reliable if well constructed ([2]Best and Kahn, 1993). Questionnaire is also economical in terms of money and time spent in its usage ([2]Awoyemi, Mereku, Onivehu, Quarshigah & Quartey, 2002). MTQ contained 24 items divided into 2 sections (A and B) constructed by the researcher based on the factors of effective communication ([2]Dynamic, 2007) while MSQ is also made up of 24 items but only one section, it is also reframed so as to suit the targeted audience – students. The four-Likert scale was used, Always, Sometimes, Rarely and Never which were assigned to values of 4, 3, 2, and 1 respectively. Three experts in the mathematics field, 2 in counseling psychology and two in the communication field were consulted for content analysis of the questionnaire. The reliability of questionnaires was established using Cronbach reliability technique in each case which was found to be 0.86 and 0.80 respectively for MTQ and MSQ.

9. MATERIALS AND METHODS

9.1 *Method of Data Collection*

With the assistance of a teacher in each school, the researcher administered the questionnaire to the respondents in the sampled schools. Each administered 105 (5 MTQ and 100 MSQ) copies of the questionnaire. Proper arrangement was made so as to receive filled questionnaire on the spot. The assigned valued of 4, 3, 2, and 1 to the four-point Likert scale allowed for easy identification of positive and negative items. Using 2.50 as the cut-off point to determine positive and negative items, then, positive or effective communication by teachers is represented by items with mean value higher than 2.50 while items with mean value of responses lower than the 2.50 is indicative of negative. The 2.50 therefore represented neutral item.

9.*2 Method of Data Analysis*

Analysis was done by means of mean, percentage, Pearson Product Moment Correlation (*r*) and the student t-test. The Statistical Package for the Social Sciences (SPSS) was used for the calculations.

10. RESULTS AND DISCUSION

The results of the study are tabulated in Tables 2, 3, 4 and 5 below:

10.1 Research Question 1:

To what extent do mathematics teachers communicate effectively in mathematics classroom?

The opinions of the teachers are presented in Table 2 below.

Table 2: Teachers' responses on the effectiveness of their communication in the Core Mathematics classroom

Items	Always	Sometimes	Rarely	Never	Mean ( )	Remark
Teacher use Twi language to teach mathematics	0	16	1	8	2.32	Disagree
Students prefer English to Twi language during lessons	0	23	1	1	2.88	Agree
Assignment scores forms part of the students term grade	13	1	7	5	2.96	Agree
Ghana Education Service provides mathematics teachers with the curriculum	18	2	1	4	3.36	Agree
TLMs are provided mathematics teachers	3	0	18	4	2.24	Disagree
Mathematics teachers improvise unavailable TLMs	0	3	16	6	1.88	Disagree
Mathematics teachers explain the meaning of words/terms/symbols used in a topic	20	0	2	3	3.48	Agree
Mathematics teacher are distracted by happenings outside the classroom	4	6	0	15	1.96	Disagree

Mathematics teachers often need loudspeakers so that students can hear them clearly	20	0	1	4	3.44	Agree
Mathematics teachers ask students question during lesson	19	2	3	1	3.56	Agree
Mathematics teachers illicit for students opinion during lessons	18	4	1	2	3.52	Agree
Students answer their mathematics teachers questions	0	12	8	5	2.28	Disagree
Students make noise during lessons	15	4	5	1	3.32	Agree
Students inform their mathematics teachers that it is time for lessons	1	0	23	1	2.04	Disagree
The required textbook are available to mathematics	19	3	2	1	3.60	Agree

Table 2 above revealed clearly that teachers were effective in 60% of the factors identified for effective communication and ineffective in 40% of the factors. In effect, to an appreciable extent (60.0%) teachers are communicating effectively during mathematics lessons. To compare teachers' and students' responses on the effectiveness of mathematics teachers' communication during lessons, students' responses were collated and summarised in Table 3 below.

Table 3: Students' responses on the effectiveness of their communication in the Core Mathematics classroom

