Effect of Understanding Learning Outcomes on Students' Performance in Geometry: The Case of Senior Secondary Schools in Maiduguri Metropolis, Borno State, Nigeria

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ABSTRACT

This study seeks to know the effect of understanding learning outcomes on students' performance in geometry taking the case of senior secondary schools in Maiduguri Metropolis, Borno State. Quasi-experimental design is used for the study. A gender based sample of 180 respondents (90 males and 90 females) out of the population of senior secondary school students in Maiduguri Metropolis are selected using stratified random sampling technique. "Mathematics Performance Test (MPT)" for pre-test and post-test with alpha calculated of 0.675 using the test-retest is used for data collection. Data analyses are done using mean, standard deviation and Analysis of Covariate (ANCOVA). The results of the analysis show among others that Understanding Learning Outcomes has significant effect on Students Performance. Also, the study reveals that gender difference has significant effect on Students' Performance when the techniques involved in Understanding Learning Outcomes were taught properly in senior secondary schools. Thus, students without using Understanding Learning Outcomes is unlikely to adopt a deep approach or to be related to higher quality of learning and difficulties caused by individual differences in the Understanding Learning Outcomes base may result in difficulties in solving mathematics problems. It is therefore, recommended among others that teachers and other relevant stakeholders should motivate and inculcate in students, positive attitudes towards mathematics to promote better academic performance.

Keywords*: Understanding learning outcomes, student performance, geometry, senior secondary schools, mathematics*

INTRODUCTION

In appreciation of the importance of Mathematics and its relevance to national development, Kiplagat, Role and Makewa (2012) confirm that mathematics study is recognized worldwide as the most important subject in most fields of human endeavours. A lot of value were attached to mathematics such as mathematics education is a national priority; the foundation upon which subsequent higher level of education depends on, as the mirror of civilization and a science of

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immutable truths (Betiku, 2001; Obioma, 2005; Maduabum and Odili, 2006, National Mathematical Advisory Panel, 2008). Others include the need for basic knowledge and application of mathematics in science and technology for purposeful and meaningful economic development. The National Policy on Education of Nigeria also reflected that the teaching of problem solving in the classroom is very essential in order to prepare the students for problem-solving challenges outside the four walls of the classroom (Fajemidagba, Salman and Ayinla, 2012). There is evidence that students lack interest in the subject and perform poorly in mathematics education (Agwagah, 2001; Betiku, 2001; Obioma, 2005; Maduabum and Odili, 2006). Studies have also reaffirmed that students at the secondary education level lack skills in answering almost all the questions asked in general mathematics especially in Geometry of circles and 3-dimensional problems (The West African Examination Council (WAEC), 2005; 2006).

It is therefore imperative for Mathematics teachers and other relevant stakeholders to motivate and inculcate in students, positive attitudes towards Mathematics to promote better academic performance. This in focus, draws attention to how the range and complexity of understanding learning outcomes be most effectively used to promote mathematical performance in geometry. This is central to this study. Thus, the study was designed to investigate the effect of understanding learning outcomes on student's performance in geometry, the case of Senior Secondary Schools students in Maiduguri Metropolis, Borno State, Nigeria. Hence, the objectives of this study are to determine the:

1. Effect of understanding learning outcomes on student's performance in geometry among senior secondary students in Maiduguri Metropolis, Borno State.
2. Gender difference in the effect of understanding learning outcomes on students' performance in geometry among senior secondary students in Maiduguri Metropolis, Borno State.

The following null hypotheses were formulated for the study.

1 Teaching prior knowledge of basic geometric and mensuration concepts does not have significant effect on understanding learning outcomes in geometry in Maiduguri Metropolis, Borno State.

2 Effect of understanding learning outcomes on students' performance in geometry among senior secondary students in Maiduguri Metropolis, Borno State does not vary with gender

METHOD

This study adopts the quasi-experimental research design. A gender based respondents of (180 = 90 males and 90 females) senior secondary school II (SSII) students were selected using stratified randomly sampling technique from a population of senior secondary school students in Maiduguri Metropolis. The study involves Mathematics Performance Test (MPT) divided into two sections.

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Section A with 35 multiple choice questions which measured the prior knowledge of basic geometric and mensuration concepts and Section B contained ten written questions in geometry (angles subtended by chords in a circle, angles subtended by chords at the centre, perpendicular bisectors of chords and angles in alternate segments, the angle which an arc subtends at the centre is twice the angle it subtends at the circumference, and angles in the same segment of a circle are equal and angles in a semi-circle is a right angle) of senior secondary two (SSII) served as the research instrument. The instrument was pilot tested and validated with a reliability index of 0.675 by test-retest. The experiment was conducted within ten lessons spread over six weeks. The data was obtained from the scores of the pre-test and post test scores.

