

Full Length Research Paper

Primary school teachers' mastery of primary school Mathematics content

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The study investigated the level of competences (or mastery) possessed by primary school teachers in primary school Mathematics. The population of the study included all primary school teachers in the South-South geo-political zone of Nigeria. Purposive sampling technique was employed to select 252 primary school teachers from the zone who are involved in the National Teacher's Institute (NTI) workshops at two centres in Rivers and Bayelsa States in 2009. A 60-item Primary School Mathematics Content Mastery Test (PSMCMT) was developed, validated and administered to the study sample. Data were analyzed using descriptive statistic (means, percentages, ranking) and inferential statistics (z-test and analysis of variance). Among others, it was found that about 77% of the sampled teachers have low level of mastery of primary Mathematics while only 3.97% exhibit high competences in the content of the subject. The aspects of the content that most teachers have mastery of are basic operations, numbers and numeration and everyday statistics. Most of the teachers have least competences in Algebraic processes. There were no significant differences in the level of mastery of the content by male and female teachers. Differences in the mean Mathematics competence by the more experienced and the less experienced teachers are not statistically significant. Academic qualifications of teachers do not influence their level of mastery of primary Mathematics. No significant difference among the mean mastery scores by B.Ed, NCE and TC II certificate holders. It was recommended that rigorous in-service training and periodic refresher courses in primary school Mathematics be planned and implemented for all primary school teachers- irrespective of their gender, years of job experience or academic qualification.

Key words: Competence, curriculum, educators, Mathematics, mastery, primary, teacher.

INTRODUCTION

Most educators in Nigeria, especially Mathematics educators are, becoming more and more aware that Nigeria's scientific and technological development is predicated on Nigerians' ability to acquire and apply Mathematics. As noted by Ali (1984), the teaching and sustaining the spirit of functional competency in Science and Mathematics is a surer but definitely longer process toward such development. Primary education forms the building blocks for further studies in Mathematics that provides a head-start and determines to a large extent

the consequent development profiles of technology and society. However, several problems have continued to hinder the efforts of Mathematics educators in realizing scientific and technological growth through formal primary education. These problems relate to teacher competency and effectiveness in Mathematics. Research evidence has shown that teacher variables in Mathematics education include knowledge of Mathematics (Harbor-Peters and Ogoamaka, 1991; and Obioma, 1985), teacher effectiveness (Badmus, 1989), teacher competencies (Wu, 1999; Ali, 1989; Obioma, 1985), teacher affective characteristics (Harbor-Peters and Ogoamaka, 1991) and teacher training programmes (Lassa, 1978; Obioma, 1989). The indicators of teacher competency in Mathematics teaching and learning are narrowed

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down by Farrell (1984) as mastery types and developmental types. In Nigeria, primary school teachers serve as generalist subject teachers. They have to be able to teach all subjects such as Mathematics, English language, Basic Primary Science and Technology, Social Studies and so on. Researchers have observed that most primary school teachers demonstrate incompetence in primary Mathematics contents (Obioma, 1985) and their non mastery of the concepts of primary Mathematics (Ibeaja and Ogoamaka, 1986).

Within the past three decades, the Primary School Mathematics Curriculum (PSMC) of Nigeria has been the subject of frequent criticism. Ohuche and Obioma (1983) in assessing the level of readiness of primary school teachers to teach the content of the primary Mathematics curriculum found that the teachers perceived themselves as competent in number, numeration and basic operations but rather perceived themselves as inadequate in Measurement, Geometry and Statistics. The issues of poor curriculum delivery continue to draw and receive the attention of curriculum planners and developers. Lack of adequate mastery of primary school Mathematics content has often been described as a determinant factor in the PSMC implementation. This scenario may be traced to the fact that most primary school teachers appear to be ill-prepared to cope with the teaching of primary Mathematics contents. In fact, a survey of the qualification and exposure of Grade Two teachers by Lassa (1978) shows that most of these cadre of teachers are poorly trained. Yet, after over three decades recent survey show that the situation has gone worse (Ezeilo and Obioma, 1991; Obioma, 1995). Obioma (1989) claimed that more than 60% primary school teachers are either ill-prepared or under prepared to cope with the PSMC. Even in American system it is posited that without a profound understanding of fundamental Mathematics, it is impossible to be a competent Mathematics teacher in Kindergarten 5 (K-5). Wu (1999) argues that it is a fact of human nature that teachers who are uncomfortable with the Mathematics they teach are not the ones to push hard for excellence in the Mathematical performance of their pupils-especially the pupils in K-5- who do not usually make any effort to learn if they are not pushed hard.

