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## ANALYSIS OF TEACHERS PERCEPTIONS ON ERRORS COMMITTED BY MATHEMATICS STUDENTS IN SOLVING TRIGONOMETRIC PROBLEMS AT NCE LEVEL

By

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### ABSTRACT

*The study explored teachers' perceptions on errors committed by their students solving trigonometric problems at Nigerian certificate of Education (NCE I students) level. The research design was a survey study. The population for the study comprised all 44 teachers and 545 students from the five colleges of educations of Northern Nigeria. 174 students were randomly selected from the five colleges of education. The researcher used open-ended unstructured questionnaire for teachers and a test for students. The Instruments were validated with reliability coefficient ( $r$ ) = 0.65, that was used for data collection. One hypothesis was stated at  $p \leq 0.05$  level of significance using  $\chi^2$ -square. Data collected was analyzed using Statistical Analysis System (SAS). The result indicates that there is no significant uniformity among the type of combined errors committed by the learners in various institutions in solving trigonometric problems and was retained. On the basis of the finding, it was recommended Teachers should take note of the different error-types student's fall into and their various sources, so that they should be able to correct them.*

### INTRODUCTION

Mathematics happens to be the queen of sciences and central subject to the understanding of all the natural science and applied sciences. No one can read medicine, Engineering, Pharmacy, Architecture to mention a few, in tertiary institutions without a solid background in Mathematics and Science (Odili 2010). Mathematics is not only the language of science, but the essential nutrient for thought, logic, reasoning and progress. Azuka (2000) viewed that science is both the

foundation of technology and bedrock of modern development. Therefore mathematics is the foundation for science, technology and modern development. For any nation to survive and develop, it has to improve its technology which can only be achieved through effective teaching and learning of mathematics. It is generally agreed that mathematics is indispensable and should be compulsorily taught in our schools. Mathematics is a useful tool in the society, more so in the present technology age. No wonder Mathematics is a compulsory

subject at Primary and secondary school levels, though not all the students are expected to become mathematicians but because of its applications in everyday life (Oyedokun, 2002). As Nigeria is developing towards the modern age of science and technology it is important that a topic like trigonometry becomes one of the mathematical aspects highly needed to be acquired for the pursuit of science and technology.

Prakitipong and Nalcamura (2006), stated that the main objectives of teaching and learning mathematics is to prepare students for practical life. Students can develop their knowledge, skills; logical and analytical thinking while learning mathematics and all these can lead them for enhancing their curiosity and develop their ability to solve problems in almost all fields of life. The problem solving nature of mathematics can be found in sub-discipline of mathematics such as in geometry, calculus, trigonometry and algebra. Trigonometry is an important area of mathematics. Because of the generalization and abstraction, nature of trigonometry it is considered to be a difficult area of mathematics (Tsamir, & Almog, 2001).

In analyzing the difficult area encountered by students Mohammed (2000), classified three types of errors committed by the learners, it is psychologically important to put forward to them their errors, not as a sign of failure but as a positive source of improvement.

This is because errors are devices which the learner uses to learn. Secondly, error shows a teacher area where his teaching may not have been effective. It serves to evaluate and provide feedback on the quality of teaching techniques and materials. A good error will reveal to the teacher the state of the learner's problem; that is, his/her areas of weakness whether he/she needs a help or whether remedial teaching is needed. Thus, with the feedback received from errors, a classroom teacher can either go ahead or revise his work. The learners can take care of such errors committed academically.

Furthermore, academic achievement is the students' overall learning experience resulting in an observable and measurable behavioral change, which includes the requisition of specific ideology, skills and technique at the end of a teaching-learning event. Quite a number of definitions of academic achievements exist in literature and most of these make attempt at capturing the essence of the concept. Korau (2006) defines academic achievement as the "extent to which a person has achieved something, acquired certain information or mastered certain skills, usually as a result of planned instruction or training". Drews (2005) sees academic achievement as an assessment of how people have learnt or attained after a learning period. Thus, once a degree of a student's learning programme is to be determined, it is the learner's academic achievement

that is being sort for. Academic achievements are usually determined through tests.