Before the commencement of the treatments, the pre-test was administered to the participants of both the control and treatment (experimental) groups. The researchers recorded the scores of the participants. After the pre-test, the experimental groups were taught how to understand the geometry topics of senior secondary. While the control groups were taught some brief biography of some Prominent Nigerian Mathematicians as some placebos and the geometry topics of senior secondary. This involves answering some questions such as: ABCD is a parallelogram with CD produced to P. Join PA and PB, if PB meets AP at Q and the area of triangles AQP and QAB are $24cm^2$ and $72cm^2$, respectively, find the area of quadrilateral BQAC. Here the method of understanding learning outcomes and the geometry topics of senior secondary II should include answering the following: what is angle and angles at a point are…, vertically opposite angles are…, how do we bisect or construct angles such as 30^0, 45^0, 60^0 and 90^0, is the condition mentioned sufficient bisect or construct, how do we draw a figure or introduce a suitable notation respectively. Expected responses are 360^0, equal, use ruler, drawing, and compasses and set square.

After the treatments, the data collected on gender of pre-test and post-test scores were used to test the hypotheses of the study. ANCOVA with pre-test as covariate, gender and status as fixed factors, and post test as dependent variables were used to test the hypotheses. ANCOVA is used in experimental studies such as quasi-experimental pretest posttest design (Vogt, 1999). Thus, the ideal application for an analysis of covariance in an experiment like this study was that subjects are randomly assigned to treatments and the expected value of the covariate mean for each group was the same. Therefore, any differences were attributed only to chance, as the covariate was measured before the treatments. These had primarily reduce the error term and remove any bias in the dependent variable means caused by change group differences on the covariate (Howell, 2002; Huck, 2004; Leech, Barrett, and Morgan, 2005). In this study, pre-test scores were used as covariate. Data obtained were analyzed using arithmetic mean, standard deviation and Analysis of Covariance (ANCOVA) at 0.05 level of significance and the results were analyzed and presented using tables. The

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ANCOVA were carried out using SPSS 16.0. Mean and Standard Deviation of variables analysed were obtained as part of the output of the analysis.

RESULTS AND DISCUSSION

In understanding learning outcomes, the result of ANCOVA in table 2 indicates that there was significance difference between the experimental and control groups in pre-test. It also shows that there was significant difference in status, which implies that there was significant difference between experimental and control groups in post-test. This means there was significance difference between the experimental and control groups post-test on effect of teaching prior knowledge of basic geometric and mensuration concepts on student understanding learning outcomes in geometry of senior secondary school. The null hypothesis one which states that teaching prior knowledge of basic geometric and mensuration concepts does not have significant effect on understanding learning outcomes in geometry was therefore rejected. Thus, teaching prior knowledge of basic geometric and mensuration concepts has significant effect on students understanding learning outcomes in geometry among senior secondary school. Since the post test of the experimental group 5.98 was higher than the control 5.96. The difference was in favour of the experimental group. The teaching of prior knowledge has improved the performance relative to teaching of biography.

Also, table 2 shows that there was no significant gender difference. This shows that there is significant interaction between males and females in respect of gender. The null hypothesis two which states that effect of teaching prior knowledge of basic geometric and mensuration concepts on understanding learning outcomes in geometry among senior secondary students' does not significantly vary with gender was therefore accepted. Since the male post-test was 6.06 higher than the female 5.88. The difference was in favour of male. Thus, gender difference in teaching prior knowledge of basic geometric and mensuration concepts have effect significant on understanding learning outcomes in geometry of senior secondary students. This implies that gender difference in teaching prior knowledge of basic geometric and mensuration concepts on understanding learning outcomes in geometry of senior secondary students had more effect on males than females.

The results of this study show that teaching prior knowledge of basic geometric and mensuration concepts had significant effect on student's general cognitive performance in geometry. In other words, students who were exposed to prior knowledge of basic geometric and mensuration concepts improve more than those who were not on general cognitive performance in geometry. Male students outperformed female students as a result of the effect of understanding learning outcomes in geometry among senior secondary school students. Thus, Students who were exposed to understanding learning outcomes improved in

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their performance in geometry than those who were not exposed. This is to say that understanding learning outcomes improve students performance in geometry. Also, male students do performed higher than female when students were exposed to understanding learning outcomes in geometry. In other words, there was significant gender difference in favour of males when students were exposed to understanding learning outcomes in geometry.

This study investigated effect of understanding learning outcomes on students performance in geometry among senior secondary school. The study was consistent with the constructivism theory advocated by Bruner (1966) which emphasizes that students should actively construct their individual mathematical worlds by reorganizing their experiences such as understanding learning outcomes in an attempt to solve their problems (Cobb, Yackel and Wood, 1992). The study found that understanding learning outcomes as well as gender difference has significant effect in geometry when using understanding learning outcomes among senior secondary school students as total difference between means of experimental and control groups, male and female students, pre-test and post test results were not static.

