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# Classroom Interactions and Mathematics Achievement

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**Abstract:** The study was carried-out to examine sustenance of qualitative universal basic education via classroom interaction in Mathematics using an empirical research design in the Nigerian public primary schools. Study made use of 200 pupils that were selected through simple random technique of every fifth positioned pupils in four public schools out of which 50 pupils were chosen in each school and four classroom mathematics teachers, so that each group of Teacher-Pupils (TP), Pupil-Pupil (PP), Pupil-Materials (PM) and Teacher-Pupils-Materials (TPM) had 50 pupils each. Two research questions and one hypothesis were raised in the study at 0.05 level of significant. One major instrument, which had two sections, was developed, validated and used for the study and it was tagged Part 1: Achievement test on Mathematics and Part 2: Attitudes towards Mathematics (r = 0.68). Data were analyzed through simple percentages, mean and standard deviation, t-test, One-way ANOVA and Scheffe's post hoc statistical tools. Finding revealed that pupils have positive attitude towards Mathematics but negative attitude towards the classroom mathematics teachers with mean scores of 54.9 and 48.5%, respectively. Pre-test mean scores and standard deviation ($\chi$, $\sigma$) of (TP), (PP), (PM) and (TPM) groups were (37.7%, 8.2), (47.4%, 8.8), (45.8%, 8.5), (40.1%, 8.7), respectively while the posttest mean scores and standard deviation ($\chi$, $\sigma$) of (TP), (PP), (PM) and (TPM) groups were (41.1%, 8.9), (55.4%, 10.7), (54.6%, 10.4), (53.0%, 10.3), respectively. Also, there was significant difference in the performance of pupils of the four groups of the classroom interaction teachers-pupils, pupils-pupils, pupils-materials, teachers-pupils-materials groups with (F-cal>F-value; df = (3,196); $p<0.05$) and as a result Scheffe's post hoc analysis was performed with (TP) and (PP) groups having significant difference in their academic performance (Scheffe's value>F-table value; df = (3,196); $p<0.05$), meaning that (PP) group performed better than the (TP) group. Also, there was significant difference in the mean score of academic performance of the (TP) group and that of the (PM) group (Scheffe's value>F-table value; df= (3,196); $p<0.05$), meaning that (PM) group performed better than the (TP) group. Furthermore, there was significant difference in the mean score of academic performance of the (TP) group and that of the (TPM) group (Scheffe's value>F-table value; df= (3,196); $p<0.05$), meaning that (TPM) group performed better than the (TP) group. However, there is no significant difference in the mean score of academic performance of the (PP) group and that of the (PM) group (Scheffe's value<F-table value; df = (3,196); $p>0.05$), meaning that (PP) group did not perform better than the (PM) group. Moreover, there was significant difference in the mean score of academic performance of the (PP) group and the (TPM) group (Scheffe's value>F-table value; df= (3,196); $p<0.05$), meaning that (TPM) group performed better than the (PP) group; but that there was no significant difference in the mean score of (PM) group and (TPM) group (Scheffe's value<F-table value; df= (3,196); $p>0.05$), meaning that (PM) group did not perform better than the (TPM) group. Further implications of the findings were analyzed in the write-up.

**Key words:** Basic education, classroom interaction, mathematics, IPM, PM, PP

## INTRODUCTION

Mathematics as a subject and by design is regarded as the most important key subject and language of science and technology in the contemporary period. If it is developed among the students appropriately, it makes a better society. If it is not applied appropriately, it enslaves the society in misery, poverty, ignorance and diseases. If it is ignored, it destroys the entire society. Meaningful development in Mathematics depends on the nature of interaction between the teacher, pupils and the concept in Mathematics to be taught and this exists within the classroom setting. In fact, quite unimaginable destruction of life and progress of society starts from ill

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conceived and unprepared interaction between the pupils and classroom mathematics teachers, since the role of Mathematics, which embodies the use of number, is indispensable. For instance, the contemporary development of Global System of Telecommunication (GSM) depends on active use of number in order to achieve the user's objective.

