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EFFECT OF FOUR PHASE CONTRUCTIVISM MODEL ON SENIOR SCHOOL STUDENTS' PERFORMANCE IN PROBABILTY IN KABBA METROPOLIS

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Abstract

The study investigated the effect of four phase constructivism model on senior secondary school students' performance in Mathematics in Kabba metropolis. The study utilized quasi-experimental, pre-test, post-test control group design. The population comprised of all senior secondary school students in Kabba metropolis. The sample consisted of 274 senior secondary school mathematics students which were selected using multi-stage sampling techniques. Two research questions and hypotheses guided the study. Mathematics Performance Test is the instrument used for collecting data. The reliability of the instrument was 0.91 using Pearson's Product Moment Correlation formula. Mean and standard deviation was used to answer the research questions, while ANCOVA was used to test the hypotheses at 0.05 level of significance. The results of the study shows that students taught probability using four phase constructivism model significantly differ than those taught using conventional methods. Based on the findings of this study, it was recommended that mathematics teachers should use the four phase constructivism model in teaching and learning of Probability.

Keywords: four phase, Constructivism, Model, Probability, performance

Introduction

Tshabalala and Ncube (2013) was of the view that mathematics is a spine, bedrock and an indispensable tool for scientific, technological and economic advancement of any nation. In mathematics is an important subject not only from point of view of getting an academic qualification at school or college, but also is a subject that prepares the students for the future challenges, irrespective of area one specialized. Sunday (2018) opined that mathematics is intimately connected to all our daily life programs and human life-long settings. Much failure in the school mathematics examinations was associated with methods of teaching that is inappropriate for most students learn mathematics in the classroom. The ineffective methods in teaching and learning of mathematics are due to the conventional method of teaching that has dominated classroom activities today. Also, it has been associated with the dismal performances of students in mathematics. Olorundare (2014) observed that the persistent poor performance of students in National Examinations conducted by WAEC and NECO have hindered a great number of students from gaining admission into tertiary institutions thereby subjecting many of them to unnecessary emotional disturbance.

Wikipedia (2016) defines Probability as the measure of the likelihood that an event will occur. Probability is quantified as a number between 0 and 1. However, it is disheartening to note that with all the importance attached to mathematics in Nigerian educational system, the performance recorded by students in West Africa Senior School Certificate Examination (WASSCE) is very disheartening. From table 1, students' performance in the last five years shows that over two million students could not meet the minimum requirements for securing admission into any tertiary institutions. The reason for this low performance could be as a result of poor learning processes of mathematics concepts. Usman, Agah and Okafor (2017); Unamba, Nwaneri and Nelson (2017) revealed that new ideas and innovative instructional strategies that have proved effective in Mathematics are cooperative learning, problem-solving, Mathematics laboratory and constructivism model. According to Piaget (1969), human beings possess mental structures that assimilate external events and convert them to fit their mental structures. Moreover, mental structures accommodate themselves to new, unusual and constantly changing aspects of the external environment, and the mind is organized in complex and integrated ways (Sunday, 2018).

Unamba, Nwaneri and Nelson (2017) viewed constructivism model as a learning strategy in which learners build connections between existing and new knowledge. Ado (2014) described Constructivism as the philosophical position which holds that any so-called reality is the mental construction of those who believe they have discovered it. From this perspective, learning is said to be a self-regulated process of resolving inner conflicts that become apparent through concrete experience,

discussion, and reflection. The basic idea of constructivism model is that knowledge must be constructed by the learner and cannot be supplied by the teacher. From Piaget‘s definition, knowledge is an interaction between subject and object. It is not a perpetual construction made by exchanges between thought and its object nor a copy of reality by the concepts of the subject that approaches the object without ever attaining it in itself (Abbs, Lai-Mei & Hairul, 2013).Piaget’s-constructivism key concepts that are applicable to learning at any age are Assimilation, Accommodation, Equilibration, Disequilibration and Schemas.

