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Students Achievement in English Language, Mathematics, Basic Science and Basic Technology as A Predictor of their Success in SSCE Science

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Abstract

Science is defined as a body of knowledge that has been objectively and systematically acquired. Producing more science students in Nigerian secondary schools will no doubt accelerate technological development as more scientists and technologists will graduate from the nation's ivory towers. This is unarguably one of the missions of vision 2020 but unfortunately most students without relevant scientific background maneuver their ways into science classes at secondary school level. The resultant effect of this is admission of average students in the science and technology departments of universities who eventually end up as half-baked graduates with little or no scientific and technological knowhow. In line with this mind-boggling understanding, there is need for school administrators to critically appraise and analyse the achievement of students in science related subjects in our junior secondary schools in order to create a prediction model that would give sufficient insight into students' ability to be successful or not in the sciences. In this paper, discriminant analysis was used to predict students' ability to be successful in science based on their scores in junior secondary school English language, mathematics, basic science and basic technology. Mathematics and English language are compulsory for all fields of study while fundamental knowledge of basic science and technology is needed to pursue a science related discipline.

KeyWords: Senior student achievement, English Language, Mathematics, Basic Technology and Science.

Introduction

Education is taken to be an instrument for achievement of national objectives (FRN, 2008). The government is adequately informed that technological advancement and social economic development of any nation are dependent on the nation's educational development. Science education is the knowledge obtained from the

systematic study of the structure and behaviour of the physical world, especially by observing, measuring and experimenting and the development of theories to describe the results of these activities (Ajayi & Ogbeba, 2017). Basic Science and Technology is the bedrock on which the core science subjects such as Biology, Chemistry and Physics at the senior secondary schools are laid. Basic Science and Technology as a subject come in existence as a result of curriculum reform movement in Nigeria to make science education more functional for sustainable national development. In performing maximally in science, a child should be able to relate and write his ideas in a simple, error free sentence. Moreover, basic numeracy and calculations are needed to do well in science.

The curriculum of Basic Science and Technology is a product of the restructuring and integration of four primary and junior secondary school science curricula namely; Basic Science, Basic Technology, Physical and Health Education and Computer Studies/Information Communication Technology (FRN, 2012). Nigerian Educational Research and Development Council (NERDC) (2012) posit that the need for integration of these science curricula became necessary for the following reasons:

- The recommendation of the presidential summit on education (2010) to reduce the number of subjects offered in primary and junior secondary schools.
- The need to encourage innovative teaching and learning approaches and techniques that promotes creativity and critical thinking in learners.
- The need to promote the holistic view of science at the Basic Education level for better understanding of contemporary and changing world and need to infuse emergent issues that are of national and global concern such as gender sensitivity, globalization and entrepreneurship.

Much emphasis is therefore placed on it to give the students the right foundation for higher endeavour in science and technology. Nations that are considered to be developed and largely considered as civilized have achieved that status through purposeful scientific education of their citizens (Ajayi, 2017). In cognizance with the importance of science and technology, Basic Science and Technology are taught in Upper Basic schools in Nigeria to prepare a base for any science and technological development. For any nation, especially Nigeria, to achieve scientific and technologically advancement, it is imperative to start planning for a firm basic scientific education foundation for her citizens from childhood. This is because children begin career exploration at a very young age. To move with this pace, Basic Science is taught at the primary school so as to catch the pupils' heart at a tender age. Furthermore, Basic Science and Technology is taught at the upper basic level to enable students to build up and concretize the knowledge of science they had at the primary school level and to lay the foundation for the study of the core science subjects such as Biology, Chemistry and Physics at the senior secondary level of education.

It is expected that by teaching Basic Science and Technology to children at basic education level, every Nigerian student would be given the basic knowledge and understanding of what science is all about and some of the innovations that are taking place around them. This assertion blends with the objectives of science teaching at the Upper Basic Education which is to produce individuals who will be able to live effectively in the modern age of science and technology and contribute to the development of the nation (FRN, 2013). Basic Science and Technology provides students at the upper basic education level with the initial theoretical and practical frameworks which are inevitable prerequisites for their future study. This statement buttressed by Ekundayo (2012) maintains that Basic Science and Technology enables students to understand science concepts, principles, theories and laws which are further elaborated in the core sciences such as Biology, Chemistry and Physics. It is regrettable that there is a public outcry due to poor quality science education, specifically in science subjects such as Biology, Chemistry and Physics.