It has often been alleged that Primary School Mathematics Teachers do not have mastery of primary school Mathematics contents. There is considerable concern expressed by public outcries which suggest that some primary school teachers are usually not capable of demonstrating content mastery of this subject. What level of mastery of arithmetic content would one have expected of primary school teachers who WAEC referred to as illiterates in the simple arts of numbers? In 1973, the West African Examination Council (WAEC) described the result of Arithmetic Test thus: In view of the work presented to examiners, the consensus of opinion was that majority of those taking the (arithmetic) test were

illiterates in the simple arts of numbers. They believe that they could pass through chance. One wondered whether some had even seen the inside of a classroom (WAEC, 1973),

Frequently, lack of mastery of content is exhibited by teachers during classroom instruction. Recalling Harbour-Peters and Ogomaka (1991) experience with a student teacher who asked his primary 5 pupils to carry out the following operation: $\frac{1}{2} \div \frac{3}{4}$ The student teacher objected

to the following solution:

$$\frac{1}{2} \div \frac{3}{4} = \frac{1}{2} \times \frac{4}{3} = \frac{2}{3}.$$

Instead, he solved it thus:

$$\frac{1}{2} \div \frac{3}{4} = \frac{2}{1} \times \frac{3}{4} = \frac{6}{4} = \frac{3}{2} = 1\frac{1}{2}.$$

During an intervention exercise with the 3rd Cluster in-Service UBE Teacher Professional Support Services of FGN/World Bank Primary Education Project (PEPII) in 2005 in Obio-Akpor Local Government Area of Rivers State, a primary 3 teacher asked one of the investigators of the study to explain a question in her pupils question paper, centrally set, for an end of year examination. The question was: Write this number in expanded form: 549 = ____, ____, and ____. If the teacher had mastery of content, she should have observed a structural error in the question. Correcting the question as 549 = ____ + ____ + ____ would have been of help to the pupils. The two examples show how teachers with different mastery of some basic Mathematics topics mangle their answers or explanations to innocuous questions that naturally arise in a classroom.

From the above observation therefore, it is obvious that the primary school teacher exhibited lack of knowledge of concepts in Mathematics. Is this assertion true of most primary school teachers today? If yes, which category of teachers, (the less experienced or more experienced) would show greater lack of mastery of content? It becomes necessary therefore to verify the state of the art through a mastery test on the Primary School Mathematics content.

OBJECTIVES OF THE STUDY

The main objective of the study is to investigate the extent of teachers' mastery of Mathematics content. More specifically, the study was designed:

1. To ascertain the level of mastery of primary school Mathematic among primary school teachers.
2. To find out the aspect of the primary school

Mathematics in which teachers have the greatest and the least competences.

3. To determine if the gender of teachers, their years of job experiences and academic qualifications influence their mastery of primary school Mathematics content.

RESEARCH QUESTIONS

Two research questions answered were:

- What is the level of mastery of primary Mathematics among primary school teachers?
- In which aspects of the content of primary Mathematics do primary school teachers demonstrate the greatest and the least competence?

HYPOTHESES

Three null hypotheses were tested at 0.05 level of significance:

- There is no significant difference between the mean Mathematics mastery scores obtained by male and female primary school teachers ($p \geq 0.05$).
- There is no significant difference between the mean Mathematic mastery scores obtained by more experienced and less experienced primary school teachers ($p \geq 0.05$).
- There are no significant differences among the mean Mathematics mastery scores obtained by primary school teachers whose highest educational qualifications are TC II, NCE and B.Ed ($p \geq 0.05$).

