

ISSN 2346-7355



FRONTIERS OF EDUCATION AND MANAGEMENT

Volume 3, No.1, November, 2015

Published by:

**DEPARTMENT OF EDUCATIONAL MANAGEMENT
FACULTY OF EDUCATION**

**ADEKUNLE AJASIN UNIVERSITY,
Akungba-Akoko, Ondo State, Nigeria**

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MONITORING AND IMPROVING STUDENTS' ACADEMIC PERFORMANCE IN MATHEMATICS USING CURRICULUM-BASED MEASUREMENT IN ILORIN, KWARA STATE, NIGERIA

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Abstract

The study examined the impact of Curriculum-Based Measurement (CBM) on Nigerian senior school students' performance in Mathematics. A total number of 42 Senior Secondary II Students were purposively selected from two schools in Ilorin East Local Government Area of Kwara State, Nigeria. The researcher adopted the quasi-experimental design. The dependent variable is students' performance on the test items administered on them and the independent variable is instructional strategy with gender as a moderator variable. Two hypotheses were formulated and tested using t-test statistics at alpha level of 0.05. The results of the study are that the CBM improves students' academic performance in Mathematics and gender has no influence on the students' academic performance in mathematics. The implications of the results for Mathematics teaching and learning are that teachers could use CBM to teach Mathematics at the secondary school level; Mathematics teachers could be trained in the use of CBM and pre-service teachers' curriculum should include the use of CBM strategy.

Keywords: Curriculum-Based Measurement, Mathematics, Performance test, Gender

Introduction

Mathematics can be described as the backbone of the Sciences. According to Fajemidagba, Salman and Ayinla (2012), Mathematics is a tool for the development of any science-based knowledge such as technology, astronomy, graphics, industry, and analytical reasoning in daily living in a modern society. Animashaun (2002) opined that the in-depth teaching of mathematics contents would provide students with the knowledge not only necessary for successful schooling but also for human survival in everyday life. There is hardly any field of human endeavour that Mathematics is not useful. Salman (2005) stated the usefulness of Mathematics in tailoring, carpentry, driving, town planning, surveying and photography which indicated that mathematics as a discipline is required in all field of life for human survival. One of the goals of Mathematics teaching and learning is the development of the ability to recognize a problem and apply the knowledge of Mathematics to obtain the solution to the problem. Fajemidagba (1986) pointed out that the ultimate goal of Mathematics learning and teaching at every level is to be able to solve problems.

Mathematics as a pivotal discipline for useful living and societal development (Eguavon, 2002) has become so valuable that there is nothing in all human endeavors that does not require the knowledge of Mathematics (Eraikhuemen and Oteze, 2008). Odogwu (2002) and Eguavon (2002), viewed Mathematics as the communication system of those concepts of shape, size, quantity and order used to describe phenomena. To Harbor-Peters (2000), Mathematics is an unending activity without limitations. However, it is necessary for students to have some basic knowledge of Mathematics in order to become a useful and effective member of the society.

Mathematics is construed as very important to the intellectual development and career choice of individual regardless of gender and age (Ebeh, 2000). Thus, it is a means of describing various phenomena, both in physical and economic situations using the concept of shapes, sizes, quantity and orders (Odogwu 2002). Mathematics serves as the only core or compulsory discipline across the globe, there is no nation of the world where Mathematics is not been taught but the language of instruction may be differ due to the official language of each nation.

The traditional chalk-and-board method, which is the most widely used in schools in Nigeria, is not very efficient and effective for the slow and average learners (Adeniyi, 2012). This has also been shown to be ineffective in engaging learners' interest, in developing conceptual understanding of the subject matter and enhancing problem-solving ability (Amazigo, 2001 & Ige, 2001). Other factors identified by Salman (2003), Yilgi and Tongjura (2000) include: limited preparation by Mathematics teachers, fright, anxiety and lack of interest on the part of students; poor methods of instruction, lack of problem solving abilities, self concept, and achievement motivation.