These tests provide means of evaluating student's performance in absolute terms such as percentage instead of comparing a student's result with those of his counterparts. Korau (2006) opined that the instrument that should be employed in educational measurement should include: Teachers-Made-Tests; Interview; Opinionnaires; Questionnaire, Standardized Test, External Examination, Personality Tests and Interest Inventory. He maintained that certain human attributes such as learning achievement, emotion intensity, skills and development of appreciation are measurable.

In this study, questionnaire and standardized test were employed for measuring and evaluating the perceptions of students in trigonometry with the aim of determining the effect of such activities on students'.

### STATEMENT OF THE PROBLEM

The researcher focus on errors made by students in trigonometry at NCE one level, one gains a better understanding and appreciation of the difficulties experienced by students in studying Mathematics. In this way, a teacher is better able to recommend focused and meaningful interventions that will minimize the most prominent errors identified. It will also give possible effective teaching approaches. The aim of this study is to find out the specific errors types committed by the

students in solving trigonometric questions at N.C.E level.

### RESEARCH QUESTIONS

Based on the problems stated above, the following questions are stated for answering.

- i) What are the perceptions of teachers' on errors committed by their students toward solving trigonometric mathematics problems at NCE one level?
- ii) Examine if there is any strong uniformity of combined errors committed by the learners among various institutions in solving trigonometric problems.

### HYPOTHESES

Based on the research question formulated on students' errors the following hypothesis was formulated and tested at 0.05 alpha values:

H<sub>0</sub>: There is no significant uniformity in combined errors committed by learners among various institutions in solving trigonometric problems.

### SIGNIFICANCE OF THE STUDY

The significance of this research therefore is to find out the errors made by students on solving trigonometry problems. But it would specifically carry out the following:

- ascertain the common errors of students in solving trigonometric problems;
- study the causes, types and nature of such errors;
- compare the errors of the students at the end of the course in order to find out the differences perceptions in trigonometry; and,
- Draw out valuable results from the finding so as to bring about a positive change in the teaching of the course at colleges of education.

## RESEARCH DESIGN

This research is a survey study. According to Nworgu, (2009) cited Kerlinger, (1973), survey research design is one in which a group of items are considered to be representative of the entire group. To ensure that the research questions were adequately answered, the following steps were discussed. The first aspect of the study was the instrument (i.e. Teachers) used for the purpose of the research on perceptions of students' toward trigonometric questions. The second aspect was the students' perceptions on answering questions of the course in trigonometry, to find out the errors committed by NCE students at various institutions.

## POPULATION AND SAMPLE

The population includes forty four (44) lecturers of mathematics from selected five colleges of educations in northern Nigeria. The second set consisted of N.C.E students offering Mathematics as one of their subject combinations. Therefore, the population was made up of 545 NCE one students of the selected five colleges of educations in northern Nigeria with the total number of 545 students as the population of the students.

Sampling techniques were used in the selection of respondents. Firstly, the purposive sampling technique was used for the selection of the lecturers, since the population is small and homogenous which served the research purpose. According to Ali (2006) where the population is small and the needed criteria to be investigated exist in the small population, there is, technically no need for any sampling. In the second aspect of selecting the subject for the study, the method of random sampling was used. Sambo (2008) observed that the use of  $\chi^2$  square test was used since is a non parametric inferential statistical method used in the analysis of frequencies or nominal data. Consequently, this statistic has found extensive applications in the field of education, particularly in the form of frequencies or categories. Hence, 174 students were chosen out of 545 students from the five colleges mentioned above, which

constituted 32% of the population. This sample is adequate enough to represent the population.

## **INSTRUMENTATION**

The instruments used for the data collection were: the perception of teachers' in teaching Trigonometry was set, that is Teachers' Questionnaire for Mathematics Teachers/Lecturers (TQMT). The questionnaire was aimed at finding the students perception in trigonometry. The questionnaire was based on open -ended unstructured was used, to sought out the errors that are likely made when solving trigonometric questions. The second aspect is on Trigonometric Achievement Test (TAT) respectively.

