EFFECTIVENESS OF ANALOGY INSTRUCTIONAL TEACHING ON STUDENTS' PERFORMANCE IN TRIGONOMETRY IN ZARIA LOCAL GOVERNMENT AREA, KADUNA STATE

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This study sought to investigate the effectiveness of analogy instructional approach on performance of SS II students in Zaria Local Government Area of Kaduna State. A total number of 5936 SS II students formed the population of the study; the sample consisted of ninety-nine (99) students selected from two coeducational school. Where one intact class was randomly selected from arms of SS II students in the selected schools for the study and sorted out into experimental and control groups through balloting. The sample was made up of forty-seven (47) students for the experimental group and fifty two (52) students for the control group. The study employed quasi-experimental design involving pretest and posttest research design. The research was guided by two research questions which were answered using descriptive statistics and two research hypotheses which were tested at P<0.05 level of significance using t-test analysis. The findings revealed that students can improve in their trigonometry performance if analogical instruction is used. More so, analogy instruction is gender friendly. Therefore, the study recommends amongst others, that Mathematics teachers should intensify effort in developing analogies from practical experience to make the students get proper concepts of mathematics and discourage rote learning and cramming of formulae and procedures of obtaining solutions without proper understanding of the concepts being learned

Keywords: Mathematics, Trigonometry, Analogy, Performance, Gender

Introduction

Mathematics is an old discipline, a formal area of teaching and learning that started more than 5000 years ago among Sumerians. As they developed mathematics, they also developed reading and writing (Ambali, 2014). The actual roots of mathematics even preceded the Sumerians as human beings since antiquity had always found reasons to communicate about size, measurement, distance, quantity and time. Thus, mathematics can be viewed as instrument that facilitate the teaching and learning of other formal school subjects and also very crucial a tool for resolving problem situation in all disciplines(Kolawole and Ajetunmobi ,2014).They also submitted that the pivotal position of mathematics to national development has resulted in the educational policy makers' resolve to position mathematics as a compulsory subjects in both pre-tertiary and even for admission into tertiary institutions in Nigeria.

The Nigerian Secondary School Mathematics Curriculum was developed and structured around six (6) main concepts namely: Algebra; Number and Numeration; Geometry; Mensuration; Statistics and probability; and Trigonometry. Orhun(2010) viewed Trigonometry as a branch of mathematics that deals with various properties of functions and the applications of these functions to determine the unknown angles and sides of a triangle and it also forms an important background for solution of problems in many disciplines, such as astronomy, technology and constructions to mention but a few. Trigonometry is an aspect mathematics that mainly deals with measurement of distances, relationship between sides

and angles of a triangle. The knowledge of Trigonometry assists the students to appreciate shapes and situation around their environment and helps to develop their inductive reasoning skills that become necessary ingredient for learning mathematics. Trigonometry constitutes a substantial part of the senior secondary mathematics curriculum, which forms a great part in their assessment in standardized examination such as the West African Examination Council (WAEC) (Abakpa, 2011).

However, despite the importance of Mathematics trigonometry) to the technological development of human in our day-to-day activities and as agent of technological development, students' performance in Mathematics (trigonometry) has not been encouraging. Table 1 illustrate the performance of students in WAEC examination from 2007 to 2017

Table 1.2 Performances of Students in Mathematics in WAEC 2007- 2017

Year	Total No. of students Who Sat	No. of Students that Obtained Credit & Above (A1-C6)	% of Students with Credit & Above (A1-C6)	No. of Students with (D7-F9)	% of Students with (D7- F9)
2007	1,275,330	198,441	15.56	1,076,889	84.44
2008	1,369,142	314,903	23.00	1,054,239	77.00
2009	1,373,009	425,633	31.00	947,376	69.00
2010	1,351,557	453,447	33.55	898,110	66.45
2011	1,540,250	587,630	38.93	952,620	61.07
2012	1,675,224	819,390	49.00	852,834	51.00
2013	1,543,683	555,726	36.00	987,957	64.00
2014	1,692,435	529,732	31.30	1,162,703	68.70
2015	1,593,442	544,638	34.18	1,048,804	65.82
2016	1,544,234	597,310	38.68	946,924	61.32
2017	1,471,151	923,486	59.22	547,665	40.78

Source: (WAEC, 2017)

However, bearing in mind the importance attached to mathematics, the continued poor performance in the subject would lead to ripple effects which will undermine the future development of nation in terms of scientific and technological development. Generally, Trigonometry is an area of study in mathematics that students believe to be particularly difficult and abstract compared with the other contents area in mathematics. Ahmadu (2014) opined a number of factors are responsible for poor performance of students in trigonometry among which include; lack of qualified mathematics teachers that will handle the abstract curriculum that does not address to immediate use of trigonometry in real life, and poor teaching strategies. Therefore, Thompson, Byerley and Hatfield (2013) suggested the use of a constructivists teaching approach which emphasis is on the students-centred as a better option compared to the traditional method.