Further to this, the annual Senior School Certificate Examinations results released by West African Examinations Council (WAEC) justified the problematic nature and generalization of poor Senior Secondary School students' performance in Mathematics. A sample of the performance of students between 2006 and 2012 is shown in figure 1. The comprehensive statistics of entries and results for May/June WASSCE from 2006 to 2012 in Nigeria reveals the decline in the performance of students in SSCE Mathematics Examinations.

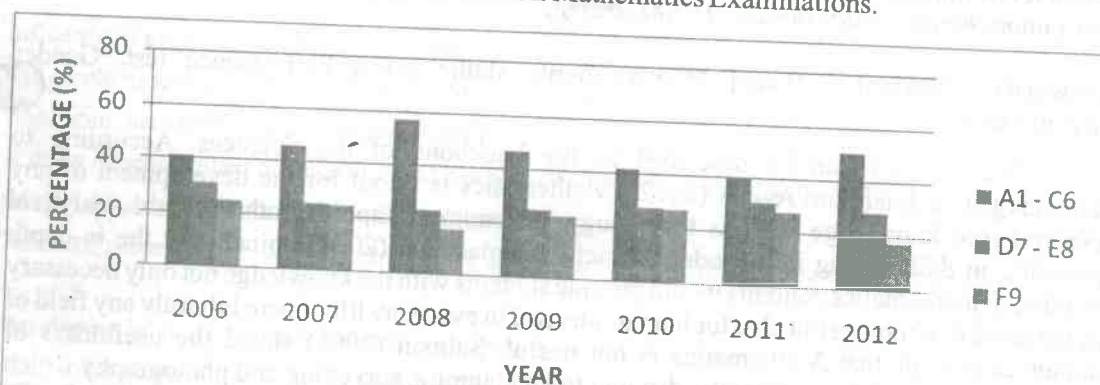


Figure 1. Trends of Students' achievement in Senior School Certificate Examinations in Mathematics in Nigeria from 2006 2012

Source: WAEC, Yaba, Lagos, Nigeria

It is observed that from 2006 to 2008 there was increase in the number of students who performed at Credit level and a decrease at both pass and failure levels in Mathematics in WASSCE Examinations in Nigeria. However, the trend was different from 2008 to 2011 with decrease in the number of students who passed at credit level and increase in both pass and failure levels. This trend may be conjectured to be the result of poor or inappropriate instructional WASSCE Examinations in Nigeria. However, the trend was different from 2008 to 2011 with decrease in the number of students who passed at credit level and increase in both pass and failure levels. This trend may be conjectured to be the result of poor or inappropriate instructional

strategies. There are some new ideas about the teaching of Mathematics contents to students at the school level. The Curriculum-Based measurement (CBM) is one of them and it is generating interest in the minds of Mathematics educators and researchers. CBM is also referred to as a General Outcomes Measures (GOMs) of students' performance in either basic skills or content knowledge. Curriculum-Based Measurement (CBM) is a method adapted by teachers to find out how students are progressing in basic academic areas such as Mathematics, reading, writing, and spelling.

CBM is helpful to teachers because it provides current, week-by-week information on the progress the students are making. When a teacher uses CBM, he or she finds out how well the student is progressing in learning the content for the academic year. CBM also monitors the success of the mode of instruction use by the teachers. If the students' performance is not meeting expectations, the teacher then changes the way of teaching to try to find the type and amount of instruction the students need to make sufficient progress toward meeting the academic goals.

Curriculum-based measurement encompasses an assessment methodology that can be used to develop goals, benchmarks, or short-term objectives for individualized educational programs for students. Teachers also use curriculum-based measurement as a means for monitoring student progress across the year.

CBM is a scientifically validated form of student progress monitoring that incorporates standard methods for test development, administration, scoring, and data utilization (Stecker & Lembke, 2005). It was developed so that teachers would have measurement and evaluation procedures that they could use routinely to make decisions about whether and when to modify a student's instructional program (Deno, 1985).

According to Wright (n.d.) much of the power of CBM seems to lie in its ability to predict in a short time whether an intervention is working or needs to be altered. CBM can help identify students in need of interventions, decide which level of intervention is most appropriate, and determine if an intervention is successful (Mellard & Johnson, 2008).