Within the classroom setting of Mathematics, there are various types of interactions such as teacher-pupils, pupils-pupils, pupils-materials and teacher-pupils-materials, with each of these interactions having considerable influence on the positive learning of Mathematics among the pupils.

According to Odubunmi (1992) social interaction in a science classroom could foster positive attitude to science among pupils. The implication of this assertion lies in the fact that once an attitude is developed towards a subject the pupils tend to perform very well as attitude must have enhanced the mastery knowledge of the subject.

Within the group of the aforementioned interactions in the classroom, especially in the pupil-pupils interaction, Okebukola (1986) opined that three different interactions still persist depending on the nature of the classroom settings and he identified these as individualistic, competitive and cooperative interactions. Each of these subset interactions has different implications towards the learning of subject in a classroom. As a result of these diverse interaction analyses in the classroom, Owolabi (2004) was of the opinion that these interactions could attain meaningful learning outcome among the pupils especially when pupils acquired the necessary scientific knowledge through social interactions by which they develop all the acknowledged indices for technological advancement. In fact, he posited a model for classroom social interaction in science among which were the identified interactions earlier mentioned. With these interactions and the nature of Mathematics that occupies a central place in the primary school's curriculum (Omaze, 1985), one is confused as to what extent these interactions assist pupils' speed in problem solving in Mathematics, effect of physical environment in Mathematics class, satisfaction in Mathematics, exposes difficulty in Mathematics and as incorporated in the features of Mathematics curriculum. It is due to the nature of interaction between the teachers, pupils that sustain better performance of pupils in Mathematics, as meaningful interaction according to Mischovisk (2001) is a clear indication of attaining success among the pupils. Once this is attained the qualitative universal basic education could be fostered.

**Statement of problem:** The study was designed to examine sustenance of qualitative universal basic education via classroom interaction in Mathematics. Specifically, the study sought answers to the following research questions:

**RQ 1:** What are the mean scores of pupils' attitude towards: Mathematics Mathematics teachers teaching and learning of Mathematics?

**RQ 2:** What are the pre-test and posttest mean score performance in Mathematics of the Teacher-Pupils (TP), Pupils-Pupils (PP), Pupils-Materials (PM), Teacher-Pupils-Materials (TPM) groups?

In view of the above-mentioned questions, one null hypothesis was formulated as:

**$Ho_1$:** There is no significant difference in the posttest mean score performance in Mathematics among the classroom interaction Teacher-Pupils (TP), Pupils-Pupils (PP), Pupils-Materials (PM), Teacher-Pupils-Materials (TPM) groups?

## MATERIALS AND METHODS

The study was an empirical research, which explored the interactions within the classroom settings and its effect on the academic performance of pupils in Mathematics. It consisted of the population of pupils of primary 5 and their classroom mathematics teachers in Lagos State. Meanwhile, a total of 200 pupils randomly selected in 4 public primary schools out of which 50 pupils were chosen in each school via simple random sampling of every 5th pupil in the arms of primary 5 and their classroom mathematics teachers. These selections were further divided into four interactive groups namely Teacher-Pupils (50), Pupils-Pupils (50), Pupils-Materials (50) and Teacher-Pupils-Materials (50). One instrument, though divided into pupils' attitude towards Mathematics and achievement test in Mathematics was developed, validated and used for the study. The instrument tagged Achievement test on pupils' classroom interaction towards learning of Mathematics. In the course of pilot study, the instrument was trial tested on selected 10 pupils of primary 5 and their classroom mathematics teachers with the Spearman rank correlation computed and showed the consistency value of 0.68 within an interval of two weeks. The value was considered high for the reliability of useful instruments, since the selected subjects were outside those of the main study. The attitudinal aspect of the instrument has coded value of

Strongly Agree (SA = 4), Agree (A = 3), Disagree (D = 2), Strongly Disagree (SD = 1) on a Likert format, so that the negative worded question means the reversibility of the scoring. The achievement aspect that contained 50 multiple-choice objectives was scored one mark for the correct answer and zero for the wrong answer. The instruments were administered to the pupils through their classroom mathematics teachers at the commencement of the study and after six weeks of experimentation with close monitoring by the assigned classroom mathematics teachers that ensure smooth transfer of the instruments back to the researcher.

