

Performance of Senior Secondary School Science Students in Aptitude Test: The Role of Student Verbal and Numerical Abilities

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Aptitude tests measure students' overall performance across a broad range of mental capabilities. This study therefore investigated the role of students' verbal and numerical abilities in students' performance on aptitude tests. Two hundred Senior Secondary School Science Students participated in the study. Three validated research instruments were used to collect data. Numerical and verbal abilities combined together to account for 38.8% of the total variance in student performance in the aptitude test ($R^2 = 0.388$, $p < 0.05$). The percentage is significant. Thus, for students to perform well in the general aptitude test, they need to have high numerical and verbal abilities. There is no significant difference between male and female students' performance in verbal ability, numerical ability and general aptitude tests. This study provides an empirically-based suggestion for students to develop high verbal and numerical skills in order to do well in aptitude test. The findings from this study also imply that verbal and numerical ability tests can be validated using a good aptitude test.

Keywords: verbal ability test, numerical ability test, general aptitude test, mathematics, gender

INTRODUCTION

In any society, language is very important. In Nigeria, a multi-lingual society, English Language has been adopted as the official language. No matter a student subject combination in Nigeria, English Language remains the means of teaching and learning except in the teaching of local languages (Olatoye, 2005). Aptitude test questions and interaction with applicants during interviews are always done using English Language as a medium of communication. Therefore, a student who is deficient in English Language will not be able to perform certain functions of Language enumerated by Obi-Okoye (2002) such as communication, rational, logical, critical or prepositional thinking and comprehension. Also, Kujore (2002) asserted that ability in language affects the child's learning in other areas. This makes proficiency in English Language very imperative to every child enrolled in the school. It is also necessary to note that several studies have linked proficiency in language to general performance. For example, English Language proficiency has been linked to performance both in mathematics (Tarte & Fennema, 1995; Olatoye, 2007) and science (Mosoeunyan, 2001; Torres & Zeidler, 2002).

Setidisho (1996) asserted that mathematics is a fundamental subject necessary for understanding of most other fields. Adeoye and Aiyedun (2003) asserted mathematics forms a binding force among the various branches of science – physical, biological and social. Many researchers have confirmed low performance in mathematics at qualifying and

placement examinations (Buhari, 1994; Okoro, 2005; Olatoye and Agbatogun, 2010). There is therefore the need to pay attention to students' verbal and numerical abilities which are expected to be the direct outcomes of the teaching and learning of English Language and mathematics respectively.

A test is an instrument designed to measure a particular aspect of human behaviour from where the totality of that behaviour can be inferred. According to Akinboye (2001), psychological tests are of two kinds; ability and affective tests. Affective tests are used to measure feelings, interests, attributes, values motive, temperament, emotions and other non-cognitive aspects of personality. Examples of such tests are: Student Problem Inventory (SPI), Study Habit Inventory (SHI) and Vocational Interest Inventory (VII). Ability tests on the other hand measure the product of mental ability or cognition. They are concerned with the mental skill and power of individuals, they measure what a person can do now and in the future, they are broadly classified in two; Achievement test and Aptitude test.

Achievement test is concerned with measuring what a candidate has learned to do. It measures amount of knowledge acquired after learning process, the test measures the gains of educational programmes; what a student has acquired from the process of learning. Examples of such types of tests are: Intelligence, numerical and verbal ability tests. Intelligence Quotient is the capacity for abstract thinking and reasoning (Toplis, 1991). Intelligence Quotient test

measures general mental ability demanding application of knowledge in verbal and non-verbal domains. It is easily influenced by present and past environment of the candidate. Akinboye (2001) gave the Raven's progressive matrices, which measures general intelligence as an example of such test.

Numerical ability tests are designed to measure the candidates' capacity to manipulate or use numbers to correctly solve problems (Ann, 2004). Such tests signify basic arithmetic prowess in an individual. According to Nunnally (2004), it is the ability to relatively solve problems in number sequencing, make accurate mathematical deductions through advanced numerical reasoning, interpret complex data presented in various graphical forms, deduce information and draw logical conclusions. All forms of school examinations in various subjects, are also broadly speaking types of achievement test of which numerical ability test is one. It can be given directly to candidates or administered as subsets of other tests. Similarly, verbal ability tests are tests used to deduce the ability of an individual to reason with words (Akinboye, 2001). They indicate the acquired capability for comprehension and communication in an official medium like English Language. This will require oral or written mode of response as the case may require.

Aptitude tests measure the innate, acquired or developed component of competency in knowledge, understanding and attitude used in doing certain kind of work at a particular level (Toplis, 1991). Aptitude may be physical or mental; the innate nature of aptitude is in contrast to achievement, which represents knowledge that is gained through learning (Carr, 2004). Aptitude breaks mental ability down into different characteristics, which are supposed to be more or less independent of each other; it is forward looking as it predicts the potential for future ability to learn a skill or set of skills in a candidate. Aptitude confirms present abilities and potentials to learn and cope with new situations in the future. The difference between aptitude test and achievement test (which include numerical and verbal ability tests) is majorly that, while aptitude test outcomes are used as predictors of future performance, on the other hand, achievement tests are only 'revealers' of present performance after learning.