## **VALIDITY AND RELIABILITY OF THE INSTRUMENT**

The questions and questionnaire used for the research were forwarded to Mathematics educators for their comments and review to see whether the questions suited the level of students and questionnaire for the teachers. The instruments were given to experts in the field of mathematics education to give suggestions in the instruments administered.

Based on this reliability, procedure the reliability coefficient of the instrument was determined using open-ended unstructured questionnaire and split half method. The spearman brown formula gave coefficient of 0.62 for Teachers Perception on Trigonometric Questions (TPTQ) and 0.65 for Trigonometric Achievement Test (TAT) respectively.

## **RESULT AND DISCUSSIONS**

Results of the study were presented according to research question asked and hypothesis formulated. The research was based on open-ended unstructured questionnaire. This form of questionnaire does not provide any response options for the respondents. Only questions pertinent to the problem are asked and the respondent is free to supply his response in his own words and in any manner he deems fit ( Nworgu ,2009). The respondent were required to tick the appropriate column for either Yes or No. The result used was only the positive response of the teachers recorded against each items as shown below.

i). what are the perceptions of teachers' on errors committed by their students toward solving trigonometric problems at NCE one level?

**Table 1:** perceptions of teachers' on errors committed by their students toward solving trigonometric problems

Items	Responses	Valid frequency	
		Yes	No
1	NCE I students make a lot of errors in solving trigonometric problems	24(73%)	9(27%)
2	Do you think students make errors in solving trigonometric problems is due to:		
a	Lack of proper understanding of actual meaning of trigonometry?	19(58%)	11(33%)
b	Poor back ground in solving trigonometric equation?	22(67%)	4(12%)
c	Inability to use letters and symbols more than angles makes the topic abstract and confusing for the students?	23(70%)	5(15%)
d	Poor entry requirement into the NCE level?	20(61%)	9(27%)
e	Lack of interest to the subject?	24(73%)	7(21%)

The results in Table 1 shows that 73% of the teachers strongly agreed that NCE I students make a lot of errors in trigonometric solutions, because of the poor background they have in geometrical aspects. While the remaining 27% of the teachers dis agree that NCE I students make a lot of errors in trigonometric solution. Hence, it is clear that a good number of the teachers are of the opinion that most NCEI students commit a lot of errors in trigonometric solutions. Item 2a, shows that 58% of the teachers strongly agreed and 33% of the teachers strongly dis agreed that lack of proper understanding of the actual meaning of trigonometry is responsible for the errors being committed. Item 2b indicates that 67% of the teachers concluded that poor

background in solving trigonometric equation is responsible for most of the errors committed in solving trigonometric solution. 12% of the teachers strongly disagreed with the researchers. Hence, most of the teachers responded positively that poor background in solving trigonometric equations is responsible for the errors committed in trigonometric solution.

Item 2c indicates that 70% of the teachers strongly agreed that students' inability to use letters and symbols is responsible for most of the errors made by students in solving trigonometric problem. Where 15% of the teachers are of the opinion that students' inability to use letters and symbols is not a good reason for the errors committed by students when solving

trigonometric problems. Since a good number of teachers responded positively, it indicates that the inability of students to use letters and symbols contribute to most of the errors committed.

From item 2d, 61% of the teachers strongly agreed that poor entry requirement into the NCE level is responsible for the errors in solving trigonometric solution, 27% of the teachers are of the opinion that poor entry requirement into the NCE level is not responsible for the errors committed by students in solving trigonometric problems. The results obtained indicate that a good number of the teachers responded positively that poor entry requirement into the NCE level is responsible for the errors being committed.

Item 2e, shows that 73% strongly agreed that students' lack of interest in the subject is responsible for the errors committed in trigonometric problems, while 21% of the teachers strongly disagreed that students' lack of interest in the subject is not responsible for the errors committed in trigonometric solution. The above result indicates that majority of the teachers are of the opinion that lack of interest in the subject is highly responsible for the errors committed in trigonometric solutions.

