NUMERICAL ABILITY: PREDICTOR OF SENIOR SCHOOL STUDENTS ACADEMIC PERFORMANCE IN PHYSICS IN ILORIN

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Abstract
For this study, students and school variables were considered in terms of student' numerical ability, gender and school proprietorship. To this end, the study examined the students' numerical ability as predictor of students' academic performance; gender and school proprietorship (private and public) were considered as moderator variables. This study was descriptive survey type that employed the use of instrument tagged "Numerical Ability Test" and sampled 300 students across 6 public and private schools. The finding (Chi-square=18.573) of this study revealed that the students' numerical ability knowledge was not enough to drive decision making, critical thinking and students' ability to apply mathematical/numerical functions needed when learning mathematics- related aspects of physics. The findings also revealed that female students (M=16.5467) performed better than their male counterparts (M=14.9133) and private schools' students (15.9800) outsmarted public schools' students (15.4800) but the differences are not significant.
Keywords: Numerical Ability, Gender and School Proprietorship

Introduction

In the field of Education, students' assessment is part of the measured standard to ascertain the level of the achievement of the planned objectives in the curriculum, to check the level of student's knowledge, to determine the outcomes of learning and experience gained and achieved so far. National Council of Teachers of Mathematics (NCTM, 1995) stated that the process of collecting evidence about the students' knowledge and ability to use mathematical knowledge and trends towards mathematics and other mathematics-related subjects like physics, chemistry, astronomy and geology is essential.

Physics as a course/subject requires a high level of mathematical knowledge for its operations. Teachers and students of physics need to be grounded well in mathematics for effective transmission of knowledge and a better understanding of physics concepts. Numerical ability or skill otherwise known as mathematical ability focuses on NCTM standards, which include concepts and skills such as Numerical sense and counting system, the concepts of numbers operations, numbers and numerical relationships, the theory of numbers calculation and estimation (NCTM,1989). Psychometric success (2013) views Numerical ability knowledge of students to be consist of basic arithmetic, such as addition, subtraction, multiplication, and division, number sequences and simple mathematics such as percentage, powers, and fraction and in which calculating or mechanical device(s) will not be allowed.

Numerical Ability otherwise known as mathematics ability has varied definitions based on a different perception of what the concept entails. Ann (2004) defined Numerical Ability test as a test designed to

measure the candidates/students' capacity to manipulate or the ability to use numbers correctly in solving problems. According to Nunnally (2004) defines Numerical ability as the ability of students to relatively solve the problems in number sequence, make accurate mathematical deductions through advance numerical reasoning, interpret complex data presented in various graphical forms, deduce information and make logical conclusion. This present study ought to make use of some mathematical functions that are very peculiar to physics concept, and its problem -solving. These functions include Conversion of numbers, Change of the subject of the formula, Variation in terms of inverse and direct, Law of Indices, Substitution of equation/notations, Significant figures, Decimal places, Standard form and Approximation respectively.

Literature Review

Olatoye and Aderogba (2011) carried out research on performances of secondary school students in the aptitude test, the role of student's verbal and numerical ability. The study sampled 200 students from five randomly selected secondary school in Ijebu area. The study employed the use of Numerical Ability Test (NAT). The reliability index of the test was 0.712 and was determined using test-retest method. The study concluded that aptitude test like numerical ability measured student's overall performances across a broad range of mental capabilities and also affirmed that there were no significant differences between male and female student's performances in numerical ability test.

Fatoke and Olaoluwa (2014) worked on enhancing student's attitudes towards sciences through problem-solving instrumentation strategy. The study employed the use of numerical ability test to measure the mathematical knowledge of students. The samples of the study were 210 senior secondary school class two chemistry students which were randomly selected. Analysis of covariance (ANOVA) tools was used to analyses the result and the findings of students revealed that the numerical ability of students does not have any significant interaction effect on student's attitudes towards chemistry.

Eman, Mohammed and Yousef (2016) carried out a study on developing a numerical ability test for students of education. The sample of the study consisted of 504 students from a university in Jordan. The used instruments contain of 45 items distributed among the dimensions. The difficulty discrimination of the test was estimated using Cronbach's Alpha and validity was accessibly arbitrations views, factors analysis and Tanaka index. The study concluded that numerical ability test can be used to measure the strength and can also be used to classify students on the level of numerical ability.

Statement of the Problem

The teaching and learning of physics at all levels of education requires sound knowledge of numerical ability. The needs for numerical ability in physics and every other field of studies enhance the student's critical thinking, creativity and drives self-decision making. Despite the importance of the numerical ability to physics, another field of studies, individuals and society at large and even this 21st century (Digital Age) of scientific and technological advancement, students' numerical ability is not adequately enough to meet up the present-day knowledge and challenges.