Many research works have been carried out on instructional strategies in order to address the issue of students' poor performance in Mathematics examination among students. These studies include that of Dambatta (2011) on concept mapping, Adeniyi (2012) on the use of personalized system of instruction; Ayinla (2011) and Fajemidagba, Salman & Ayinla (2012) on teacher instructional strategy pattern; Salman, Ayinla et al (2012) on problem-solving instructional strategy; Salman, Ayinla, Yahaya, Yusuf & Ahmed (2012) on the use of behavioural-based instructional strategy and Okebukola (2002) on role playing and programme instruction. All these instructional strategies have been proved to improve students' academic performance when properly utilized, but the focus of this present study is on how to use Curriculum-Based Measurement as a means of improving students' academic performance in Mathematics through regular and consistent assessment of students' performance and modification of teacher's instruction for enhancing students' progress academically.

Research Questions

The following questions were raised and answered in this study:

- i. What is the effect of Curriculum-Based Measurement on the performance of secondary school students in Mathematics?
- ii. What are the effects of the CBM on secondary school students' academic performance in mathematics when gender is considered?

Hypotheses

As a support to the research questions the following hypotheses were formulated and tested:

HO₁: There is no significant difference in the academic performance of students taught Mathematics using the CBM and their counterpart in the control group.

HO₂: There is no significant difference in the academic performance of senior school males and females taught Mathematics using the CBM in Senior School.

Method

This research work is a quasi-experimental type. It employed the non-randomize non-equivalent, Control group design. The experimental group was taught with the use of the CBM and the control group taught by their teacher who has no knowledge of the CBM

Sample

The sample for the study comprised of 42 students purposively selected for a senior school (SS 2) in Ilorin East Local government Area of Kwara State, Nigeria. Twenty students were assigned to the experimental group and 22 students assigned to the control group. The choice of SS 2 students was considered appropriate because these students are not preparing for any external examination and have sufficient time for the pre-instruction required for the use of the CBM system. The selected schools are co-education schools with Senior Secondary School 1 - 3, the age group of students at this level of education ranges from 13 - 17 years. The students have been taught Mathematics at SS 1 class and at first terms in 2013/2014 academic session.

Instruments and Procedure for Data Collection and Analysis

The following topics were considered for this study; Algebraic Processes (4): Gradients of Straight Lines and Curves (Gradient of a straight line, Sketching graphs of straight lines, Equation of a straight line and Gradient of a curve); Algebraic Processes (5): Algebraic Fractions (Simplification of fractions, Substitution in fractions, Equations with fractions and Undefined fractions) and Numerical Processes (3): Sequences and Series (Sequences, Arithmetic progressions, Geometric progressions, Series, the sum of an arithmetic series and the sum of a

geometric series). The researchers adopted Demonstration method and Instructional strategy pattern to teach the experimental group

Two instruments were developed for this study: (a) Mathematics Progress Test (MPTs) and (b) Mathematics Performance Test (MPT). The Mathematics Progress Test (MPTs) contained five (5) word problems which were adopted by the researchers from the past WAEC Mathematics questions. The West African Examinations Council (WAEC) is a body in charge of senior school certificate examinations in Nigeria and other West African countries. The examinations conducted by WAEC are used for the students to gain admission into tertiary institutions in Nigeria and other countries of the world.