From the constructivist's perspective, learning is not a stimulus-response phenomenon. It requires self-regulation and building of conceptual structures through reflection and abstraction (Umar, 2015). The way in which knowledge is conceived and acquired, the types of knowledge, skills and activities emphasized, the role of the learners and teacher, and how goals are established; all these factors are articulated differently in the Constructivist's perspective. In constructivism instruction, students are encouraged to use their own ways of thinking about solving problems. They are not asked to adopt someone else thinking but encouraged to refine their own. Although the teacher presents tasks that promote the invention or adoption of more sophisticated techniques, all methods are valued and supported. Through interaction with mathematical tasks and other students, the student's own intuitive mathematical thinking gradually becomes more abstract and powerful. The role of the teacher as conceived by Constructivism is to guide and support students’ invention of viable Mathematics ideas rather than transmit knowledge or ways of doing Mathematics to the students (Kauru & Sodangi, 2016).
Nayak (2012) stated that teachers adopting constructivism model must be able to pose tasks that bring about appropriate conceptual reorganizations in students. This approach according to the author requires knowledge of both the normal developmental sequence in which students learn specific mathematical ideas and the current individual structures of students in the class. Teachers must also be skilled in structuring the intellectual and social climate of the classroom so that students discuss, reflect on, and make sense of any mathematics tasks. There are several constructivism models; four phase model; five phase model; six phase model; seven phase model, negotiation model among others. The four phase constructivism model which is the focus of this study includes four stages consistent with cognitive theories on how learning occurs (Sunday, 2018). These faces are shown in table 1

Table 1

Four Phase Constructivism Model

PHASE	Activities
Invitation:	Students recognizes the problem of the day's lesson through observation and then having the decision to tackle the problem
Exploration:	Several attempts would be made to solve the problem (trial and error) but perseverance and consistency are required to keep it on
Proposing:	Haven't arrived at a solution, then the information would be to explanation communicate to others, which is the explanation stage and solution
Taking action:	This phase is the application phase where new knowledge is transferred to develop product and produce the idea.

Source: Bybee and Sunday (1990)

Statement of the Problem

Scholars and stakeholders are continuously worried about the persistent fear and failure students keep experiencing in both internal and external examinations in Mathematics in Nigeria. This is majorly attributed to the dictate and uninspiring teaching methods by mathematics teachers. Suleiman (2011) identified probability as one of the abstract and complex concept in mathematics. The WAEC Chief Examiners' report for 2016, 2018 and 2020 indicated probability as one of the areas students did not perform very well in mathematics. The report further stated that meaningful learning can take place provided mathematics teachers incorporate a good teaching and learning strategy. Several researchers have revealed that Constructivism models enhance students' performance in Mathematics: Ado (2014) study was on trigonometry, Onwuka (2015) study was on geometry at Junior secondary school, Umar (2015) study was on construction and loci, Aydishey and Gharbi (2015) utilize the 4E's on circle and Plane geometry in Iran, while Kauru and Sodangi (2016) investigated 7E's on Algebra in Kaduna state, Nigeria. Usman, Agah and Okafor (2017) studies utilized the 5E's in Geometry at Onitsha zone in Nigeria. None of these studies used the four phase model on Probability in senior secondary schools in Kabba Metropolis. Hence this study investigated the Effects of four phase constructivism model on students' performance in probability in Kabba metropolis of Kogi state.

Research Questions

The following research questions guided the study:

1. What is the difference in the performance of students when taught probability using the four phase constructivism model and those taught using the conventional methods in Kabba metropolis?
2. Will there be any difference in the performance of male and female students when taught probability using the four phase constructivism model in Kabba metropolis?

Research Hypotheses

The following research hypotheses were formulated for the study:

1. There is no significant difference in the performance students when taught probability using the four phase constructivism model and those taught using the conventional methods in Kabba metropolis.
2. There is no significant difference in the performance of male and female students when taught probability using the four phase constructivism model in Kabba metropolis.

Methodology

A quasi experimental design was adopted for this study. This allowed the researchers to utilize intact senior secondary school two (SS2) classes. Probability is usually taught in SS2 so the researchers utilized these periods to carry out the experiment without jeopardizing the flow of the school academic programs. The population of the study comprised of 2346 senior secondary school students in Kabba metropolis. The sample consisted of 274(159 male and 115 female) students which were purposively selected from the Government senior secondary schools in the area. The instrument used for collection of data is Probability Performance Test (PPT) designed by the researchers. The instrument is a forty-item objective test and ten-item short answer essay test. The PPT was validated (content and face) by three experts of mathematics education in the university and one from test and measurement. The test retest methods was used to carry out the reliability of the instrument and Pearson's Product Moment Correlation formula was used to calculate the reliability coefficient which gives 0.89.

The researchers went to the selected schools obtain permission from the School's Principal to be able to conduct research. The mathematics teachers of the selected classes were trained as research assistance which taught the intact classes during their normal mathematics lessons. Pretest and posttest were administered to both the control and experimental groups before and after the treatment respectively. The experiment lasted for six weeks. The collected data was analysed and results obtained as shown in table 2, 3 and 4.

Results

Research Question One: What is the difference in the performance of students when taught probability using the four phase constructivism model and those taught using the conventional methods in Anyigba metropolis?