Meanwhile, the data collected was analyzed through descriptive statistics like mean and standard deviation, one-way ANOVA and Scheffe's post hoc analysis at significant level of 0.05. Rationale for the ANOVA was due to four-identified groups of pupils' achievement in Mathematics of the classroom interactions.

## RESULTS

**RQ 1:** What are the mean scores of pupils' attitude towards: Mathematics, Mathematics teachers and teaching and learning of Mathematics?

Table 1 show the pupils' attitude towards Mathematics via the mean score point that was converted to percentages in order to bring out meaningful interpretation. It was observed that virtually all the pupils had good disposition towards learning of Mathematics, but in contrast had negative disposition to their classroom mathematics teachers handling the subject. For instance, items 4, 9, 11and 18 had statements of attitudes of pupils towards classroom mathematics teachers revealed that pupils' interest in the subject is often constrained by the teacher or the environment under which learning takes place, except item 20. What is of interest in the finding is that pupils were of the opinion that Mathematics is not an exclusive subject of masculine as shown in the response of item 1. Meanwhile, the inference that can be made here lies in the fact that irrespective of groups of pupils in the study, all the pupils have positive attitude towards Mathematics and it depends on the circumstances under which learning takes place that determine their achievement.

**RQ1:** What are the mean scores of pupils' attitude towards: Mathematics, Mathematics teachers and teaching and learning of Mathematics?

Table 2 is summary of Table 1 which shows the attitude of pupils towards the subject and the classroom mathematics teachers. It reveals that pupil' attitudinal mean score and standard deviation ($\chi$, $\sigma$) of (54.9%, 0.2530) towards Mathematics and (48.5%, 0.2223) towards mathematics teachers though an over all mean score and standard deviation ($\chi$, $\sigma$) of (53.0%, 0.2852) was obtained. The implication of the finding is that much interest could have been developed among the pupils towards Mathematics but the classroom mathematics teachers teaching the subject have wasted such. Once pupils have no interest in the classroom teacher teaching the subject the level of success in that subject might not be substantive if that subject is not compulsory.

**RQ2:** What are the pre-test and posttest mean score performance in Mathematics of the Teacher-pupils, Pupils-pupils, Pupils-materials and Teacher-pupils-materials groups?

