Effects of Bransford-Stein Model on Performance in Trigonometry, among Senior Secondary School Students in Kano State, Nigeria

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Abstract
The Study examined the Effects of Bransford-Stein Model on Performance in Trigonometry among Senior Secondary School Students in Kano State. The Study used a Quasi-Experimental Pretest/Posttest, Control Group design. A sample of 125 (60 males; 65 females) Senior Secondary School two (SS2) Students were selected from 25 public Schools in Kano Metropolis. Due to lack of enough public Coeducational schools in the State, Four Senior Secondary Schools were drawn for the study, two of the schools were selected from males' schools using random sampling. While the remaining two schools were selected from girls' schools using similar procedure. Two groups were involved for the Study namely: Experimental group (Bransford-Stein Model) and Control group respectively. Out of the selected males' schools one of the schools was used as experimental while the other was used as control group. Similarly, among the selected female schools, one of the schools was used as experimental while the other was used as control group. One research question was answered and one null hypothesis was formulated and tested at $P \leq 0.05$significance level. Trigonometry Performance Test (TPT) with reliability index 0.86 was the instrument used for data collection. Data collected were analysed using Mean, Standard Deviation and student t Distribution Statistics. Based on the findings of the study it was concluded that Bransford-Stein Model has potentials to improve students' performance. The results indicated that students taught using Bransford-Stein Model performed significantly better, than those taught using Lecture Method. Based on the findings a number of recommendations were made among which is the employment of Bransford-Stein Model in teaching Trigonometry at the senior secondary school levels, so as to enhance the students' academic performance.

Keywords: Effects, Bransford-Stein Model, Performance and Trigonometry.

Introduction

Mathematics educators have put in efforts aimed at identifying the major problems associated with the teaching of secondary school Mathematics. Despite the efforts, the problem of poor performance in Mathematics has continued to persist. So many reasons that have contributed to the failure in the subject have been identified by researchers, such as attitude of students, lack of Instructional materials among others. Ale, 2009 has attributed the cause of the poor performance on the conventional lecture method of teaching. According to him, the lecture method of teaching does not allow students to accomplish learning and lack meaningful and authentic learning activities to enable students construct their understanding of knowledge. Furthermore, involvement of students in teaching and learning process such as the use of activity based method which means departure from the traditional methods of teaching is a means of ensuring active learning in Science and Mathematics.

The call for a departure from lecture methods of teaching with its attendant poor performance indices has been sounded by researchers (Abakpa, 2011). The implication of lapses identified in the conventional teaching method is that the non-traditional teaching methods such as problem-solving models that will improve students' performance and retention ability have to be explored. However, Bolaji in Maruta (2018) attributed the cause of the poor performance to the following factors: Demographic (gender, socio-economic status, parent's educational level), Instructional (teacher competency, instructional strategies, and techniques, curriculum, school context and facilities) and Individual (Self-directed learning, Mathematics ability, motivation) factors.

Maruta (2018) however, stressed that, the use of teaching methods especially in Mathematics plays an important role in learning the subject and urged the teachers to employ students' centred methods such as Polya and Bransford-Stein Models used in the research to teach the subject (especially Trigonometry). There exist a number of Models that improve students' performance, attitude and retention available for teachers to use. They include Polya (1957), Bransford-Stein (1984), Gick, (1986) Schoenfeld (1992), among others. In these types of models, students are actively involved in the learning process and the responsibilities of identifying the problem, exploring possible solutions and applying them to arrive at appropriate answers are mainly done by the students. The teacher's role is just to observe and guide.