Based on the questionnaire and research test being conducted at various institutions, the researcher was able to locate some possible errors which the learners commits, while solving the problems as shown below.

On the responses of teachers at various schools, there is a high degree of agreement among teachers that a lot of errors are being committed by students in solving trigonometric problems, even after they have been taught the same. This finding was confirmed by the pilot test because not only the test carried out in a specially designed school among students who have finished treating the topics, but still is an indication that this is a problematic topic and the cause of it is yet to be found.

On the teachers' perceptions, students are likely to make errors when solving trigonometric problems such as: conversion of trig-ratio to acute angle, finding range of angles, proving some trigonometric terms. From the findings (Inekwe, 2001 and Mamba, 2012) are of the same views, that the causes of all these errors are due to the students:-

1. Lack of proper understanding of the actual meaning and lack of interest in the subject;
2. Poor background in solving quadratic equations;
3. Lack of understanding of mathematical operations and transposition of letters;
4. Inability to use letters and symbols more than angles, which makes the topic abstract and more confusing to them.

From teachers' responses also one has a strong belief that lack of interest to the subject and poor background of mathematics right from primary and

secondary school cause the students to make numerous errors in the course (trigonometry).

**HYPOTHESIS**

ii). *There is no significant uniformity in combined errors committed by the students among various institutions in solving trigonometric problems.*

To test this hypothesis a chi square was used (of five schools and error types).The  $\chi^2$  -square statistics was used because there are five schools and the researcher was looking for significant difference at  $P \leq 0.05$ . The results obtained are as shown in table 2 below.

**Table 2:**  $\chi^2$  -Square comparison of combined Errors committed by students among various institutions.

Source of Variation	Value	Df	P-Value	Remark
Pearson chi square	92.38	88	0.35	NS*
Likelihood Ratio	87.25	88	0.50	
Linear – by – linear Association	1.81	1		
N of valid Cases	50		0.18	

\*Not Significant at P-value >0.05

From the Statistical Analysis System (SAS) system output above, the Pearson chi-square error type is 92.38 with a P-value of 0.35. From the result, the P-value = 0.35 > 0.05 level of significance, it can then be concluded that there is no significant uniformity in combined errors committed by the learners among various institutions. Hence, the alternative hypothesis is rejected while the null hypothesis is retained. This really shows that there is no significant uniformity within the combined error types (ie  $E_{1-x}$ ) committed by various institutions in solving trigonometric problems. The finding with respect to the learners errors are generally

similar to the finding of some researchers such as Tsamir & Almong (2001), and Blanco & Garrote (2007), that there is no uniformity in errors committed by the students at various institutions.

**RECOMMENDATIONS**

The following recommendations are made in the light of this study.

1. The teachers should take note of the instructional errors which adversely affect their student’s learning and interest in Mathematics. It would equally help to put the



teachers at alert to those common errors in the teaching process in order to make students avoid them. Furthermore, it would throw some lights to students preparing to teach at secondary school level, after graduating at NCE level to avoid much errors committed in solving trigonometric solutions.

2. They should be aware of the different error-types that student's fall into and their various sources, so that they (teachers) should be able to correct such errors for the students.
3. In teaching trigonometric equations a teacher should give a good presentation which will enable him have a right perception of equality, i.e. whatever is on the left hand side of an equation is equal to that on the right hand side.
4. Teachers should be encouraged to attend conferences and seminars so as to update their knowledge on teaching methodologies.

## CONCLUSION

From the results of this study revealed that the teacher's perception on students' perceptions toward trigonometric questions indicates that most of the students performed poorly when solving problems at NCE I level at various institutions. The study also shows that the students have many misconceptions in the use of formulas and symbols in trigonometry, which affect

their learning of trigonometry. It is vital that students recognize that symbols and formulas that are used to represent unknown quantity or variable have different meanings in different context. Trigonometry is so significant as a part of mathematics that its foundation must begin to be built in the very early stage to the real life problems.

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