Table 1: Mean and standard deviation of students' attitude

| S/N | Statement | Count | Mean | Std Dev ($\sigma$) | Mean (%) | R |
|---|---|---|---|---|---|---|
| 1 | Mathematics is essential a masculine subject | 200 | 2.13 | 0.939 | 42.6 | D |
| 2 | Mathematical facts are what mathematicians agree they are | 200 | 2.84 | 0.901 | 56.8 | A |
| 3 | The object of mathematical activity is to reveal reality | 200 | 2.64 | 0.911 | 52.8 | A |
| 4 | I feel irritable few minutes before my Mathematics class | 200 | 2.27 | 0.956 | 45.4 | A |
| 5 | I have a feeling of dislike during my Mathematics class | 200 | 2.66 | 0.998 | 53.2 | A |
| 6 | Mathematics is characterized by the methods and process | 200 | 2.57 | 0.963 | 51.4 | A |
| 7 | The Mathematical theory are applicable to other subjects | 200 | 3.12 | 0.823 | 62.4 | A |
| 8 | Mathematical theories are valid if they work | 200 | 2.87 | 1.046 | 57.4 | A |
| 9 | I feel depressed for days after my Mathematics class | 200 | 2.28 | 0.974 | 45.6 | A |
| 10 | Mathematics promotes knowledge in different ways | 200 | 2.83 | 1.056 | 56.6 | A |
| 11 | Mathematics teachers give pupils feedback regularly | 200 | 2.37 | 1.017 | 47.4 | D |
| 12 | I understand Mathematics when in group of colleagues | 200 | 3.01 | 0.852 | 60.2 | A |
| 13 | Constant practice of Mathematics ensure its understanding | 200 | 2.71 | 1.020 | 54.2 | A |
| 14 | Some topics in Mathematics makes the subject difficult | 200 | 2.53 | 0.964 | 50.6 | A |
| 15 | Mathematics text materials encourage learning the subject | 200 | 3.14 | 0.893 | 62.8 | A |
| 16 | Knowledge of numbers is a key to understand Mathematics | 200 | 2.80 | 0.952 | 56.0 | A |
| 17 | My parents often encourage me to learn Mathematics | 200 | 2.65 | 1.028 | 53.0 | A |
| 18 | Mathematics teachers encourage pupils to learn by doing | 200 | 2.18 | 1.057 | 43.6 | D |
| 19 | Compulsory Mathematics for pupils develops society | 200 | 2.61 | 1.006 | 52.2 | A |
| 20 | Mathematics is understood if teachers use aids to teach it | 200 | 2.79 | 1.027 | 55.8 | A |

Keys: A = Agree and D = Disagree

Table 2: Summary mean and standard deviation scores of pupils 'attitude

| Variables | Mathematics | Mathematics teachers | Teaching and learning of Mathematics |
|---|---|---|---|
| Count (n) | 2800 | 1200 | 4000 |
| Mean ($\chi$) in% | 54.9 | 48.5 | 53.0 |
| Standard deviation ($\sigma$) | 0.2530 | 0.2223 | 0.2852 |
| ÓX | 7689 | 2910 | 10600 |
| $ÓX^2$ | 8448633 | 2822759 | 11236325 |

Table 3: Pre-test and post-test scores of achievement test of students

| | | Teacher-Pupils (TP) | | | Pupils-Pupils (PP) | | |
|---|---|---|---|---|---|---|---|
| Tests | Students | Count (n) | Mean ($\chi$) | Std Deviation ($\sigma$) | Count (n) | Mean ($\chi$) | Std Deviation ($\sigma$) |
| Pre-test | 200 | 50 (25%) | 37.7 | 8.2 | 50 (25%) | 47.4 | 8.8 |
| | | Pupil-Materials (PM) | | | Teacher-Pupils-Materials (TPM) | | |
| | | Count (n) | Mean ($\chi$) | Std Deviation ($\sigma$) | Count (n) | Mean ($\chi$) | Std Deviation ($\sigma$) |
| | | 50 (25%) | 45.8 | 8.5 | 50 (25%) | 40.1 | 8.7 |
| Posttest | Students | Teacher-Pupils (TP) | | | Pupils-Pupils (PP) | | |
| | 200 | Count (n) | Mean ($\chi$) | Std Deviation ($\sigma$) | Count (n) | Mean ($\chi$) | Std Deviation ($\sigma$) |
| | | 50 (25%) | 41.1 | 8.9 | 50 (25%) | 55.4 | 10.7 |
| | | Pupil-Materials (PM) | | | Teacher-Pupils-Materials (TPM) | | |
| | | Count (n) | Mean ($\chi$) | Std Deviation ($\sigma$) | Count (n) | Mean ($\chi$) | Std Deviation ($\sigma$) |
| | | 50 (25%) | 54.6 | 10.4 | 50 (25%) | 53.0 | 10.3 |

