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Efficacy of Cognitive Learning Outcomes on Students' Performance in Geometry among Senior Secondary Students School in Maiduguri

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Abstract

In this research we investigate whether Cognitive learning outcomes have efficacy on students' performance in geometry of senior secondary schools. The objective of the study was to determine whether Cognitive learning outcomes has significant efficacy on students' performance in geometry among senior secondary schools. The study tested there is no significant efficacy of Cognitive learning outcomes on students' performance in geometry among senior secondary school. A quasi-experimental design was adopted and three senior secondary schools were selected to drawn 30 male and 30 female students from each school respectively using stratified randomly sampling technique. Geometry Achievement Test (GAT) served as the research instrument. The instrument was validated and its alpha reliability index was obtained to be 0.7 using test-retest. Mean, standard deviation and Analysis of Covariance (ANCOVA) were statistical tools used for analysing from scores of pre-test and post-test. The finding showed that Cognitive learning outcomes has significant efficacy on students' performance in geometry among senior secondary schools. Thus, Cognitive learning outcomes has significant efficacy on students' performance in geometry among senior secondary schools. It is therefore, recommended that there is significant efficacy of Cognitive learning outcomes has efficacy on students' performance in geometry among senior secondary schools.

Keywords: Cognitive learning outcomes, efficacy, students' performance and geometry

Introduction

Knowledge is growing as new demands and changing circumstances lead to more specialized and expanding exponentially. For instance, in 20 century learning was emphasized on how to manufacture services, while the 21st century dwelt on information and knowledge services. These indicate that knowledge in the 21st century learning skills consider Information and communication technology as a means of transforming how human being learn, the nature of how work shall be conducted and the meaning of social relationships for shared decision-making, information sharing, collaboration, innovation, and speed for entrepreneurships and enterprises education.

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Furthermore, knowledge shall no longer be used in the conduct of manual labour or use of routine skills where machines or easily out-sourced to less expensive labour markets. Moreover, successful knowledge is ability to communicate, share, and use information to solve complex problems, adapt and innovate in response to new demands and changing circumstances. Others involves to command and expand the power of technology to create new knowledge. Therefore, the basic skill competencies and knowledge expectations of the 20th century have not addressed the complex problem of the 21st century. Some authors such as Carroll in 2007 and Trilling and Fidel in 2009 have suggested some means of meeting these challenges in schools includes enabling students to acquire the creative thinking, flexible problem solving, collaboration and innovative skills that will be need to successful in work and life.

Several countries realised mathematic education as a national priority; the foundation upon which subsequent higher level of education depends on; the mirror of civilization and a science of immutable truths (Agwagah, 2001; Obioma, 2005; Okereke, 2006). The role of mathematics education study as the most important subject in most fields of human endeavours and is recognized worldwide was reaffirmed by Kiplagat, Role and Makewa in 2012.

Also, the National Policy on Education of Nigeria (FRN, 2013) emphasizes on the need for basic knowledge and application of mathematics in science and technology for purposeful and meaningful economic development. It is also reflected that the teaching of problem solving in the classroom is very essential means of preparing the students for problem-solving challenges outside the four walls of the classroom (Fajemidagba, Salman & Ayinla, 2012).

Although a lot of value were attached to mathematics, but evidences shows that students lack interest in the subject and they perform poorly in mathematics education (Agwagah, 2001; Obioma, 2005; Maduabum & Odili, 2006). Studies have also reaffirmed that students at the secondary education lack skills in answering almost all the questions asked in general mathematics especially in Geometry of circles and 3-dimensional problems in particular (The West African Examination Council ((WAEC), 2006).

The curricular content of mathematics in Nigeria is based on the syllabus prepared by the NERDC for both Universal Basic Education and senior secondary levels. But students preferred to answer questions on number and numeration, algebraic processes and statistics. In facts there were apparent advantages and merits attached to skills in answering questions in geometry of circles and 3-dimensional problems. Such advantages and merits include time management, easy to earn higher marks and less space consumption compared with the other aspects of mathematics at the secondary education.