The MPT questions were drawn from the contents of Mathematics covered weekly. The test was given to the students at the end of each week after the treatment. The Mathematics Performance Test (MPT) was adopted from the MPTs and consisted of twenty (20) Multiple choice questions and five (5) theory questions covering all the contents of Mathematics covered for the study. The reliability of the instrument was obtained using test-re-test method, the results obtained were analyzed using Pearson Moment Correlation Coefficient and 0.86 was obtained. Weekly activities during the three weeks period of this study for the experimental group are as shown in Table 1. The researcher taught the students gradients of straight lines and curves in the first week of the experimentation and immediately after the completion of the teaching, the researcher conducted a progress test for the students in order to determine whether the learners really understand the concept taught. The result of the test showed that only 11 students out of the 20 selected students scored 50 percent and above which shows that majority of the students do not understand the concept as expected. Therefore, as one of the rules guiding the CBM, the researcher has to change the mode of instruction in order to make the learner understand the concept better. In the second week of the experimentation, the researcher taught the students Algebraic fractions with use of instructional strategy pattern as an intervention strategy, at the end the 2nd week, the researcher conducted another progress test for the students based on the content covered for the week, the result shows that 16 out of the 20 selected students scored 50 percent and above which is an improvement over the former week performance. Since the majority of the students score above the researcher's set benchmark, therefore as one of the rules of CBM, the researcher needs to retain the intervention strategy adopted and raise the set benchmark from 50% to 60%. In the third week, the researcher taught the students numerical processes with the use of instructional strategy pattern and at the end of the week, another progress test was conducted based on the content covered for the week, the result shows that 18 out of the 20 selected students scored 60% and above which is also an improvement over the 2nd week performance. This shows that the use of instructional strategy pattern brings about students good performance in Mathematics. In the 4th week, the researcher conducted mathematics performance test based on the content covered for the three weeks of experimentation to both the experimental group who was exposed to the use of CBM and the control group who was not exposed the use of CBM in order to determine the effects of the use of CBM on students' performance. The results obtained from this test (mathematics performance test) were used for the data analysis in this study.

Table 1

Weekly activities for the experimental group

W k	Topic Taught	Methodology Adopted	Teacher's Activities	Students' Activities	Feedback	Remarks
1	Gradients of Straight Lines and Curves	Demonstration Method	1. The Teacher demonstrates how to construct both straight line and curves to the students using chalkboard graph with straight edge. 2. The teacher checks the students construction and ask them to make necessary adjustment	1. Students observe the teacher demonstrates and constructs; and do the same in their graph books 2. Students make the necessary adjustment on their construction based on teacher's observation	Only 11 students out of 20 scored the 50 percent and above	Teacher needs to change the mode of Instruction
2	Algebraic Fractions	Instructional strategy Pattern	Teacher gets students to recall/review the prerequisites; indicates nature of expected terminal performance;	Students solved the given problems and write the corrections the teacher made	16 out of 20 students score 50 percent and above	Teacher needs to retain the methodology and raise the bench mark to 60
3	Numerical Processes	Instructional strategy Pattern	Teacher gets students to recall/review the prerequisites; indicates nature of expected terminal performance;	Students solved the given problems and write the correction the teacher made	18 out of 20 students scored 60 percent and above	Teacher needs to retain the methodology and raise the bench mark to 70
4	Mathematics Performance Test for both experimental and the control	The researchers administered the test to the students	The Teacher administered the mathematics performance test to the students under strict	The students write the mathematics performance test	The researchers mark the students scripts	The researchers compared the experimental students

groups supervision

Results

The data collected from the post-test for both the experimental and the control groups were analyzed using mean scores, standard deviation and t-test statistics. The null hypotheses were tested at an alpha level of 0.05 in order to determine the existence of the significant differences.

Research Question One:

What is the effect of Curriculum-Based Measurement on the performance of secondary school students in Mathematics?

Table 2

Mean Gain Scores of Performance of both Experimental and Control Groups

Group	Group Statistics	Pretest	Posttest	Mean Gain Score	Mean Gain Scores Difference
Experimental Group	N	20	20		
	Mean	34.00	53.60	19.60	
	Std Deviation	11.02	4.36		
					4.39
Control Group	N	22	22		
	Mean	32.09	47.30	15.21	
	Std Deviation	7.15	6.40		

Table 2 shows the mean gain scores of students that participated in the Mathematics Performance Test. The mean gain score for students in the experimental group (CBM group) was 19.60, while the mean gain score for students in the control group was 15.21. The mean gain score of the experimental group was 4.39 higher than that of the control group. Further analysis was conducted to test whether the difference in the means was statistically significant; this was shown in Table 3.