METHODOLOGY

Sample

The sample for this study consisted of Primary School teachers from the South- South zone of Nigeria. Purposive sampling technique was employed in selecting primary school teachers involved in the NTI workshops at two centers in Rivers and Bayelsa States. These teachers are either holders of teacher's grade two, (TC II), NCE or BEd Certificates. They were participants in the 2009 Millennium Development Goals Training Workshops for Primary School Teachers in the four core subjects (Mathematics, English Language, Social Studies and Basic Science and technology). The sample included 252 male and female primary school teachers who participated in the Millennium Development Goals workshops for Primary School Teachers in Rivers and Bayelsa States in 2009.

Instrumentation

The instrument used for obtaining data relevant for the study is the Primary School Mathematics Content Mastery Test (PSMCMT) developed by the investigators. It consists of two sections. Section I A sought information on the teacher's personal data. These include qualifications and years of experience. Section B

consists of sixty multiple choice tests items of primary school Mathematics content. The PSMCMT has six sections. Section I consists of 10 items assessing the teacher's mastery in number and numeration. Section II consists of 10 items assessing teachers mastery on Basic operation involved in primary school Mathematics. Section III has 10 items assessing teacher's mastery of measurement. Section IV consists of- items assessing teacher's mastery of Algebraic processes. Section V consists of 10 items assessing teacher's mastery of practical and descriptive geometry. Section VI consists of 10 items assessing teacher's mastery of primary school everyday statistics. The test items are designed to assess the following cognitive levels of Mathematics objective - computation, comprehension and application.

The PSMCMT was first developed using a 6×3 (content \times levels) Table of specifications to ensure adequate coverage of content. The PSMCMT was face-validated by three university lecturers who are Measurement and Evaluation and Mathematics Education experts, two in Mathematics Education and one in Educational Measurement and evaluation. This was done by means of experts' opinions sharing a degree of concordance among them that was equal to or higher than 80%. Reliability check of the assessment instrument was conducted on twenty teachers in Akwa-Ibom State, using Alpha Cronbach with a value of 0.87. Therefore, internal consistency was found to be highly reliable for measuring the primary Mathematics content. It was administered to the workshop participants in a captive's situation through the NTI resource persons. It was not a timed test since the teachers were allowed as much time as they wanted. The time taken by the teachers to do the test ranged between one and two hours.

Data were analyzed using descriptive statistics (means, ranking, percentages) and inferential statistics (z-test and Analysis of Variance- (ANOVA). The findings are as presented in Tables.

RESULTS AND DISCUSSION

The results of data analyses are presented in the serial order of listed research questions and hypotheses.

Research Question 1

What is the level of mastery of primary Mathematics among primary school teachers? The scores earned by teachers in the primary Mathematics mastery test were classified into 5-representing the extent of mastery of the subject.

As shown in Table 1, no teacher belongs to the category of very high level mastery. Only 3.97% of the sample exhibited high level of mastery of the primary school Mathematics. About 19.05% have medium mastery of the content while as high as 56.75 and 20.24% have low and very low level of mastery of the primary Mathematics content. Thus, those who have low mastery of the content ranked first followed by those who have very low level of mastery. Put together, about 76.97% of the sample exhibit low level of mastery of primary Mathematics content. This is appalling because no one can effectively teach what he does not know very well. The implication is that majority (about 77%) of primary school teachers does not even have mastery of Mathematics, they are employed to teach. The implication

Table 1. Distribution of Primary School teachers on the basis of their mastery of primary school Mathematics

Sample	Level of mastery of primary Mathematics									
	Very high level mastery (49-60)		High level mastery (37-48)		Medium level mastery (25-36)		Low level of mastery (13-24)		Very low level mastery	
	No	%	No	%	No	%	No	%	No	%
252	0	0	10	3.97	48	19.05	143	56.75	51	20.24
Rank		5		4		3		1		2

Table 2. Mean scores of teachers on mastery of the six aspects of primary Mathematics.

S/N	Sections of Mathematics content	Means score	Rank
	Numbers and Numeration	4.38	2
2	Basic operations	5.73	1
3	Measurement	2.29	5
4	Algebraic processes	1.28	6
5	Practical & descriptive geometry	2.61	4
6	Everyday statistics	2.8	3

is that their training programmes are ineffective and requires intervention. Teachers also need to be given regular in-service training in the content of primary Mathematics that they are teaching.