Teaching mathematics through these Models provide a learning environment for students to explore problems on their own and to invent ways to solve the problems. Such activities allow them to facilitate connections of related ideas, to consolidate their mathematical knowledge and to think creatively. Many researchers and educators have been carrying out several researches and studies on the effects of Polya Model on Students performance and very few cares to determine the effects of the other models such as Bransford-Stein, Schoenfeld, Gick etc. on students' performance. However, having realised the importance of using models to teach the subject, some researchers such as Suleiman (2010), Fajemidagba and Suleiman (2012), Ameen (2013), Rayahu and Kartono (2014), Salman and Ameen (2014) and Maruta (2018) among others have focused on determining the effect of other models especially Bransford-Stein on students' performance. Bransford-Stein models is purely activity based and comprises five stages (1) identification of the problem (2) defining and representing the problem (3) exploiting possible strategies (4) acting on those strategies (5) looking back.

Researches that compared the use of Bransford-Stein Modes with the other Models such as Polya, Schoenfeld, Mayer etc. including the Lecture Methods in teaching Mathematics are very few Maruta, (2018).

Trigonometry is a branch of mathematics that studies relationships between side lengths and angles of triangles. It is that branch of mathematics concerned with specific functions of angles and their application to calculations. There are six functions of an angle commonly used in Trigonometry. Their names and abbreviations are: Sine (sin), cosine (cos), tangent (tan), cotangent (cot) secant (sec) and cosecant (csc). Trigonometry was specifically chosen by the researchers because Topics in Trigonometry are taught for its usefulness in other branches of mathematics, and in generalization of scientific truth. WAEC (2013) reports that it is an aspect of mathematics that presents difficulties to students. Moreover, there is no any external examination be it WAEC, or NECO that does not carry questions from Trigonometry topics, and the students have not been doing well in those questions as persistently being reflected in the Chief examiners' reports, (WAEC 2005-2013).

Objective of the Study

The aim of the present study was to determine the effect of Bransford-Stein Model on students' performance in teaching Trigonometry among senior secondary school students when compared with Traditional Lecture Method.

Research Question

What is the mean score difference in students' performance in Trigonometry between those taught using Bransford-Stein's Model and the group taught with Lecture Method?

Hypothesis

There is no significant mean score difference in students' performance in Trigonometry between those taught using Bransford-Stein's Model and the group taught with Lecture Method.

Methodology

A Quasi-Experimental Design was adopted for this study. The sample of the study consisted of 125 (60 males and 65females) senior secondary school two (SSII) students in four public senior secondary schools in Kano State, Nigeria. The four schools were selected using simple random sampling techniques employing balloting method from 25 senior secondary schools in Kano Metropolitan with a total population of 9,770 students in SSII at the time of this study. Due to lack of enough private coeducational schools in the state, out of the four drawn schools, two of the schools were selected from Males' schools using balloting. The other two schools were selected from the females' schools using similar procedure. Out of the two male schools, one of the schools was used as male experimental group and the other was used as male control group. Similarly, the two selected female schools were used for male experimental and control groups respectively. The Experimental Groups received their treatment using Bransford-Stein's Model and the control groups were taught using the Conventional Lecture Method.

The instrument used to collect data for this study was Trigonometry Performance Test (TPT) with reliability index 0.86. The instrument consisting of 20 items was developed by the researchers based on the SSII Mathematics Curriculum in Trigonometry. The items were constructed using Bloom's cognitive level lower and higher order questions. The lower order questions covered knowledge and comprehension of the cognitive domain while the higher

order questions covered applications and analysis. The 20 items were multiple-choice objective questions with five options (A, B, C, D &E). The TPT was scored out of 100% which means each correct answer is 5marks. The instrument was validated by experts in Mathematics Education. The validated TPT was pretested in a pilot study and the reliability coefficient index was computed using PPMC to be 0.86. The reliability coefficient showed that the instrument was reliable and could therefore be used for the main study (Olayiwola, 2010). The four schools were pretested using (TPT) before the commencement of the treatment and the result was analysed using ANOVA at $P \leq 0.05$ significant level to justify that the four schools were not significantly different in ability level. Later the two groups were exposed to six weeks' treatment by the research assistants who were trained by the researchers for a period of two weeks before the commencement of the experiment. At the end of the 6 weeks' treatments Posttest was administered to the two groups and determined the performance effect of the treatments. The essence of using ANOVA is because we have more than two groups and we are looking for significant difference in the students' learning ability (if any). Because both the control and experimental groups consists of male and female students.