Previous studies attributed students' poor performance in mathematics at the Basic Education and senior secondary school levels to factors such as the societal view that mathematics is difficult, lack of mathematics laboratory, lack of incentive, the abstract nature of mathematics, poor teaching facilities, shortage of qualified mathematics teachers, overloaded curriculum activities, poor funding, politics in the educational system, non-availability of necessary facilities, drill and verbal recitation methods, cultural beliefs, and making sense of extant knowledge, negotiating meaning,

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comparing what is known to new experiences as well as resolving discrepancies between what is known and what seems to be implied by new experiences(Ajagun ,2000; Igbokwe, 2000; Ogunkunle, 2000; Madu, 2004; Nnaka & Anaekwe,2004; Okebukola 2005; Ogbeba & Ogbeba, 2007; Umoren & Aniashi, 2007). Other includes inadequate instructional material, poor teaching methods, faulty curriculum and student's attitudes to sciences and mathematics.

Dochy (1996) identified the diverse skills and knowledge that cause heterogeneity and pose challenges for education. These includes Knowledge of facts (Free recall; enumeration; recognition), Knowledge of meaning (Defining; understanding), Integration of knowledge (Understanding interrelations; classifying; comparing) and application of knowledge (Problem*solving*). This shows differences in types of knowledge that influence the quality of learning and student achievement in a significant manner and general cognitive learning outcomes. In describing what general cognitive learning outcomes is? There is a lack of proper definitions of knowledge, as Dochy & Alexander (1995) showed that there is general vagueness or lack of precision in the definitions. This also lead in the subcategories or forms of general cognitive process such as conceptual knowledge, which is further divided into content knowledge, subjectmatter knowledge, domain knowledge and discipline knowledge, and metacognitive knowledge, which includes self or person knowledge, task knowledge and strategy knowledge.

Despite the investments of the Nigerian government at all levels, academic performance is found to be low at all levels. The question should include what aspect of mathematical knowledge would enhance students' performance in geometry of senior secondary schools' students. The issues may be lack of adequate information on the efficacy of general cognitive learning outcomes on Students' Performance in Geometry among Senior Secondary Students Schools. Although, some scholars have indicated that students' ability to solve mathematics problems can be greatly enhanced, if they are taught to construct useful representations of the given problem such as general cognitive learning outcomes.

Therefore, in attempting to understand students' actions one could raise the question, what is the efficacy of Cognitive learning outcomes on Students' Performance in Geometry among Senior Secondary Students Schools? An understanding of this knowledge is important as it would have implications for the progress made by the students with problems and activation of strategies that are relevant for their solutions.

Objective of the Study

The objective of this study was to determine efficacy of Cognitive learning outcomes on students' performance in geometry among Senior Secondary Schools.

Hypothesis

H_o: Cognitive learning outcomes has no significant efficacy on student performance in geometry among Senior Secondary Schools.

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METHOD

A quasi-experimental design was adopted and three senior secondary schools were selected to drawn from 30 male and 30 female students from each school respectively using stratified randomly sampling technique. Geometry Achievement Test (GAT) served as the research instrument. The instrument was validated and its alpha reliability index was obtained to be 0.7 using test-retest. Mean, standard deviation and Analysis of Covariance (ANCOVA) were statistical tools used for analysing from scores of pre-test and post-test. Geometry Performance Test (GPT) that contained 35 multiple choices and 10 written questions in geometry of senior Secondary two (SSII) served as the research instrument after pilot testing, validation to obtained the reliability index of 0.7 using test-retest method. The experiment was done for a total of ten lessons spread over six weeks. The pre-test and post test scores served as sources of data and the statistical tools consists of mean, standard deviation and analysis of covariance (ANCOVA) at 0.05 level of significance were used in analyzing the data.

Results Table 1: Mean and Standard Deviation on efficacy of Cognitive learning outcomes on Students' Performance in Geometry among Senior Secondary Schools

		Pre-Test		Post Test	
Group	**Gender**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Experimental	Male	41.93	5.53	62.47	3.68
	Female	40.80	4.32	62.18	3.70
	Total	**41.36**	**4.93**	**62.32**	**3.67**

Table 2: ANCOVA on Efficacy of Cognitive learning outcomes on Students' Performance in Geometry

Source	**Sum of Squares**		**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Preclo	10.81	1	10.81	0.39	0.53	**0.00**
Status	5471.71	1	5471.71	198.10	0.00	**0.53**
Gender	628.51	1	628.51	22.75	0.00	**0.12**
Status Gender	*704.47	1	704.47	25.51	0.00	**0.13**
Error	4833.75	175	27.62			
Total	590868.50	180				
Corrected Total	**11848.05**	**179**				