A good quality science education is one that provides all learners with capabilities they require to become economically productive, and develop sustainable livelihood, contributes to peaceful and democratic societies and to enhance individual well-being. In this era of science and technology, Nigerians will need to be knowledgeable in science to prosper in a complex and global society. Therefore, there is need to ensure inclusive and equitable quality science education. Quality improvement in science education encompasses the all-round development of learners in Basic science and technology at upper basic education level and in core science subjects such as Biology, Chemistry and Physics respectively at senior secondary education level.

Federal Republic of Nigeria (FRN, 1986), in the national policy on science and technology, (NPST) defines science as the generation of knowledge about life. Science seeks knowledge and understanding of the world and life itself and owes its advancement to observation and knowledge. The Economic, social and political growth of a nation or society is predicated on its scientific and technological advancement -since science helps man to improve his environment and supply his basic needs such as food, health, shelter and clothing. The acquisition of scientific literacy by the youth is a necessary means towards the attainment of scientific and technology excellence. Science education has the overall effect of producing individual who will be capable of making valid and thoughtful decisions on science based social issues which daily confront them. The tremendous growth in science and technology has made life comfortable for a greater number of people by improving their quality of live-in areas such as medicine, transportation, agriculture, communication, teaching and industrialization (Symons 2003).

In the area of health and medicine, diseases that could not be diagnosed and treated in the past are now being treated and cured as a result of science and technology. Many people have been healed of cancer and kidney problems. Blood groups and genotypes can be determined to help blood transfusion and transplant of organs such as the heart and

kidney. Present day science has also led to the discovery of new drugs. Technology devices such as television, radio, telex, telegraph, telephones etc. are available for easy and effective communication. Other more advanced means of communication are the E-mail, websites and internet devices. Science and technology have contributed remarkably to improvement in the system of communication in this millennium.

There has been remarkable improvement in the transportation sector. Science and technology have made possible modem transport modes such as automobiles, planes, rockets, space vehicles. Apart from the invention of faster modes of transportation, the channel of transportation has also been modified which has in turn promoted better domestic and international trades and travels. Industries has often been labor-intensive but science and technology have brought about mechanization thereby accelerating production. Science and technology have made mechanized farming possible. In a nutshell, science and technology has brought a great improvement in the variable of plant and animal breed such as development of early maturing varieties that are disease resistant and better methods of storage of crops.

Science is an intensely human, intensely creative enterprise. Science dominates our lives and presents society with tremendous opportunities and tremendous challenges. Scientific knowledge allows us to develop new technologies, solve practical problems and make informed decisions both individually and collectively. Science enhances critical thinking. Scientific concepts typically begin with an idea followed by an experiment to substantiate that idea through technical methods and analysis. It dictates a logical way of approaching unfamiliar topics, ensuring students can learn how to relate theoretical and practical work (Urevbu, 2001).

Science is an integral part of various fields from agriculture to medicine and every day in between. In a world where new scientific advancement crops up seemingly by the hour, a background in science ensures students are not left behind by the ever-shifting tides of technological wave. It teaches learners to be self- sufficient in an environment where constant change is the only constant. Beyond the potential scientific breakthroughs, there are individual benefits to learning science such as developing our ability to ask questions, collect information, organise and test our ideas, sole problems and apply what we learn. Science offers a powerful platform for building confidence, developing communication skills and making sense of the world around us.

Public policy decisions that affect every aspect of our lives are based in scientific evidence. As children grow up in an increasingly technological and scientifically advanced world, they need to think, learn, solve problems and make informed decisions. These skills are integral to every aspect of a student's education and life from school to career. Science education is one of the most important subjects in schools due to its relevance to students' lives and the universally applicable problem-solving and critical thinking skills it uses and develops. These are life- long skills that allows students to generate ideas, weigh decisions intelligently and even understand the evidence behind

public policy making. Teaching technological literacy, critical thinking and problem solving through science education gives students the skills and knowledge they need to succeed in school and beyond (Eneh, 2000).

