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# EFFECTS OF BRANSFORD-STEIN MODEL ON GENDER ACADEMIC RETENTION IN TRIGONOMETRY AT SENIOR SECONDARY SCHOOLS LEVEL IN KANO STATE, NIGERIA

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## Abstract

*The study examined the effect of Bransford-Stein Model on Senior Secondary School Students' Retention in Trigonometry in Kano State. Quasi-Experimental Design was adopted. The study comprised 9,770 SSII students from 25 senior secondary schools. A sample of 125 students of four intact classes was used. Two of the classes were from girls' schools for experimental and control groups and the remaining two were from boys' schools. One research question and null hypothesis were formulated, answered and tested at p≤0.05. Trigonometry Performance Test with reliability index of 0.86 was used for data collection. ANCOVA was the Statistical tool used. Results indicated that significant difference exists between mean retention scores of male and female students taught Trigonometry using Bransford-Stein Model and those taught using Lecture. Students taught using Bransford-Stein Model retained significantly better than those taught using Lecture Method. It was recommended that seminars be organised on Bransford-Stein Model deployment*.

**Keywords**: Students, Bransford-Stein Model, Retention, Gender and Trigonometry.

## Introduction

Trigonometry has enormous number of uses in science, Engineering and other subjects. Trigonometry is part of mathematics that is concerned with the relationship between the angles and sides of triangles Hornby (2010). Trigonometry application is highly required in other areas such as Oceanography, naval and aviation industries among others. Therefore, it is not surprise regarding the emphasis placed by Nigerian government on learning the subject as outlined in the National Policy on Education (FRN 2013).

Applications of Trigonometry concepts play a great role in science and other subjects such as Architecture, Cartography and building among others. Tuna (2013) expressed that, learning Trigonometry means always seeking the truth and willing to rectify the truth that is temporarily accepted. Despite all the roles played, Trigonometry is still considered very difficult and abstract compared to other mathematical fields, Gur (2009). Students often find errors, misconceptions, and obstacles in learning Trigonometry. For these reasons and many others, it is necessary for any student to learn Trigonometry using activity based method, so that the concepts learnt could easily be understood, remembered, retained and recall at any point in time. Unlike Lecture method, learning Trigonometry using Bransford-Stein Model provides the students with opportunity to improve their critical thinking and participate actively in the learning process.

Efforts to reduce or eliminate some of the difficulties and encourage knowledge retention in learning Trigonometry, calls for the use of an appropriate method /strategy that involves critical thinking and students' active participation in the learning process. Since Bransford-Stein Model consists of verities of students' activities and active participation in problem solving, it was hoped that positive effects on the retention ability of the students may occur when the model was used in teaching Trigonometry.

Some educators such as Suleiman, (2010), Ameen, (2013), Suleiman and Fajemidagba & Suleiman (2012) among others have tested the effect of Bransford-Stein Model on students' performance and compared the effectiveness of the model with the lecture method. However, none of them attempted to find out the effect of the model on the students' retention which is a major factor in determining the students' performance.
Despite the importance attached to Trigonometry, the gender performance and retention in the subject is still discouraging, Maruta (2018).

In discussing the factors affecting students' retention in Trigonometry, reference should be made to gender. Due to the role of retention in learning process, Davis (1979) as cited by Abbas and Habu (2014), maintained that if the learner cannot retain the effects of the previous experiences, there could be no progress from one practice period to another. Several studies by Altiner and Dogan (2018), Hidayati (2020), Sartika and Fatmanissa (2020), Wahyuni and Widayanti (2020) amongst others showed that the students' problem in solving trigonometry tends to be high such as students do not understand the problems given, do not master the basic concept of trigonometry, have problem in determining the formula to solve the problem and performing basic arithmetic operations.
Some educators such as Bichi, (2002), Abakpa, (2011) and Maruta, (2018) among others blamed the conventional method of teaching and regards it as being responsible for the poor concept retention. According to them, the inability of the students to retain and recall the concepts learnt due to lack of active participation in the learning process at an appropriate time plays a great role in their performance.

Azuka (2009). pointed out that an active learning instructional strategies can be created and used to engage students in (a) thinking critically or creatively, (b) speaking with a partner, in a small group, or with the entire class, (c) expressing ideas through writing, (d) exploring personal attitudes and value, (e) giving and receiving feedback, and (f) reflecting upon the learning process.

Retention plays a major role in the understanding, comprehensibility and application of mathematical concepts. According to Ekwue and Umukoro (2011) students learn, retain and understand better when what they are taught is linked correctly and meaningfully related to their experiences and when real life examples are used.

Educational psychologists have used knowledge retention as one of the criteria for distinguishing between short term and immediate memory (Ladan, Dantani, Ayas &Adamu, 2009). The mind acquires the materials of knowledge through sensation and perception (Chianson et al, 2011). These acquired materials in the mind needed to be preserved in the form of images for knowledge to develop. If a stimulating situation happens, retained images are stored to make memorization possible. In the context of this work, retention refers to the act of absorbing, holding, or continuing to hold or have facts or things learned.