Analogy refers to a cognitive process of transferring information or meaning from a familiar source (analogue) to an unfamiliar source (target). Holyoak and Stigler (2004) defined analogy as an inductive mechanism based on structured comparisons of mental

representation. Analogy is when some less familiar domains or abstract concepts are made more understandable to the learners by making references to similar relations, objects or situation with which the learners are familiar through activating relevant prior knowledge which is already understood by the learners. The aim is explaining an abstract concept or process by comparing it to something that is familiar to the learners.

Gender is the range of physical, biological, mental and behavioural characteristics pertaining to and differentiating between masculinity and femininity. For many years different studies have been conducted to investigate the effects of gender on academic performance at different levels (primary, post-primary and tertiary) and on different subjects. Muduabum and Odili (2007) studied the trends in male and female students' performance on Further Mathematics (trigonometry) in Senior School Certificate Examination (SSCE) in Nigeria from 1999 to 2005. The findings showed that male attained higher percent scores at credit level than the female.

In a similar study conducted by Anagbogu and Ezelira (2007) in which they examined gender difference in scientific performance in Awka Education Zone, in Anambra, the findings reveled that female students performed better than their male counterparts. It can sum up that literature on gender difference in academic performance reveals mixed results. In view of this, the study intends to find out the effects of analogical instruction on the performance of students in trigonometry and whether, it has effects on gender performance.

Objectives of the Study

The main purpose of this research work was to find out the effects of analogical instruction on performance in trigonometry among secondary school students in Zaria. Specifically, the study sought to investigate the:

1. Effectiveness of analogical instruction on senior secondary school students performance in trigonometry
2. Effectiveness of analogical instruction on the performance of male and female students in trigonometry

Research Question

Based on the stated objectives, the following research questions were formulated for answering: -

1. What is the difference in the mean performance scores between students taught trigonometry using analogical instruction and those taught using lecture method
2. How does the mean performance scores of male and female students differ when taught trigonometry using analogical instruction.

Research Hypotheses

From the research questions, two null hypotheses were formulated and were tested at probability level of $P \leq 0.05$ significance

There is no significance difference in the mean performance scores between students taught trigonometry using analogical instruction and those taught using lecture method

There is no significance difference in the mean performance scores between male and female students taught trigonometry using analogical instruction

Methodology

Research Design

The study employed quasi-experimental control group involving pre-test and posttest as advocated by (Sambo, 2008). This is made of two groups, one experimental and the other control group. The experimental group (E) was taught using analogical instruction while the control group (C) was taught using lecture method. A pre-test was given to both groups before treatment. A post-test was administered after the treatment to determine whether analogical instruction has an effect. Figure 1 illustrates the research design for the study

$$E \longrightarrow O_1 \longrightarrow X_1 \longrightarrow O_2$$
$$E \longrightarrow O_1 \longrightarrow X_0 \longrightarrow O_2$$

Fig.1: Research Design illustration Sambo (2008)

Population and Sample for the Study

The population of the study comprised all the senior secondary two (II) students in Zaria education zone of Kaduna state. This is made up of 22 senior secondary schools with 12 co-educational 5 boys and 5 girls schools with a total population of 5936 comprising of 3306 boys and 2630 girls of average age 16 to 19 years. The sample consisted of ninety-nine (99) students selected from two coeducational schools. Where one intact class was randomly selected from arms of SS II students in the selected schools for the study and sorted out into experimental and control groups through balloting. The sample was made up of forty-seven (47) students for the experimental group and fifty-two (52) students for the control group. Table 2 shows detail of the sample.

Table 2: Sample for the Study

Group	No. of Students		
	Male	Female	
Experimental	**47**	**25**	**22**
Control	**52**	**29**	**23**
Total	**99**	**54**	**45**

Instrumentation

The instrument used for this study was Trigonometry Performance Test (TPT) containing a forty item multiple choice questions with four options (A-D) each obtained from a collection of West African Examination Council (WAEC) past questions papers from (2010 - 2017) relevant to the topics of instruction.

The instrument Trigonometry Performance Test (TPT) was validated by four (4) experts in the field of mathematics education, two Ph.D. holders of the rank of Senior Lecturers from the Department of Science Education, Faculty of Education

ABU, Zaria and two Principal Lecturers from Federal College of Education, Zaria.

These experts validated the instrument based on adequacy and relevancy of the instrument in relation to objectives of the study. Necessary amendments were made on the instrument based on their suggestions.

The study employed a test re test method on the scores obtained from pilot study. After the first test, two weeks interval was given for the second test, this in line with Sambo (2008) recommendation. A reliability coefficient of r = 0.79 was obtained using Persons Product Moment Correlation Coefficient.

The researcher taught the concept of trigonometry selected for the study for six weeks, after administration of pre-test by using lesson plans and lesson notes prepared on analogical instruction. The experimental group was taught using analogical instruction and was exposed to post-test after the treatment. However, the control group was also taught the same concepts based on lesson plans and lesson notes prepared using lecture method after which they were equally exposed to post-test.