Compared to achievement tests, aptitude tests cover a broader area and look at other range of experiences. Achievement tests are closely tied to particular school subjects. Aptitude tests tell us what a student brings to the task regardless of the specific curriculum that the student has already experienced. The difference between aptitude test and achievement tests is sometimes a matter of degree, some aptitude and achievement tests look a lot alike. Generally all

tests are used for the following purpose; selection, admission and certification.

If the student scores in verbal and numerical ability tests significantly predict the score in aptitude test, it then means that verbal and numerical ability tests can be validated using a good aptitude test. This will be a significant contribution of this study to knowledge apart from providing empirically-based suggestion for students to develop high verbal and numerical skills in order to do well in aptitude test.

Research Questions

The following research questions are answered in this study:

1. What is the combined influence of numerical and verbal abilities on student performance in the general aptitude test?
2. What is the relative influence of students' verbal ability on their performance in the general aptitude test?
3. What is the relative influence of students' numerical ability on their performance in the general aptitude test?
4. What are the relationships among students' performances in general aptitude, verbal and numerical ability tests?
5. Is there any significant difference between male and female students' performance in (i) verbal ability (ii) numerical ability and (iii) general aptitude?

METHODOLOGY

Design, Sampling Technique and Sample

The design used for this research was descriptive survey. This is because data were collected on a sample of respondents, which are representative of the target population. As such, the findings can be generalized on the whole population. The target population for this study was the senior secondary school science students in Ijebu Area of Ogun State, Nigeria. Five senior secondary schools were randomly selected from Ijebu Area. In each school, forty science students selected through random sampling participated in the study. Thus, the sample size for the study is 200. The sample comprised one hundred male and one hundred female students selected from the senior secondary II level in all the schools. The average age of students is 16.5 years.

Research Instruments

The instruments used were developed by the researchers. They are: Numerical Ability Test (NAT), Verbal Ability Test (VAT) and General Aptitude Test (GAT). Each of NAT, VAT and GAT contains thirty items. The instruments were given to experts for comments and suggestions before the final version was administered on the respondents. The test retest reliability coefficients for NAT, VAT and GAT are 0.712, 0.722 and 0.699 respectively.

METHOD OF DATA ANALYSIS

Research question 1 was analysed using multiple regression. Research questions 2 and 3 were analysed using linear regression, research question 4 using Pearson product-moment correlation while t-test was used to analyze research question 5. Analyses were done at 0.05 level of confidence using a two-tailed test.

RESULTS

Research Question 1:

What is the combined influence of numerical and verbal abilities on student performance in the general aptitude test?

Table 1: Numerical and verbal abilities as predictors of student general aptitude performance

R = 0.623 R Square = 0.388 Adjusted R Square = 0.382 Standard Error = 4.051						
Analysis of variance						
	Sum of square	Df	Mean Square	F	Sig. value	Remark
Regression	2049.943	2	1024.972	62.455	0.000	*Significant
Residual	3233.052	197	16.411			(p<0.05)
Total	5282.995	199				

In the table 1, numerical and verbal abilities combined together to account for 38.8% of the total variance in student performance in the aptitude test (R Square = 0.388, p<0.05). The percentage is significant. Thus, for students to perform well in the general aptitude test, they need to have high numerical and verbal abilities.

Research Question 2

What is the relative influence of students' verbal ability on their performance in the general aptitude test?

Table 2: Verbal ability as a predictor of student performance in general aptitude test.

R = 0.551 R Square = 0.303 Adjusted R Square = 0.300 Standard Error = 4.312						
Analysis of variance						
	Sum of square	Df	Mean Square	F	Sig. value	Remark
Regression	2049.943	1	1024.972	62.455	0.000	*
Residual	3233.052	198	16.411			(p<0.05)
Total	5282.995	199				

In the table 2 above, student verbal ability alone accounts for 30.3% of the total variance of performance in general aptitude test (R. Square =0.303, p<0.05). This percentage is significant. Thus, verbal ability is important for students to perform well in the general aptitude test.

Research Question 3

What is the relative influence of students' numerical ability on their performance in the general aptitude test?

Table 3: Numerical ability as a predictor of students' performance in the general aptitude test

R = 0.597 R Square = 0.356 Adjusted R Square = 0.353 Standard Error = 4.145						
Analysis of variance						
	Sum of square	Df	Mean Square	F	Sig. value	Remark
Regression	1881.641	1	1881.641	109.534	0.000	*
Residual	3401.354	198	17.179			(p<0.05)
Total	5282.995	199				

In table 3 above, students' numerical ability accounts for 35.6% of the total variance in general aptitude performance. (R Square 0.356, p<0.005). This percentage is significant. Thus, for students to perform well in the general aptitude test, they should also be very good in verbal ability.