Research Question 2

In which aspects of the content of primary Mathematics do primary school teachers demonstrate the greatest and the least competence? The mean scores of all sampled teachers were computed for each of the six subsections of the test. The results are indicated in Table 2.

Results of data analysis in the Table 2 reveals that among the primary Mathematics contents, Basic Operation ranked first in the order of mastery by teachers. The mean scores for basic operations (5.73) is the highest. It is indicative of the fact that most primary school teachers have good mastery of basic operations. This is followed by numbers and numerations (4.38) and everyday statistics (2.8). The finding shows that the aspects that teachers have the greatest competences are (1) Basic Operation (2) Numbers and Numeration and (3) Everyday Statistics. It also reveals that most teachers have the least competences in Practical and Descriptive Geometry (ranked 4th) Measurement (ranked 5th) and Algebraic Processes (ranked 6th). The implication is that much needs to be done to improve teacher's competences in Algebraic Processes in which they have the least mastery. Special training programme could be planned to either train or retrain all serving primary school teachers in the contents where their competences are at low ebbs.

Hypothesis 1

There is no significant difference between the mean Mathematics mastery scores obtained by male and female primary school teachers ($p \geq 0.05$). The mean scores earned by male and female teachers on the mastery test in primary Mathematics were computed. The standard deviation scores were also computed. The z-test statistics that was computed to test, the first null hypothesis yielded the result in Table 3.

As shown in Table 3, the mean Mathematics mastery scores by males and female teachers are 21.68 and 18.13 respectively. The z-statistics calculated is 0.27 while the critical value of z-at 0.05 level of significance and 250 degrees of freedom is 1.96. Since z-calculated is less than the z-tabulated value, we would accept the null hypothesis. This implies that there is no significant difference in the mean Mathematics mastery scores by male and female primary school teachers. Although males recorded a higher mean score than females, the difference is not statistically significant.

It is the finding of this study that the difference in the mastery scores by male and female primary school teachers is not statistically significant. This means that male and female teachers are at par when mastery of Primary School Mathematics is the subject of comparison. Other studies by Ball (1988), Harbor-Peters and Ogoamaka (1991), Uwah (2005), Durndell et al. (1990) Head and Ramsden (1990) have noted higher achievement and mastery of science in favour of males. Whitehead (1984) has argued that some types of motivation-extrinsic motivation I (one's competition and desire for a high-status job) and extrinsic motivation II (a desire for a highly paid

Table 3. Z-test analysis of mean scores by male and female teachers on the mastery of Primary Mathematics test.

Parameter	Gender of teacher					
	Male	Female	Z-calculated	Df	Level of significant	z-tabulated
Sample (n)	69	183				
Mean (X)	21.68	18.13	0.27*	250	0.05	1.96
Standard Deviation (SD)	91.27	96.23				

* Not significant at 0.05 level.

Table 4. Z- test analysis of mean scores of the more experienced and less experienced teachers on the mastery of primary Mathematics test.

Parameter	Job experience					
	More experienced	Less experienced	Z-calculated	Df	Level of significant	z-critical
Sample (n)	181	71				
Mean (x)	19.66	17.9	0.14*	250	0.05	1.96
Standard Deviation (SD)	108.03	77.01				

*Not significant at 0.05 level.

job) influences teachers output. This may account for the poor performance of the teachers on the PSMCMT as Obioma (1989) had observed that these teachers showed no sign of motivation.

Hypotheses 2

There is no significant difference between the mean Mathematics mastery scores obtained by more experienced and less experienced primary school teachers ($p \geq 0.05$). Relevant data were subjected to z-statistical tests. The results are as indicated in Table 4.

The data shown in the Table 4 reveals that the mean score obtained by the more experience and the less experienced teachers are 19.66 and 17.9 respectively. This implies that the more experienced teachers exhibit greater mastery of the primary school Mathematics content than their less-experienced colleagues. The finding conforms to a priori expectation that "Practice makes perfect". The more experienced teachers are showing greater competences than the less experienced teachers. This suggests that the school management should endeavour to keep its more experienced teachers and avoid brain-drain so that they can continue to put their experiences to bear in the school system.