Items	**Always**	**Sometimes**	**Rarely**	**Never**	**Mean ( )**	**Remark**
My mathematics teacher use Twi language to teach mathematics	40	50	320	90	2.08	Disagree
My mathematics teacher is fluent in English language	120	195	115	70	2.73	Agree
Assignment scores forms part of the students term grade	280	120	40	60	3.24	Agree
Ghana Education Service provides mathematics teachers with the curriculum	370	70	45	15	3.59	Agree
Mathematics teachers use TLMs during lessons	33	77	312	78	2.13	Disagree
Mathematics teachers ask students to make TLMs by themselves	28	92	339	41	2.20	Disagree
Mathematics teachers explain the meaning of words/terms/symbols used in a topic	384	94		22	3.49	Agree
Students are distracted by happenings outside the classroom	41	189	21	249	2.04	Disagree
Students hear all that their mathematics teacher says during lessons	394	63	32	11	3.68	Agree
Mathematics teachers ask students question during lesson	305	140	40	15	3.47	Agree
Mathematics teachers elicit for students opinion during lessons	357	78	44	21	3.54	Agree
Students answer their mathematics teachers questions	305	27	43	125	3.02	Agree
Students make noise during lessons	453	32		15	3.85	Agree
Students inform their mathematics teachers that it is time for lessons	45	67	315	73	2.17	Disagree
The required textbook are available to mathematics	433	57	0	10	3.83	Agree

Students' responses on the effectiveness of their teachers communication during lessons is presented on Table 3. It was revealed that teachers were effective in 66.7% of the factors identified for effective communication and ineffective in 33.3% of the factors from the students' opinion. This means there is concordance between teachers and students' opinion on the factors of effective communication.

10.2 Research Question 2

Is there any significant relationship between the teachers' and students' responses on the effectiveness of teachers' communication in the mathematics classroom?

Here, the researcher determined the relationship between the two responses using Pearson Product Moment Correlation (r) as shown below in Table 4. The data showed no violation of normality and linearity or homo scedasticity. There was a strong, positive correlation between teachers and students' responses which was statistically significant (r = .0.928, n =15, *p* < .005). In essence, there is a strong relationship between what teachers and students consider constituting effective communication during mathematics lessons.

Table 4: Correlations between the teachers' and students' responses on the effectiveness of teachers' communication in the mathematics classroom

	Teachers' Response	**Students' Response**
Pearson Correlation	1.000	.928
Sig. (2-tailed)	.000	.000
There was no significant relationship between teachers and students' responses on the effectiveness of teachers' communication during mathematics lessons ($p<0.05$).	15	15

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

The significance of the relationship was determined by testing the null hypothesis.

10.3 Hypothesis

The null hypothesis was tested with student t-test and Table 5 is the summary of the results.

Table 5: T-test results

Responses (Subject)	**N**	**Mean**	**Alpha (α)**	**df**	***t*-cal**	***t*-crit**
Teachers	15	2.85	0.05	14	2.180	2.145
Students	15	3.00				

Table 5 showed that the calculated value of *t* (2.180) is greater than the *t*-critical value (2.145) hence the research rejected the null hypothesis. Therefore, there was significant relationship between teachers and students' responses on the effectiveness of teachers' communication in the mathematics classroom. This finding is in sharp contrast with [1]Okigbo and Okeke (2010) research in which the null hypothesis was rejected.

11. FINDINGS

The major findings emanating from the research include the following:

1. It was seen that mathematics teachers are effectively communicating with students to an appreciable extent. Responses from both the teachers and students as shown in table A1-A4 underscoring strong relationship and significance confirmed this notion. Perhaps their low achievement in mathematics may be due to what [1]Yüksel-Şahin (2008) refer to as 'mathematics anxiety' a situation where a student has a preconceived notion about mathematics ([1]Umay, 1996) as difficult to understand, hence he or she develops an attitude of not liking both mathematics and the tutor with the concomitant result – failure.
2. It was also discovered that many students believed in themselves that natural ability, good luck and lots of hard and work studying at home will make them do well in mathematics. These reasons explain why they could make noise in the classroom during lessons and get distracted when the teacher is in the class. According to [1]Yara (2010), such conception usually leads to failure in mathematics even though the teacher is effectively communicating necessary mathematical information.

12. CONCLUSIONS

In view of the findings emanating from this study, the following conclusions were drawn:

1. According to the analysis presented above, mathematics teachers are really making concerted effort to explicitly explicate the knotty tangles of mathematics as confirmed by 60% from teachers' response and 66.7% from students' response.
2. There is a significant relationship between teachers' and students' responses on the effectiveness of teachers' communication in the mathematics classroom.

13. RECOMMENDATIONS

Based on the findings and the conclusions enumerated above regarding effective communication in mathematics classroom, the researcher made the following recommendations:

1. The essence of mathematics education is the conveyance of mathematical probing, thought pattern and orientation to students; hence, mathematics teacher should strive to understand their students so as to isolate mitigating factors responsible for low achievement in mathematics. This will facilitate mutual understanding and allay unwholesome attitude exhibited by students.
2. In order to accentuate achievement in mathematics education, GES should make provision for adequate teaching and learning materials. These items would make the abstract calculations in mathematics real, lively and understandable.

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