Table 3 shows equal distribution of 50 (25%) pupils each into four groups such as Teacher-Pupils (TP), Pupils-Pupils (PP), Pupil-Materials (PM) and Teacher-Pupils-Materials (TPM) with their Pre-test and Posttest scores in the administered achievement test. The mean scores and standard deviation ($\chi$, $\sigma$) of the Pre-test score of (TP) group is (37.7%, 8.2), (PP) group has (47.4%, 8.8), (PM) has (45.8%, 8.5) and (TPM) has (40.8%, 8.7). This result shows that all the groups were within the same low range of academic achievement in Mathematics with the lowest and highest means scores found in the (TP) and (PP) groups, respectively. In the Posttest scores (TP) group has the mean scores and standard deviation of (41.1%, 8.9) which was higher than the mean score of the Pre-test score, (PP) group has the mean scores and standard deviation of (55.4%, 10.7) which is no longer in the low range of the Pre-test score but an improvement in performance, (PM) group has the mean scores and standard deviation ($\chi$, $\sigma$) of (54.6%, 10.4) which is higher than the Pre-test mean scores and (TPM) group has the mean scores and standard deviation of (53.0%,10.3) that is higher than the performance of the Pre-test mean scores. Generally, there were varying degree of mathematics performance among the groups in their Pre-test and Posttest scores rate of improvements were 3.4, 8.0, 8.8 and 12.9 for the (TP), (PP), (PM) and (TPM), respectively. The implication of this finding shows that in general pupils were below average in Mathematics Pre-test scores when compared their means scores with public examination like General test's criterion standard. The Posttest mean scores confirmed that pupils could learn better and faster when allowed to play around the materials to facilitate learning rather than teacher's interactive method without materials. At times it could be said that subject like Mathematics is often made difficult via the approach used by the classroom mathematics teachers as shown in the pupils' scores of (TP) group. The interesting aspect of the finding is that of pupils' negative attitude towards classroom mathematics teachers reflects in the achievement scores of the entire students of (TP) group. According to Nwaboku (2006) teacher, the answer is blowing in the wind is indeed true reflection of what is happening in the classroom nowadays when the facilitator is no longer making the learning exciting, instead complicating the issues. One would have expected the (TP) to perform best among all the groups due to existence of facilitator of knowledge yet the handling of these pupils portend a stumbling block to the understanding of the subject. It is possible that classroom mathematics teacher was stereotype to a particular method of teaching that did not promote learning because the result of the (TPM) group demonstrates the effect of the materials in the pupils' scores. It is possible that teacher in the (TP) group do not bring relationship between concept and method used to enhanced learning.

**$Ho_1$:** There is no significant difference in the posttest mean score performance in Mathematics among the classroom interaction Teacher-Pupils, Pupils-Pupils, Pupils-Materials and Teacher-Pupils-Materials groups?

Table 4: ANOVA of posttest scores of grouped students' interactions

| Source of variation | Sum of squares | df | Mean square | F-cal | F-cal | Significant |
|---|---|---|---|---|---|---|
| Between groups | 131.922 | 3 | 43.974 | 28.5085 | 2.60 | p<0.05* |
| Within groups | 302.316 | 196 | 1.54248571 | | | |
| Total | 434.237 | 199 | | | | |

* Significant

Table 5: Scheffe's post-hoc analysis of significance

| Ith group | Jth groups | Scheffe's values |
|---|---|---|
| (TP) | (PP) | 105.296* |
| | (PM) | 93.844* |
| | (TPM) | 72.918* |
| (PP) | (PM) | 0.3295 |
| | (TPM) | 2.9659* |
| (PM) | (TPM) | 1.3182 |

* Significant

Table 4 shows the ANOVA of posttest scores of pupils where it is revealed that there was significant difference in the performance of pupils of the four groups. The study reveals that one group mean score is significant difference in the posttest mean score performance in Mathematics among the classroom interaction Teacher-Pupils, Pupils-Pupils, Pupils-Materials and Teacher-Pupils-Materials groups with (F-cal>F-value; df = (3,196); p<0.05) and as a result Scheffe's post hoc analysis was performed in order to ascertain the actual group that such happened.