Table 2

Mean and standard deviation of students taught Probability in the experimental and control group.

Groups	Type of Test	No. of Students	Mean	S-deviation	Mean Difference
Experimental	Pretest	167	27.36	9.21	31.53
	Posttest	167	58.89	11.32	
Control	Pretest	107	28.79	9.35	15.48
	Posttest	107	44.57	12.16	
					16.05

Table 2 shows the mean score of the experimental and control groups. The table indicated that the experimental group had a pretest of 27.36 and posttest of 58.89 with a men difference of 31.53, while the control group had a pretest of 28.79 and posttest 44.57 and a mean difference of 15.48. The results show that the experimental group performed better than the control group with a mean gain of 16.05.

HO_1: There is no significant difference in the performance students when taught probability using the four phase constructivism model and those taught using the conventional methods in Kabba metropolis.

Table 3 *shows the Analysis of Covariance test analysis carried out to determine whether Students taught using four phase constructivism model and those taught*

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	887.237[a]	2	443.619	19.352	.000	.090
Intercept	4659.330	1	4659.330	396.895	.000	.596
Pretest	94.967	1	94.967	8.781	.052	.016
Method	432.349	1	432.349	29.877	.000	.076
Error	3861.347	272	14.196			
Total	176196.000	274				
Corrected Total	3923.995	273				

a. R Squared = .078 (Adjusted R Squared = .091)

with CMT differed significantly in their performance in Probability. This test resulted to F-value 29.88 for the group (Experimental and Control group) is significant at .000 which is less than 0.05 ($p < .05$). Therefore, the null hypothesis stated was rejected. Thus, there is a significant difference in the performance of Students taught probability using four phase constructivism model and those taught with CMT.

Research Question Two: What is the difference in the performance of male and female students taught probability using the four phase constructivism model in Anyigba metropolis?

Table 4

Mean and standard deviation of male and female students taught Probability in the experimental group.

Gender	Type of Test	No. of Students	Mean	S-deviation	Mean Difference
Male	Pretest	86	29.21	10.26	33.22
	Posttest	86	62.43	14.01	
Female	Pretest	81	25.41	8.47	29.72
	Posttest	81	55.13	11.21	
					3.50

Table 4 shows the mean score of the male and female students in the experimental group. The table indicated that the male students had a pretest of 29.21 and posttest of 62.43 with a men difference of 33.22, while the female students had a pretest of 25.41 and posttest of 55.13 and a mean difference of 29.72. The results shows that the male students performed better than the female students with a mean gain of 3.50.

Table 5

Summary of Analysis of Covariance of Student performance based on gender.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	87.158[a]	2	87.158.	2.057	.130	.017
Intercept	5578.110	1	5578.110	329.500	.000	.576
Pretest	43.733	1	43.733	1.562	.213	.006
Gender	81.509	1	81.509	3.234	.143	.011
Error	9238.107	165	55.989			
Total	832196.013	167				
Corrected Total	3923.415	166				

a. R Squared = .019 (Adjusted R Squared = .023)

Table 5 shows the Analysis of Covariance carried out to determine whether Male and Female Students taught Probability using four phase constructivism model differed significantly in their performance.. This test resulted to F-value 3.234 which is not significant at .143 which is above 0.05 ($p > .05$). The Null hypothesis as formulated was not rejected. This implies that there was no significant difference in the performance scores of Male and Female Students taught Probability using Four Phase Constructivism model.

Summary of Major Finding

1. There is a significant difference in the performance of students taught Probability using four phase constructivism model and those taught with conventional methods in favor of those taught with four phase constructivism.
2. There is no significant difference in the performance of students taught Probability using four phase constructivism model based on students' gender.

Discussion

Based on the results in table 2 and table 3, the four phase constructivism model enhances students' performance in probability. This could be as a results of the student-centered approach of the model which allow the students to take the Centre stage of learning and the teacher facilitates knowledge construction. This findings is in line with the findings of Aydishey and Gharbi(2015) whose findings revealed significant difference in students' achievement when taught circle and Plane geometry using the four phase constructivism model in Iran. Also the findings of this study collaborated the findings of Usman, Agah and Okafor (2017) who discovered that constructivism model enhances students' performances significantly irrespective of gender.

Conclusion

Based on the findings of this study it can be concluded that the four phase constructivism model enhances students' performance in Probability significantly without any biased on gender.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Mathematics teachers should endeavor to use the four phase constructivism model when teaching Probability and other related mathematics topics.
2. Workshop should be organize for mathematics teachers on how to effectively use the four phase constructivism model in teaching probability.

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