Research Question 4

What are the relationships among students' performances in general aptitude, verbal and numerical ability tests?

Table 4: Correlation matrix of student performance in verbal, numerical and general aptitude tests.

Variables	Verbal Ability	Numerical Ability	General Aptitude
Verbal Ability	1.000		
Numerical Ability	+0.713*	1.000	
General Aptitude	+0.551*	+0.597*	1.000

*Significant (p<0.05), N=200.

In table 4 above, the highest positive significant relationship is between student performance in verbal and numerical ability tests (r = +0.713, p<0.05). The higher the students' verbal ability, the higher the numerical ability. There is also a positive significant relationship between student verbal ability and general aptitude (r = +0.551, p<0.05). Thus, the higher the students' verbal ability, the higher the general aptitude. Likewise, there is also a positive significant relationship between numerical ability and general aptitude (r = +0.597, p<0.05). Also, the higher the students' numerical ability, the higher the general aptitude.

Research Question 5

Is there any significant difference between male and female students' performance in (i) verbal ability (ii) numerical ability and (iii) general aptitude?

Table 5: Comparison of male and female student performances in verbal ability, numerical ability and general aptitude tests

Variables	Gender	N	Mean	Std. dev	Std. error	Df	T	Sig. value	Remark
Verbal Ability	Male	100	17.800	8.295	0.830	198	-0.662	0.508	NS
	Female	100	18.510	6.786	0.671				
Numerical Ability	Male	100	19.250	5.778	0.578	198	-0.352	0.725	NS
	Female	100	19.520	5.052	0.505				
General Aptitude	Male	100	24.180	5.524	0.552	198	0.479	0.632	NS
	Female	100	23.380	4.774	0.447				

NS = Not Significant ($p > 0.05$)

In table 5 above, there is no significant difference between male and female students' performances in verbal ability, numerical ability and general aptitude tests. Male and female students have similar levels of verbal ability, numerical ability and general aptitude.

DISCUSSION OF FINDINGS

Consistent with previous research studies, the correlation between student performance in the aptitude test and each of the other tests (verbal and numerical tests) was significant. Drucker (1994), in a study had discovered that numerical ability will assist in hypothesizing relationships. This is also supported by findings in this study as performance in numerical ability translated to similar performance in verbal and general aptitude domains. Similarly, Bakare (1990) asserted that trainable cognitive domains like numerical and verbal skills could lead to improvement in general aptitude performance considering that similar faculties of the brain will determine performance in all ability test types like numerical and verbal tests.

Though this study reported that there is no significant difference between male and female students' performances in verbal ability, numerical ability and general aptitude tests, yet gender inequality in numerical ability has been widely reported. Bassey, Joshua & Asim (2004) reported that male students performed better than females in numerical ability tests. Goldin, Katz and Kuziemko (2006) showed that female high school students now outperform male students in most subjects and in particular on verbal tests. Zeidner (1986) reported that though male students performed better in general aptitude test than their female counterparts especially on quantitative subtest, the difference is not statistically significant. There is therefore the need to carry out further studies in this area. The highest positive significant relationship is between student performance in verbal and numerical ability tests. This corroborates the earlier finding by Kujore (2002) that ability in language affects the child's learning in other areas. This makes proficiency in English Language very imperative to every child enrolled in the school. Several studies have linked proficiency in language to general performance. For example, English Language proficiency has been linked to performance both in mathematics (Tarte & Fennema, 1995) and

science (Mosoeunyane, 2001; Torres & Zeidler, 2002).

Aptitude tests measure students' overall performance across a broad range of mental capabilities. But aptitude tests also often include items which measure more specialized abilities (such as verbal and numerical skills) that predict scholastic performance in educational programmes. (Hostedware Corporation, 2004). This probably explains why there is high correlation between student scores in aptitude test and scores in both the verbal and numerical ability tests in this study. This finding also suggests that for an aptitude test to be considered valid, it should show a significant positive correlation with both verbal and numerical tests. Aptitude tests are excellent predictors of future, scholastic achievement and provide ways of comparing students' performance under the same situation.

CONCLUSION AND RECOMMENDATIONS

Since Aptitude performance is the potential of a person to learn effectively in future engagements, it is therefore important that schools should develop curricula that are effective in developing skills of students in numerical and verbal domains as a means of improving performance of students in general aptitude tests. It is obvious from findings to research question four that both verbal and quantitative ability have high correlation, this relationship indicates that one is needed for appropriate interpretation and understanding of other hence a balanced approach should be adopted in teaching of both numerical and verbal skills. Student performance in all the test types considered in this study is not sensitive to gender. Therefore, gender should not be a factor to be considered when determining the type of assessment procedure to be employed with students. This study provides an empirically-based suggestion for the need to develop high verbal and numerical skills in order to do well in aptitude test. The findings from this study also imply that verbal and numerical ability tests can be validated using a good aptitude test.

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