Engaging the enthusiasm of the student is pivotal. The culture of technological literacy, critical thinking and excessive central measurement and assessment in Education, undertaken with laudable aims, has in practice not only undermined the professional autonomy of the teacher and inhibited school-based curriculum innovation, but has killed the love for learning in many young people. If students cannot apply what has been learnt outside the classroom, they have gained very little of lasting value however well they may perform in tests. Science and Technology Education in the new millennium will need to move from rational planning based on projections to interactive and strategic planning in order to accommodate rapid changes resulting from knowledge explosion and information technology. In support of the fact that science and technology is growing at an unprecedented rate, Aboade (cited in Abdullahi, 1998) said: in a community where knowledge is not allowed to grow, that community remains largely elementary and primitive in the technological age. Thus, students should be encouraged to study science both at junior and senior secondary school levels.

Unarguably, science and technology is one of the bases of industrial and economic development. In line with this understanding, there is need for school administrators to critically appraise and analyse the achievement of students and consequently create a prediction model that would give insight into their ability to be successful in science. This paper explored how discriminant function can be used to predict students' ability to be successful in science based on their scores in English language, mathematics, basic science and basic technology at the junior secondary school.

Discriminant function analysis was first propounded by Bernard (1935) as means of using one set of variables to discriminate between two categories of another variable. The analysis was later extended to more than two dependent groups by Brown (1970) and Bryan (1950) Discriminant analysis is concerned with differences among groups of individuals. It reveals the characteristics that make their relevance clear and also show their relative importance. Discriminant analysis is a multivariable method of classification (Fisher,1936) which is similar to regression analysis except that the dependent variable (DV) is categorical rather than continuous (Draper and Smith, 1981). It can be used to classify, explain classifications and make predictions when the dependent variable (DV) is dichotomous, e.g., success/failure, yes/no. As an analysis concerned with the relationship between a categorical variable and a set of interrelated variables, it can also be used to determine which continuous variable discriminates between two or more naturally occurring groups. Discriminant analysis is thus a tool for predicting group membership from a linear combination of variables. Discriminant function analysis is used to determine which continuous variables discriminate between two or more naturally occurring groups.

There are two types of discriminant analysis that is the predictive discriminant analysis PDA and the descriptive discriminant analysis DDA. Stephens (1996) described the distinction between PDA and DDA in the following way; In the predictive discriminant analysis the focus is on classifying subjects into one of several groups whereas in the descriptive discriminant analysis the focus is on revealing major differences among the groups. Research questions are generally of the descriptive type or of the predictive type. Both type of questions is hardly addressed in a given research situation.

The two types of discriminant analysis have different histories of development. Discriminant analysis for the first three or four decades focused on the prediction of group membership PDA is appropriate when the researcher is interested in assigning individuals to groups based on composite scores on several predictor variables. The accuracy of such predictions can be assessed by examining the 'hit rates' as against chance.

Discriminant analysis is often seen as the reverse of MANOVA. In MANOVA, the researcher takes two or more groups and compares their scores on a combination of DVs in an attempt to discover whether or not there exist significant group differences. However, in discriminant analysis, this process is reversed (Sprinthall, 2000). In MANOVA, the IVs are the grouping variables and the DVs are the predictors. But in discriminant analysis, the DVs serve as the grouping variables and the IVs are the predictors. (Tabachnick and Fidell, 1996) If the goal of the analysis is to describe group differences, the researcher would determine the number of dimensions (discriminant functions) that maximise the differences among the groups in question. In contrast, if prediction is the goal of as analysis, the researcher might use discriminant function scores in order to predict from which group subjects came. This procedure can be used to predict membership in a particular group for new of future subjects from the same population.

Although discriminant analysis seems not to have been used very much in educational and behavioural science research, it has very interesting potentialities. Like multiple Regression, it can be used in two ways:

- to classify subjects into groups on a combination of measures
- to study the relations among variables in different groups and population.

The main goal of discriminant function analysis is to predict group membership from a set of independent variables known as predictors. For example, an educational psychologist may wish to classify students into intelligent or non-intelligent. If the psychologist has measures that seem to be related to delinquency like social class values and personal beliefs and also knowledge of the actual delinquency of a group of students, the measures and the knowledge of delinquency can be used in discriminant function. Consequently, if the prediction is reasonably successful the function can be used to assess the probable delinquency of other individuals. Furthermore, this analytical procedure can be extended to other variables like success versus failure, vote for versus vote against.