Keys: Preclo = Pre-test of cognitive learning outcomes, Status = Experimental and control groups, Gender = Male and female

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The results of ANCOVA in table 2 revealed that there was no significance difference between the experimental and control groups in pre-test in cognitive learning outcomes. It shows that there was significant difference in status, which is there was significant difference between experimental and control groups in post-test. This means there was significance difference between the experimental and control post tests on efficacy of teaching prior knowledge of basic geometric and mensuration concepts on student general cognitive performance in geometry of senior secondary school. The null hypothesis ($\mathbf{H_o}$) which states that General Cognitive learning outcomes does not have significant efficacy on student performance in geometry among Senior Secondary Schools students in Maiduguri Metropolis, Borno State is therefore rejected. Thus, general cognitive performance has significant efficacy on senior secondary school students in geometry. Since the post test of experimental group 62.32 was higher than that of control group 51.11. The difference was in favour of the experimental group. Therefore, Cognitive learning outcomes has improved the performance relative to teaching of biography.

Also, table 2 shows there was significant gender difference. As there is significant interaction between males and females as the table indicate in respect of gender was $0.00 < 0.005$. From table 4.1a the mean of male post-test was 54.86 and female were 58.58. The difference 3.72 was in favour of female. Thus, Cognitive learning outcomes had more efficacies on female than male.

Summary

The study showed that General Cognitive learning outcomes significant efficacy on student's performance in geometry. In other words, students who were exposed to General Cognitive learning outcomes improve more than those who were not in geometry. The study was consistent with the constructivism theory advocated by Bruner (1966) which emphasized that students should actively construct their individual mathematical worlds by reorganizing their experiences in an attempt to resolve their problems (Cobb, Yackel& Wood, 1992). The study had established whether General Cognitive learning outcomes have significant efficacy on student's performance in geometry of senior secondary school. Quasi-experimental design and Analysis of covariance were used for this study. The study found that when using General Cognitive learning outcomes (remembering, understanding, applying, analyzing, evaluating and creating) of senior secondary school students as total difference between means of experimental and control groups, pre-test and post test results were not static. The study corroborates with the findings of De Corte (1992) that the key to developing an integrated and generative knowledge base is to build upon the learners' general cognitive knowledge. This statement clearly implied that individual differences in the general cognitive base are a primary source of differences in student's achievement (Dorchy, 1996). Piaget (1971) also describes human behaviour as ability to use past experience in order to solve the present and future problems.

Specifically, the null hypothesis (H_o: General Cognitive learning outcomes does not have significant efficacy on students' performance of senior secondary school students in geometry) was tested; the finding revealed that total difference between means of both post test result was

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therefore 11.21, which was in favour of experimental group. Also there was significant difference between experimental and control groups in post-test as partial eta squared in respect of status was 0.53> 0.005 level in geometry when using General Cognitive learning outcomes. This study concluded that students performance improve in geometry when using General Cognitive learning outcomes. This finding is against the works of Schoenfeld (1987) revealed that (1)"geometric form" is preferred over "geometric substances" (2) that a geometry problem not solved in a few minutes is unsolvable, and (3) that geometry (or mathematics) is a collection of facts established by others that "are inaccessible to them except by memorizing". The study is in line with the findings that learners develop understanding, ideas and beliefs about the natural world outside the formal learning environment (Kupier, 1991). Tobin (1991) affirmed that learning science involves making sense of extant knowledge, negotiating meaning, comparing what is known to new experiences and resolving discrepancies between what is known and what seems to be implied by new experiences.

Conclusions

Based on the findings of this study, it was concluded that teaching prior knowledge of basic geometric and mensuration concepts can significantly have efficacy on learners' performance in geometry by General Cognitive learning outcomes (remembering, understanding, applying, analyzing, evaluating and creating) learning outcomes among Borno state senior secondary student's. This implies that where General Cognitive learning outcomes were adequately used in teaching learners, then their performance in geometry will be improved (high) learning outcomes among senior secondary students.

Recommendations

Based on the findings of this study, it is recommended that Students should be exposed to General Cognitive learning outcomes in order to improve their performance in geometry curriculum among senior secondary schools students. The study, therefore suggested further studies should be conducted on each of the General Cognitive learning outcomes.

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