Results

Research Question

What is the mean score difference in students' performance in Trigonometry between those taught using Bransford-Stein's Model and the group taught with Lecture Method?

Table1: Mean Gain Scores of Students' Performance when taught Trigonometry using Bransford-Stein Models and Lecture Method respectively.

Group	N	Mean		Mean Gain Score
		Pretest	Posttest	
Exp (Bransford-Stein)	60	4.33	9.28	4.95
SD		4.653	4.585	
Control	65	4.02	6.22	2.20
SD		3.520	1.745	

The computed mean Pretest scores are, 4.33 and 4.02 for Bransford-Stein Model and the lecture control groups respectively. The computed mean Post test scores are 9.28 and 6.22 for Bransford-Stein Model and the Lecture Control groups respectively. This shows that the experimental group has higher mean scores than the Lecture Control method. Therefore, there exist a difference between the mean performance scores of the experimental and the control groups. To find out how significant is the difference, the null hypothesis was tested using t-Distribution Statistic.

Null Hypothesis:

There is no significant mean score difference in students' performance in Trigonometry between those taught using Bransford-Stein's Model and the group taught with Lecture Method.

Table 2: t-Distribution Statistic on Students' Mean Performance using Bransford-Stein Model and Lecture Method.

Variable	N	Mean	SD	Df	P	Decision
Bransford-Stein Model	60	9.28	4.585	123	0.001	Sig
Lecture Method	65	6.22	1.745			

Results of the student t-test statistic showed that significant difference exists in the performance of students when taught Trigonometry using Bransford-Stein Model and those taught using Lecture Method. Reason being that the calculated P value of 0.001 was less than the $P \leq 0.05$ significance. The groups taught using Bransford-Stein Model had higher mean performance score 9.28 compared to Lecture Method that has the mean performance score of 6.22. This implies that significant difference exists on the academic performance of students in favour of Bransford-Stein Model compared to Lecture Method when used in teaching Trigonometry. Therefore, the null hypothesis was rejected.

Discussion of Findings

From the analysis in the Tables 1 and 2, significant difference exists in the performance of students when taught Trigonometry using Bransford-Stein Model. The students taught using Bransford-Stein Model had higher mean gain score compared to those taught using Lecture Method. The hypothesis which states that there is no significant difference in the Performance of Students when taught Trigonometry using Bransford-Stein Model and those taught with Lecture Method is therefore, rejected.

This study contradicts the findings of Ameen (2013) whose findings reveals that no significant difference was observed when Bransford-Stein Model was used in teaching Trigonometry compared with those taught using the Lecture Method. The findings do not corroborate with the findings of Suleiman (2010), Fajemidagba and Suleiman (2012) whose results of the findings showed that there was no significant difference exists in the performance of students when Bransford-Stein was used in teaching mathematics compared with those taught using the Lecture Method.

The implication of this study is that if students are given the opportunity to learn mathematics through Bransford-Stein Model, their 'mathematics phobia' and sense of difficulty in the subject will vanish leading to greater performance in all examinations.

Conclusion

The results indicate that there is significant difference between the performances of students in favour of those who were taught Trigonometry using Bransford-Stein Model. This implies that Bransford-Stein Model has the potentials to improve students' performance when used in teaching Trigonometry at the senior secondary school level. This may not be unconnected with the number of learning activities involved in the Model compared to the Lecture Method.

Recommendation

Based on the findings of the study, students taught using Bransford-Steins Model had better mean score performance difference in Trigonometry compared with the group taught with Lecture Method. It is therefore, recommended that Mathematics teachers should be given

training by the professional bodies such as Mathematical Association of Nigeria (MAN) and Science Teachers Association of Nigeria (STAN) among others on how to employ the use of Bransford-Stein Model to teach Trigonometry at the senior secondary school level. This will help the learners to be involved in activities that will enable them develop their own critical thinking and understanding of the knowledge.

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