Table 3

t-test statistics on the posttest scores of experimental group and the control group

Group	N	Mean	Std Dev	df	t-cal	t-tab
Experimental Group	20	53.60	4.36	40	3.60	2.02
Control Group	22	47.30	6.40			

The result on Table 3 was used to test the first hypothesis. The posttest mean scores of the experimental group is 53.60 and that of the control group is 47.30. The standard deviation for the experimental group is 4.36 and that of the control group is 6.40 respectively. The observed t-value is 3.60 and the critical t-value is 2.20. Since the calculated t-value is greater than the critical t-value, the null hypothesis is rejected. This implies that there is a significant difference in the performance of students exposed to Curriculum-Based Measurement and those in the control group in favour of the CBM group.

Research Question Two

What are the effects of the CBM on senior school students' academic performance in mathematics based on gender?

Table 4

Mean Gain Scores of Performance of Experimental Group based on gender

Group	Group Statistics	Pretest	Posttest	Mean Gain Score	Mean Gain Scores Difference
Male	N	11	11		
	Mean	32.27	54.70	22.43	
	Std Deviation	9.23	3.72		6.32
Female	N	9	9		
	Mean	36.11	52.22	16.11	
	Std Deviation	13.14	5.14		

Table 4 shows the mean gain scores of experimental group students that participated in the mathematics performance test based on gender. The mean gain score of male students was 22.43, while the mean gain of female students was 16.11. The mean gain score of the male students was 6.32 higher than that of the female students. Further analysis was conducted to test the second hypothesis. The results on the test are shown on Table 5.

Table 5

t-test statistics on the posttest scores of experimental group based on gender

Group	N	Mean	Std Dev	Df	t_{cal}	t_{tab}
Male	11	54.73	3.72	18	1.26	2.10
Female	9	52.22	5.14			

In Table 4, the posttest mean and the standard deviation for the male students is 54.70 and 3.72 while that of the female students is 52.22 and 5.14 respectively. The calculated t-value is 1.26 and the critical t-value is 2.10 at 0.05 alpha level of significance. Since the calculated t-value is less than the critical t-value ($1.26 < 2.10$), it means that there is no significant difference in the posttest mean scores of the male and female students. This shows that the two groups performed less equally on the important.

Discussion

In this study, the analysis of the research question one shows that the use of CBM significantly improved the students' performance in mathematics, the mean gain score of the students in the experimental group is 19.60 while that of the control group is 15.21 and the t-test analysis of hypothesis one revealed that the students in experimental group exposed to curriculum-based Measurement performed significantly better in Mathematics than their control group counterpart. This attests to the efficacy of Curriculum-based measurement as a tool for improving students' performance in Mathematics. This finding corresponds with the findings of Mellard & Johnson (2008); Foegan, Jiban & Deno (2007); McMaster & Espin (2007); Stecker (2007) and Stecker & Lembke (2005) that had worked on the effect of curriculum-based measurement (CBM) on students' academic performance in mathematics and found it effective for students' better academics performance.

The research question two revealed that the mean gain score of male students (22.43) in the experimental group is higher than that of their female (16.11) counterpart, while the t-test analysis of hypothesis two revealed that there is no significant difference in the academic performance of male and female students taught Mathematics with the use of curriculum-based measurement, this shows that gender has nothing to do with students performance. This result is

analysis of hypothesis two revealed that there is no significant difference in the academic performance of male and female students taught Mathematics with the use of curriculum-based measurement, this shows that gender has nothing to do with students performance. This result is in agreement with the findings of Ayinla (2011), Adeniyi (2012), and Fajemidagba, Salaman & Ayinla (2012) which stated the gender has nothing to do with students' academic performance. That is, individual student performance is not as a result of been a male or female student but as a result of individual efforts and determination to succeed academically.

Conclusion

Findings from this study revealed the promise of the curriculum-based measurement at improving students' academic performance in Mathematics. Further, the findings revealed that the CBM has promise for both male and female students in the teaching and learning of mathematics.

Recommendations

The following recommendations are considered appropriate and relevant based on the findings of this study: Curriculum-based measurement should be used in teaching at secondary school level of education; more time should be allotted to the teaching and learning of Mathematics (i.e double period); government at all levels should organize training/workshop on how to use CBM to improve students' academic performance for the service teachers and the use of CBM strategy should be included in the Mathematics teacher education programme.

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