It should be noted however that the z-calculated is 0.14 while z-critical is 1.96. Since the calculated is less than the tabulated, we would accept the null hypothesis. It means that the differences in the means by experienced and less experienced teachers is not statistically significant. This calls to question the training programmes that produced the teachers. It suggests that both

experienced and less experienced teachers are yet to master Mathematics content and require rigorous training.

Hypothesis 3

There are no significant differences among the mean Mathematics mastery scores obtained by primary school teachers whose highest educational qualifications are TC II, NCE and B.Ed ($p \geq 0.05$).

The mean primary Mathematics mastery test scores by B.Ed, NCE and TC II teachers were computed. The sum of scores, sum of scores squared, the total sum of scores and the total sum of scores squared were computed. Analysis of variances (ANOVA) was computed. The results are as shown in Table 5.

The data analysis results presented in Table 5 shows that NCE teachers have the highest mean Mathematics mastery score (19.2) followed by B.Ed holders (18.52) while the TC II holders have the least score (15.25). The finding conforms to a priority expectation. Most B.Ed degree holders involved in the study are trained to teach Social Studies, Religions, English, Business Education, Science and Mathematics in the secondary schools while the NCE holders are to teach at the basic education level (Primary and Junior Secondary). It could be that B.Ed holders have learnt more advanced Mathematics and have forgotten the basic ones they are required to teach the elementary school pupils. Refresher courses in the content of primary Mathematics ought to be planned and implemented for all B.Ed holders who teach in primary schools. It is quite unfortunate also to find the TC II

Table 5. Analysis of variance among the mean mathematics mastery scores by B.ED, NCE and TC II teachers.

Parameter	B.ED holder	NCE holder	TC II holder			
Sample (n)	93	147	12			
Sum of scores $\sum x$	1722	2823	183			
Sum of scores squared $\sum x^2$	36938	63907	3997			
Mean (\bar{x})	18.52	19.2	15.25			
$\sum x$ total	4728,	$\sum x^2$ total = 104842,	N Total = 252			
	Df	Ss	Ms	F calculated	Df	F critical
SSb	2	182.35	91.18			
SSW	249	15953.35	64.07	1.42*	249	3.04
SST	251	16135.9				

* Not significant at 0.05 level.

holders coming last in terms of mastery of primary Mathematics. The theory of forgetting and remembering may offer a part of the explanation for the observation.

It can be seen in Table 5 that the F-ratio (Analysis of variance) computed yielded 1.42 while F-calculated is 3.04. Since the F-calculated is less than the F-critical, we would accept the null hypothesis. It implies that there are no significant differences among the mean primary Mathematics mastery scores by B.Ed, NCE and TC II holders. One would have expected the TC II and NCE holders to have significantly higher mastery of the content than B.Ed teachers, but the finding reveals that the 3 groups are at par. The deduction that teachers do not have adequate competences or mastery of primary Mathematics-irrespective of academic qualification does not affect teacher's mastery of primary Mathematics.

CONCLUSION AND RECOMMENDATIONS

Primary Mathematics education forms the building blocks for further studies in Science and Mathematics which provides the consequent development profiles. But one problem that has hindered the efforts to realize the objectives of primary Mathematics education programme is the non-readiness of primary school teachers to teach the content of the primary Mathematics curriculum.

In this study we found that about 77% of the sampled teachers have low level of mastery of primary Mathematics while only 3.97% exhibit high competences. However, most teachers have least competences in Algebraic processes. No significant differences exist in the level of mastery of content by male and female: More experienced and less experienced and academic qualification.

Given the crucial role played by teachers in the lives and learning of children, the possibility of improving their competency seems worth trying. Thus, we recommend

the following:

1. Rigorous in-service training should be given to primary Mathematics teachers;
2. Periodic refresher courses in primary school Mathematics be planned and implemented;
3. The millennium development goals projects of national teachers institute (NTI) should be expanded with more time assigned to the exercise.

For 1-3 above, more primary and secondary Mathematics content should be introduced. This we hope will improve the mastery of the Mathematics content.

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