According to Adekanye (1992), discriminant analysis has been extensively used in studying finance and financial economics, particularly bank failures. It has been used in medicine (Van Viet and Gupta 1973) and in predicting administrative performance in industries. Discriminant function analysis undertakes the same task as multiple linear regressions. Discriminant Function Analysis (DFA) has been used extensively in the past to derive optimal combinations of variables to differentiate groups because of its computational simplicity. However, DFA assumes that the predictors (i.e., tests included in the model) are each normally distributed and the set of predictors has a multivariate normal distribution along with homogeneous variance-covariance matrices (Harrell, 2001).

Discriminant function analysis (DFA) is a data-reduction technique used to make decisions about naturally occurring group membership. It can answer theoretical questions but has proved especially useful in applied research. Discriminant function analysis (DFA) is a statistical procedure that classifies unknown individuals and the probability of their classification into a certain group (such as sex or ancestry group). Discriminant function analysis makes the assumption that the sample is normally distributed for the trait. The posterior probability and typicality probability are applied to calculate the classification probabilities (Albanese et al., 2008).7 The posterior probability is the probability that an unknown case belongs to a certain group based on relative Mahalanobis' distances measuring the distance to the centre or centroid of each group. The typicality probability is how likely the unknown case belongs to a group based on variability within all groups. The discriminant function procedure has been programmed into most standard statistical packages for greater applicability.

Usoro (2006) carried out a study on classification of students into various departments based on their cumulative results for one-year foundation programme known as pre-National Diploma (PRE-ND) in the polytechnic system. Charles and June (1970) carried out a study to determine if a differentiation or separation among students graduating, withdrawing or failing could be identified. Adebayo and Folayemi (1998,1999) applied the t-statistic to investigate how predictable the final year result would be using the first-year result or Grade Point Average (GPA) of some selected university graduates. In the past twenty-five years, research in academic jurisdiction has centred on graduation withdrawal, failure and selection of students on the basis of either collegiate success or cumulative result. The study however is centred on the establishment of predictive ability of student's achievement in English Language, Mathematics, Basic Science and Basic Technology on their success in SSCE science

Research Questions

1. Can students' success in science be reliably predicted from their JSCE scores in English language, mathematics, basic science and basic technology?

2. If students' success can be reliably predicted, along how many dimensions do the two groups (success groups and failure group) differ?
3. Given the obtained classification function how adequate is the classification? In other words, what proportion of cases is classified correctly?

Methodology

Discriminant analysis was used to find the extent to which students' success can be determined from their achievement in JSCE English language, mathematics, basic science and basic technology. The independent variables are a profile of scores which are at interval level and are normally distributed with equal variance and covariance. The dependent variable is categorical with two categories that is dichotomous (successful or not successful).

The participants comprised 80 SSI science students randomly selected from ten secondary schools in Ibadan North Local Government Area of Oyo State. They were divided into two groups.

Eighty achievement test items in mathematics, physics, chemistry and biology were used for the study. The items were drawn from the SSI syllabus.

The performance of the students in the achievement test was rated 1 and 0; 1 for successful and 0 for not successful. Discriminant analysis was then conducted to assess whether the four predictors, JSCE students' scores in English language, mathematics, basic science and basic technology, could distinguish those who would be successful from those who would not.

Results

The discriminant analysis output is in four parts.

1. Preliminary statistics that present the mean and standard deviation for each of the predictors
2. Test of Equality of Group means
3. Discriminant function coefficient
4. Group classification

1: Group Statistics

Recorded Science	Mean	Std. Deviation	Valid N (listwise)	
			Unweighted	Weighted
Fail Eng.	43.47	12.493	36	36.000
Maths.	46.69	10.269	36	36.000
B. Sci.	50.22	7.612	36	36.000
B. Tech	51.47	6.914	36	36.000
Pass Eng.	57.30	12.678	44	44.000
Maths.	54.18	10.810	44	44.000
B. Sci.	54.07	8.546	44	44.000
B. Tech	58.70	9.370	44	44.000
Total Eng.	51.08	14.301	80	80.000
Maths.	50.81	11.150	80	80.000
B. Sci.	52.34	8.315	80	80.000
B. Tech	55.45	9.059	80	80.000

Table 1 pre sents the descr iptive statistics - the mean and standard deviation for each of the predictors. It is titled Group Statistics.