According to Ugwuanyi (2014) the ability to remember takes place more effectively when experiences are passed to the learner through the appropriate instructional method.

For the students to have sound academic retention, the conventional method of teaching (teacher centred) needs to be discourage and change completely to students' centred method. Ezeamenyi (2004) in Nnaji (2013) contended that for improvement of retention of learned materials in mathematics, activity-based learning is indispensable. Retention, thus, depends mainly on teaching strategy adopted by the teacher. Nnaji (2013) pointed out that Research evidences have consistently indicted teaching method as a major factor determining the achievement and retention of students in mathematics. Hence, the search for better methods and newer innovations is a great challenge facing science educators. In the same vain Maruta (2018), stated that the conventional method doesn't allow students to participate actively in the learning process and discourages them to have both inductive and deductive reasoning.

According to Maruta (2018), the call for a departure from the traditional method of teaching necessitates the search for an instructional strategy that allows students active participation in the learning process. Maruta (2018) further stressed that, Bransford-Stein Model being one of the instructional models with varieties of students' learning activities has potential to improve the students' attitude, retention and performance when used in teaching Trigonometry.

The question now is how does the use of Bransford-Stein's Model affect the gender academic retention when used as an instructional strategy?

It is for this reason and considering the learning activities involved in the problem-solving Model of Bransford-Stein that the researchers selected Bransford-Stein Model, used the Model and determined the effect of the Model on gender academic retention in teaching Trigonometry. The effectiveness of the Model was compared with that of the Lecture Method.

One of the goals of Trigonometry teaching is to improve the ability of learners to recognize a problem and apply the knowledge of Trigonometry to get the solution to the problem. Learning Trigonometry will remain ineffective without an appropriate teaching strategy. For this reason, the researchers believes that, if students are allowed to experience Trigonometry through Bransford-Stein Model during Trigonometry lessons, their academic retention will improve and their fear in learning the subject will vanish leading to greater positive productivity in all examinations. Through Bransford-Stein Model, learners are given free hands and are exposed to a different strategy for solving problems. The model contains five stages namely: (1) Identification of the Problem, (2) Defining the Problem, (3) Exploring possible solutions, (4) Act on the selected strategy, (5) Look back and evaluate the effects.

**An overview of Bransford-Stein Model**

| Stage | Component of the Problem | Students' activities |
|---|---|---|
| 1 | Identification of the Problem | Awareness that the Problem exist? What are the relevant data in the Problem? What is the relationship between the given information?<br>Is the management of all the terms |

| | | |
|---|---|---|
| | | understood by you? |
| 2 | Defining and representing the problem | Classify the problem information, Sort out the relevant information, Understand the information given in the problem. |
| 3 | Exploring possible strategies | Is there any other approach to the problem? Look for relevant information from another angle. Retrieve knowledge relevant to the problem information from stored knowledge. Do you need a diagram, list or table? |
| 4 | Acting on those strategies | Carry out the plans. Are you using the strategies correctly? Have you used all the important information? |
| 5 | Looking back and evaluate the effects of those activities | Evaluating the result. Which of the strategy leads to the correct solution? Is the solution generalizable? Can you use the strategy for handling another problem? |

**Objective of the Study**

The objective of this study therefore, was to examine the effects of Bransford-Stein Model on students' retention in learning Trigonometry. Specifically to find out if there is any difference between the mean retention scores of Male and Female students when taught Trigonometry using Bransford-Stein and those taught using Lecture Method.

**Research Question**

i. What is the difference between the mean retention scores of Male and Female students when taught Trigonometry using Bransford-Stein and those taught using Lecture Method.

**Research Hypothesis**

$H_0$: There is no significant difference between the mean retention scores of male and female students when taught Trigonometry using Bransford-Stein Model and those taught using Lecture Method

**Methodology**

Quasi-experimental design non-randomized was adopted for this study. The study comprised 9,770 SSII students from 25 senior secondary schools. Samples of 125 students of four intact classes were used. Two of the classes were from girls' schools for experimental and control groups and the remaining two were from boys' schools for experimental and control group. This was due to lack of adequate number of public coeducation senior secondary schools in the state. Otherwise, two intact classes from two coeducational senior secondary schools (to be used for experimental and control groups) could suffice.

## Participants

The population of the SSII students in the metropolis as at the time of the study was 9,770. Two groups were involved for the study namely, experimental and control groups. The experimental groups were taught Trigonometry using Bransford-Stein Model while the Control groups were trained the same concepts of Trigonometry but using the conventional Lecture Method. The experimental group consist of 60 students (30 males and 30 females), while the control group consist of 65 students (30 males and 35 females) respectively.

## Assessment of students' retention on learning Trigonometry

The instrument used to collect data for the study was Trigonometry Performance Test (TPT) with reliability index 0.86. The instrument consisting of 20 items were developed by the researcher 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 items were scrutinized and validated by the experts (Mathematics Educators) in the faculty of education, Ahmadu Bello University Zaria. 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).