Table 5 shows the Scheffe's post hoc analysis of significant of (TP) group and (PP) group where it was found that there was significant difference in the mean score of academic performance of pupils of the two groups (Scheffe's value>F-table value; df = (3,196); p<0.05), meaning that (PP) group performed better than the (TP) group and as such very significant due to treatment effect. Also, there is significant difference in the mean score of academic performance of the (TP) group and that of the (PM) group with (Scheffe's value>F-table value; df= (3,196); p<0.05), meaning that (PM) group performed better than the (TP) group and it is significant. Furthermore, there is significant difference in the mean score of academic performance of the (TP) group and that of the (TPM) group (Scheffe's value>F-table value; df = (3,196); p<0.05), meaning that (TPM) group performed better than the (TP) group. What is interest here is that both groups had teachers to facilitate learning of Mathematics though (TP) group has no materials but it is expected that teacher have the knowledge of the subject to impart on pupils. One would have expected no significant difference between these two groups as their teachers were mandated to cover the same content areas of Mathematics for their pupils within stipulated period. However, there is no significant difference in the mean score of academic performance of the (PP) group and that of the (PM) group with (Scheffe's value<F-table value; df= (3,196); p>0.05), meaning that (PP) group do not perform better than the (PM) group. It is surprise to understand here that the two groups performed better with none better than other, it shows that pupils could learn better either through cooperative learning or when allow finding out things for themselves. Moreover, there is significant difference in the mean score of academic performance of the (PP) group and the (TPM) group with (Scheffe's value>F-table value; df = (3,196); p<0.05), meaning that (TPM) group performed better than the (PP) group. What to observe here is that teacher's allowing pupils to manipulate materials for themselves brings out meaningful learning outcome among pupils thereafter making them perform better than compared group; but that there was no significant difference in the mean score of (PM) group and (TPM) group in their academic performance of pupils with (Scheffe's value<F-table value; df= (3,196); p>0.05), meaning that (PM) group do not performed better than the (TPM) group and this might not be unconnected to the nature of interaction that exists on one hand and the possibility of materials used to enhanced learning.

## DISCUSSION

Towards ensuring meaningful learning outcome in Science and Mathematics different approaches have been suggested by various scholars Okebukola (1986), Odubunmi (1994) just mention few with different contribution. This study has demonstrated the findings of the above-mentioned scholars when one look at the result obtained for the PP, PM and TPM groups of the classroom interaction to foster learning among the pupils. It is a clear indication that pupils learn faster when the teaching is skewed towards them and this is when they are allowed to see, manipulate objects by themselves instead of being remote-controlled by the external person. Study has shown that some of the dismal performance of pupils could be attributed to the manner in which the instruction was presented to them as the case of the TP group, which one would have expected to perform than the rest due to the presence of the teacher. However, the study is in sharp contrast to Moschkovich (2001) that perceive teacher, as facilitator of learning when in actual sense seems to be learning inhibitor. This has buttressed the claim of Nwaboku (2006) that indeed' the answer is blowing in the wind'. Meanwhile, the hope is not lost after all it is the responsibility of the teachers to make pupils understand concept under consideration and

through which they could be evaluated, hence the study recommended that teachers should blend their methodology, enrich with good teaching aids to foster learning in the classroom otherwise their role will be out of need very soon. Furthermore, teachers should encourage mutual participation among the pupils, setting-up the materials and play a guided role in the course of learning among the pupils. It is important to observe here that whatever pupils derive by themselves last longer in memory than what they are told. Also, mastery of concept seem to be clear among the pupils when they are taught with the language within peer group and as such learn faster than situation which present knowledge to them in isolation as the case of conventional teaching strategy of teacher takes all. Hence, teachers' preparation should be overhauled on one hand and that series teaching seminars should be organized for the classroom mathematics teachers towards sustenance of universal basic education.

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