Results

The data collected through pres-test and post-test scores of the students were subjected to descriptive statistics

Research Question One: What is the difference in the mean performance scores between students taught trigonometry using Analogical Instruction and those taught using lecture method.

Table 3: Descriptive Statistics on Performance of Experimental and Control groups

Group	N	Mean	S.D	Mean Diff.
Experimental	47	80.65	5.749	
				29.40
Control	52	51.25	6.866	

From Table 3 the mean performance and standard deviation of in Experimental and Control groups were 80.65, 5.749 and 51.25, 6.866 respectively with mean difference of 29.40 in favour of experimental group. Hence, it can therefore be assumed that students in from Experimental group performed better than students from the control group. However, further analysis was conducted to ascertained whether the difference in the means was statistically significant and this led to hypothesis one.

Hypothesis One: There is no significant difference in the mean performance scores of students taught Trigonometry using Analogical Instruction and those taught using lecture method.

Table 4: t-test Analysis on performance of Experimental and Control groups

Group	N	Mean	S.D	Mean Diff.	Tcal	Tcrit	p_{value} Decision
Experimental	47	80.65	5.749	29.40	21.9	1.96	.001 significant
Control	52	51.25	6.866				

Significant at $t_{cal} > t_{crit}$

From table 4 it was observed that there was significant difference between the mean performance scores of experimental (80.65) and the control group (51.25) at 0.05 level of significance ($t_{cal} = 21.9 > t_{crit} = 1.96$; df = 97, $P < 0.05$).

Therefore, hypothesis one was rejected. Hence, there was significant difference in the mean performance scores of students taught trigonometry using analogical instruction and those taught using lecture method.

Research Question Two: How do the mean performance scores of male and female students differ when taught trigonometry using analogical instruction

Table 5: Descriptive Statistics on Performance of Male and Female Experimental group

Group	N	Mean	S.D	df	Mean Diff.	Pvalue	Decision
Male	25	45.00	8.485	45	0.91		
Female	22	45.91	7.904				

Table 5 revealed that the male had a mean score of 45.00 with standard deviation of 8.485 while the female students had a mean of 45.91 and standard deviation of 7.904. this result shows that the female students mean performance score was slightly better than that of their male counterparts

Hypothesis two: There is no significance difference in the mean performance scores of male and female students taught trigonometry using analogical instruction

Table 6: t-test analysis on Performance of Male and Female students (Experimental group)

Group	N	Mean	S.D	df	Mean Diff.	Tcal	Tcrit	Pvalue	Decision
Experimental	25	45.00	8.485	0.91	0.89	1.96	0.730		
N/S Control	22	45.91	7.90						

From table 6, the mean performance and standard deviations of male and female students in experimental group were 45.00, 8.485 and 45.91, 7.904 respectively with mean difference of 0.91 in favour of female students. However, the (t_{cal}=0.89 < t_{crit}=1.96; df = 45, p> 0.05). therefore, the null hypothesis was retained and it was concluded that , there is no significance difference in the mean performance scores of male and female students taught trigonometry using analogical instruction

Discussion of Results

Findings from the study revealed that there is significant effect on the students' performance in trigonometry when taught using analogical instruction. The experimental group obtained higher scores in the Trigonometry Performance Test (TPT) as compared to those who were taught using lecture method. The significant difference in favour of the experimental group suggests effectiveness of analogical instruction. This result is in accordance with findings of Wushishi (2006); Owolabi (2007); and Ayandat et al (2012). Who all opined that analogy instructional strategy is a tool for improving students' performance.

The findings of this study also shed some light on the effects of analogical on gender, the findings revealed that the interaction effect between analogical instructional strategy and gender was not significant on students performance .This findings agrees with earlier studies of Okigbo (2010); Nneji (2013); and Ajai and Imoko (2015) who reported that gender is not a significant influencing factor in students' performance.

Conclusion

Based on the findings of the study, it was concluded that the use of analogical instruction improves students' performance than the lecture method when taught trigonometry. Also, it was concluded that gender is not a significant influencing factor in the students' performance in trigonometry when taught using analogical instruction.

Recommendations

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

1. Teachers at primary and post-primary levels should employ the use analogical instruction in the teaching of trigonometry in senior secondary schools. Since analogical instruction help to improve the performance of students in trigonometry.
2. Science based teachers should be encouraged to be attending seminars and workshops to keep themselves abreast with the new teaching strategies like analogy instruction for better result.
3. Relevant professional bodies like the Mathematics Association of Nigeria (MAN) Science Teachers Association of Nigeria (STAN) should organize seminars and workshops to train mathematics on the use of analogies so that they incorporate it in their teaching of trigonometry.
4. Mathematics teachers should intensify efforts in developing analogies from practical experience to make the students get proper concepts of mathematics and discourage rote learning and cramming of formulae and procedures of obtaining solutions without proper understanding of the concepts being learned.

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