According to West African Senior Secondary Certificate Examinations Chief Examiner's Report (2013; 2014; 2015; 2017) revealed that reasonable number of physics students were unable to apply the knowledge of numerical functions such as approximation, conversion, substitution and deduction making in the course of solving questions relating to mathematics in physics. However, there are limited studies on the assessment of senior secondary school physics students' numerical ability. Therefore, this study tends to assess the level of senior secondary school physics students' numerical ability in Ilorin, Nigeria.

Research Questions

The following research questions were to seek answers to:

1. What is the level of senior secondary school physics students' numerical ability knowledge based on observed dimensions?
2. Does difference exist between male and female physics students' performance in numerical abilities?
3. Does difference exist between physics students' performances in numerical ability test based on school proprietorship?

Methodology

The design for the study was a descriptive study of survey type. The study samples included 300 physics students of 3 public and 3 private senior secondary schools in Ilorin that are purposively selected based on their physics student's population (school with lesser number of physics students were not considered). Fifty students were randomly picked from each of the selected senior secondary schools. The sample comprised of 25 males and 25 females from each sample senior secondary schools. The total of 150 males and 150 females was involved in the study.

Research Instrument

The instrument used was the Researcher's designed. The instrument was tagged Numerical Ability Test (NAT) which contains 40 items of nine-dimensional mathematical functions (Conversion, Substitution, Change of Subject of Formula, Variation, Significant Figure, Decimal Places, Approximation, Application of Law of Indices and Standard Form). The instrument was face and content validated by experts in mathematics and physics for comments, critics and suggestions to check whether the test would determine what it supposes to measure before a final version was printed for administration to students and the content validity index stood at 0.89. The test-retest method was used to determine the reliability index of the instrument which was 0.78.

Presentation of Results

Research question one state that what is the level of senior secondary school physics students' numerical ability knowledge based on observed dimensions?

Chi-square independent test statistics was used to analyze data obtained. Summary of the result was presented in table 1.

Table 1

Level of Senior Schools Students' Performance in Numerical Ability Test

	Value	**Df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	18.573[a]	20	.550
Likelihood Ratio	20.552	20	.424
Linear-by-Linear Association	1.215	1	.270
N of Valid Cases	300		

a. 18 cells (42.9%) have expected count less than 5. The minimum expected count is .50.

The result presented in Table 1 revealed that the Asymp value 0.550 is higher than the table value 0.50 this implies that the level of students' numerical knowledge in the nine observed dimensions is low.

Research question 2 state that does difference exists between male and female physics students' performance in numerical abilities?

Descriptive statistics (mean and standard deviation) was used to analyze data obtained. Summary of the result were presented in table 2.

Table 2

Male and Female Students Performance in Numerical Ability Test

Gender	**Mean**	**N**	**Std. Deviation**
Male	14.9133	150	4.21715
Female	16.5467	150	3.44192
Total	15.7300	300	3.92877

The result presented in Table 2 revealed the difference in the performance of students in numerical ability test based on gender. The result shows that the female students outperformed their male counterparts in the test but the difference is that significant. The mean score of the female students is 16.5467 and the mean score of the male students is 14.9133. this implies that the female students have higher mean score and performed more better than the male students in Numerical Ability Test.

Research question 3 state that Does difference exist between physics students' performances in numerical ability test based on school proprietorship? Descriptive statistics were used to analyze the result. Summary of the result was presented in the table 3 below.

Table 3

Public and Private Schools' Students Performance in Numerical Ability Test

School	Mean	N	Std. Deviation
Public	15.4800	150	3.71957
Private	15.9800	150	4.12468
Total	15.7300	300	3.92877

The result presented in Table 3 above revealed that the students from private schools outsmart their public counterpart but not that significant. The mean score of the public-school students stood at 15.4800 while their private schools counterparts stood at 15.9800. This result implies that the private school students outsmarted their public schools' counterparts in Numerical Ability Test.

Discussion of the Result

The results of the research question one revealed that the level of senior school students' numerical ability knowledge in the nine chosen dimensions is significantly low. The findings means that the level of numerical/mathematical knowledge needed for the operations in mathematics, physics and mathematics-oriented subject are not sufficient and this posed a serious danger to the performance of students in internal and external examination, decision making, critical thinking, cognitive and psychomotor developments. This finding is in agreement with Ulku, Leyla and Dilek (2016).

Also, the result in table two explained that no significant difference existed between female and male students though the female students performed better than male students. This finding is in line with research outcome of Olatoye and Aderogba (2011).

Lastly, the result in table three revealed that no significant difference existed between public and private school. The finding revealed that private school students outperformed public school students.

Conclusion

On the basis of these findings, it was concluded that the level of senior school students' knowledge of numerical/mathematics basic functions were not adequate for critical thinking, decision making and development of cognitive and psychomotor abilities.

Recommendations

Based on the findings of this study, it is recommended that

1. Teachers teaching physics and mathematics should ensure that the students have the fundamental numerical/mathematics ability knowledge;
2. Teachers should ensure that the students were given chance to solve some class room works using some of these numerical/mathematics functions so as to enhance students' knowledge positively.

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