The study corroborate with the findings of Glaser and De Corte (1992) cited in Dorchy (1996) which reveals that difference in performance between boys and girls are attributed to the possession of masculine and feminine genotype known as logos and eros in males and females respectively. Also the key to developing an integrated and generative knowledge base is to build upon the learners' prior knowledge. This statement clearly implied that individual differences in the prior knowledge base are a primary source of differences in student's achievement (Dorchy, 1996). Piaget and Inhelder (1969) pinpoint that the way children think and reason are qualitatively different from older children and adults. Their responses to questions are usually different from older peers because they think differently. The quality of answers and the way they tackle problems become more and more refined with increase in age. Piaget (1971) also describes human behaviour as ability to use past experience in order to solve the present and future problems.

Specifically, on the issue of effect of understanding learning outcomes on students' performance in geometry, the null hypotheses tested found that understanding learning outcomes had significant effect on students' performance in geometry as the post-test mean for the experimental group was 5.98, while that of control group was 5.96. The difference between experimental and control groups was therefore 0.12 in favour of experimental group. Furthermore, there was significant difference in status, that is there was significant difference between experimental and control groups in post-test at the 0.005 level as partial eta squared in respect of the status was 0.01 This means there was significant difference between the pre-test and post-test on effect of student understanding learning outcomes in geometry among senior secondary school. This is in-line with

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Clements and Battista (1992) study which found that students misconception in geometry lead to a "depressing picture" of their geometric understanding. These misconceptions can be traced to students focus on a limited number of examples of the shape plus the students' tendency to consider inessential but common features as essential to the concept. On gender difference, the study shows that there was significant gender difference. Also, there is no significant interaction between status and gender as the partial eta squared in respect of status and gender was 0.00 and there is no significant interaction between male and female as there was no partial eta squared in respect of gender. In other words the mean of post-test scores of male was 6.06 and female were 5.88. The difference was 0.18 in favour of male. Dochy (1996) agrees that individual differences in prior knowledge base are primary source of differences in student's achievement.

Table 1: Mean/standard deviation of effect of teaching prior knowledge of basic geometric and mensuration concepts on understanding learning outcomes

		Pre-Test		Post-Test	
Group	**Gender**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Experimental	Male	4.78	1.44	6.07	1.18
	Female	4.44	1.34	5.89	1.34
	Total	4.61	1.39	5.98	1.25
Control	Male	4.27	1.56	6.04	1.13
	Female	4.42	1.29	5.87	1.22
	Total	4.35	1.43	5.96	1.17
Total	Male	4.61	1.40	6.06	1.15
	Female	4.43	1.31	5.88	1.38
	Total	4.91	1.49	5.94	1.42

Source: School record of the principals of the three participating schools, 2014

Table 2: Result of ANCOVA on effect of teaching prior knowledge of basic geometric and mensuration concepts on understanding learning outcomes

Source	**SS**	**Df**	**MS**	**F**	**Sig.**	**PES**
Preund	36.03	1	36.03	28.02	0.00	0.14
Status	1.92	1	1.92	1.50	0.22	0.01
Gender	0.00	1	0.00	0.00	0.98	0.00
Status * Gender	0.20	1	0.20	0.15	0.70	.00
Error	225.04	175	1.29			
Total	6827.00	180				
Corrected Total	262.73	179				

Key: *SS = Sum of Squares; Df = Degree of freedom; MS = Mean Square; F = Frequency; Sig. = Significance; PES = Partial Eta Squared; Preund = Pre-test of understanding learning outcomes.*

Source: School record of the principals of the three participating schools, 2014

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this study, it was concluded that teaching prior knowledge of basic geometric and mensuration concepts can significant have effect on learners performance in geometry by general cognitive performance, remembering, understanding, applying, analysing, evaluating and creating learning outcomes among Borno State senior secondary students. This implies that where prior knowledge of basic geometric and mensuration concepts were adequately taught

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learners performance in geometry will be high on general cognitive performance, remembering, understanding, applying, analysing, evaluating and creating learning outcomes among senior secondary students. The findings also reveal that gender difference have significant effect on general cognitive performance, remembering, understanding, applying, analysing, evaluating and creating learning outcomes when teaching prior knowledge of basic geometric and mensuration concepts in geometry. The findings show that female students performance in geometry will be high than male student performance when teachers use prior knowledge of basic geometric and mensuration concepts on general cognitive performance, remembering, understanding, applying, analysing, evaluating and creating learning outcomes among senior secondary student's. However, the study recommends that students should be exposed to understanding learning outcomes in order to improve their performance in geometry, and gender difference in understanding learning outcomes using any concepts of any aspect of other subject among senior secondary schools students should not be a matter of concern when teaching.

Further studies should be conducted on effect of understanding learning outcomes in other aspects of mathematics of Federal or States senior secondary school students. The study should be replicated in other States of the Federation to enable comparative analysis. Some topics using their general cognitive performance, remembering, applying, analysing, evaluating and creating learning outcomes in other aspects of mathematics of Federal or States senior secondary school students should be studied. Some topics using gender difference to teach general cognitive performance, remembering, understanding, applying, analyzing, evaluating and creating learning outcomes in other aspects of mathematics of Federal or States senior secondary school students should also be studies.

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