## Data analysis procedure

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-week treatments Post-test was administered to the two groups and determined the performance effect of the treatments. After two weeks of no treatment the same questions were reshuffled, administered as post-posttest and determined the retention effect.

## Results

## Research Question

i. What is the difference between the mean retention scores of Male and Female students when taught Trigonometry using Bransford-Stein and those taught using Lecture Method?
ii. To answer the research question, mean retention difference scores of male and female students were used.

| **Table 1:** | **Male and Female Students' Retention Mean Difference Scores** | | | |
|---|---|---|---|---|
| **Treatment Groups** | **Gender** | **Male Mean Post-Post-Test Score** | **Female Mean Post-Post-Test Score** | **Mean Retention Difference** |
| Bransford-Stein | Mean | 18.18 | 14.80 | 3.38 |
| | N | 30 | 30 | |
| | Standard Deviation | 9.538 | 6.359 | |
| Lecture Method | Mean | 9.77 | 10.86 | 1.09 |
| | N | 30 | 35 | |
| | Standard Deviation | 4.323 | 4.388 | |

The outcome of the descriptive statistics in Table 2 showed that differences exist between the Mean Retention Scores of Male and Female Students when taught Trigonometry using Bransford-Stein's Models and those taught using Lecture Method.

The mean retention scores of Male and Female students taught using Bransford-Stein's Model, were 18.18 and 14.80 respectively. While the mean retention scores of Male and Female students taught using Lecture Method, were 9.77 and 10.86 respectively. Looking at these Mean Retention Scores, it was obvious that the experimental group (Bransford-Stein Model)has higher mean retention scores for both Male and Female Students when compared with the lecture method.

The computed mean differences were 3.38 and 1.09 for the Male and Female Students in respect of Bransford-Stein Model and the Lecture Method respectively.

In order to determine how significant, the difference was, Analysis of Covariance was used and tested the hypothesis.

**Hypothesis**

There is no significant difference between the mean retention scores (Post-Post-test) of Male and Female students when taught Trigonometry using Bransford-Stein Model and those taught using Lecture Method.

**Table 2: ANCOVA Summary of Effects of Bransford-Stein Model and Lecture Method on Students' Retention (Post-post-test) Scores in Trigonometry**

| **Source** | **Type III Sum of Squares** | **df** | **Mean Square** | **F** | **Sig.** |
|---|---|---|---|---|---|
| Corrected Model | 2732.612[a] | 3 | 910.871 | 22.003 | .000 |
| Intercept | 44702.401 | 1 | 44702.401 | 1079.822 | .000 |
| Gender | 81.779 | 1 | 81.779 | 1.975 | .161 |
| Groups | 2376.233 | 1 | 2376.233 | 57.400 | .000 |
| Gender*Groups | 311.344 | 1 | 311.344 | 7.521 | .007 |
| Error | 10183.888 | 245 | 41.398 | | |
| Total | 57139.000 | 250 | | | |
| Corrected Total | 12916.500 | 249 | | | |

R Squared = .212 (Adjusted R Squared = .202

The Analysis of Covariance (ANCOVA) statistics above showed that significant differences exist between male and female students' retention scores taught using Bransford-Stein Model and those taught using the lecture method. Reasons being that the Calculated p value of 0.007 on the Gender versus study groups is lower than the 0.05 alpha level of significance and the computed F value of 7.521 is greater than the 3.000 F radical value at df 1.The mean retention scores for male and female students when taught using Bransford-Stein Model were18.18 and 14.80 respectively, while the mean retention scores for male and female students when taught using Lecture Method were 9.77 and 10.86 respectively.

Therefore, the null hypothesis which state that there is no significant difference between male and female students' retention (Post-Post-test) scores when taught Trigonometry using Bransford-Stein Model and those taught using the lecture method was rejected.

## Discussion of Results

Method of teaching was implicated to be a major factor affecting students' academic retention in Trigonometry. The findings of this study revealed that significant difference exist between the academic retention scores of Male and Female students when taught Trigonometry using Bransford-Stein Model and those taught using Lecture Method.

The finding was in line with that of Umar, et al (2006) and Samuel (2013) who reported that there was a significant difference between the retention ability in favour of students taught using problem-solving when compared with those taught using Lecture Method.
The finding was also in line with that of Hoidn and Karkkainen (2014) who reported that students taught using problem-based teaching method retained more knowledge than those taught using LTM. However, the finding contradicts the findings of Wynn, Mosholder and Larsen (2014) who reported that gender effect was insignificant in the knowledge retention of students taught using problem-solving model.

## Conclusion

Based on the findings of this study, it was concluded that Bransford-Stein Model has great potential to improve the academic retention mean scores of Male and Female students when used in teaching Trigonometry when compared with Lecture Method.

## Recommendation

1. Government, through the Ministry of Education should ensure the provision of adequate instructional materials at the Secondary Schools level to facilitate the use of Bransford-Stein Model in teaching Trigonometry in particular and Mathematics in general.

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