Table 2: Tests of Equality of Group Means

	Wilks' Lambda	F	df 1	df 2	Sig.
Eng.	.766	23.849	1	78	**.**000
Maths	.887	9.938	1	78	**.**002
B. Sci.	.946	4.419	1	78	.039
B. Tech	.840	14.827	1	78	.000

Table 2 shows the test of equality of mean of group statistics. Test of equality of group means shows whether there was a significant effect of category for each of the predictor variables. For example, the table shows that there is significant difference in the mean scores in mathematics of those who failed, and those who passed (F=9.938; df=1). Wilk's Lambda, a multivariate test of significance shows that the difference is not significant as the values are very close to 1.

Table 3: Standardized Canonical Discriminant Function Coefficients

Subject	Function
	1
Eng.	.676
Maths	.208
B. Sci.	-.119
B. Tech.	.474

Table 3 is the summary of canonical discriminant functions, the centre of the whole analysis.

With respect to the structure coefficients in the above table, the most important predictor is English language (.676) followed by basic technology (.474), mathematics (.208), and basic science (-.119). The negative value of basic science shows that it correlates negatively with the value of the function whereas the other variables correlate positively.

Table 4: Classification of Results

Original Count	**Predicted Group Membership**			
Success				
	Fail	Pass	**Total**	
Fail	23	13	36	
Pass	10	34	44	
% Fail	63.9	36.1	100.01	
Pass	22.7	77.3	100.0	

From the table, students that passed science are the most accurately predicted (77.3%) whereas those that failed were the least predicted (63.9%). The model correctly predicted 77.3% of those who passed and 63.9% of those who failed. The cross validated classification showed that overall 71.3% were correctly classified.

Conclusion and Recommendation

The result of this study revealed that English Language contributed most in distinguishing students who pass the sciences from those who failed. This is indicative of the relevance of language in instruction. Consequently, the language of instruction is important irrespective of whatever teaching method is applied by teachers. Emphasis should therefore be placed on the use of English in our secondary schools as this can heighten the level of comprehension of science concepts and hence greater achievement in the sciences. In the light of this, relevant English textbooks should be made available in our libraries. Well trained and qualified English teachers should be employed to handle the teaching of English language as this will go a long way to improve the student's comprehension of the subject and hence more understanding of the science subjects.

References

Adebayo S.B. & Folayemi. T (1998). Effect of rare outcome on the measure of agreement. Index J. Nig. Stat. Assoc. 13: 1-10. ol 2.

Adekanye F. (1992). The Nigerian banking system in the context of policies of financial regulation and deregulation. *AERC Research* Paper, Final Report.

Ajayi, V.O., & Ogbeba, J. (2017). Effect of gender on senior secondary chemistry students' achievement in stoichiometry using hands-on activities. American Journal of Educational Research, 5(8), 839- 842.

Ajayi, V.O. (2017). Effect of hands-on activity-based method on interest of senior secondary students in organic chemistry. Scholarly of Education, 6(1), 1-5.

Bernard, O (1935). History and philosophy of science. Reading in General Studies vol 2.

Brown G .W (1970). Discriminant function. Annals of Mathematical Statistics. Cambrige university press.

Bryan (1950) Cannonical correlation and its relationship to discriminant function and multiple regression. Journal of American Meteorological Society. 25 (1), 23 – 31.

Charles B.K. June E.H (1970). Predicting graduation withdrawal and failure in college by multiple discriminant analysis. Journal of educational measurement (7), issue 2, 25 - 91

Draper and Smith (1981). Applied Regression Analysis, 2nd edition, John Wiley & Sons, New York.

Ekundayo, M. B. (2012). Teaching science in Africa. Salem: Mede Nigeria Limited.

Eneh, J.O. (2000). *History and Philosophy of Science*: an outline Magnet Business Enterprise Publishing Division.

Federal Ministry of Science and Technology (1986). *National Policy on science and technology. Abuja.* Luckozim Publishers.

Federal Government of Nigeria (2013). National policy on education. Lagos: NERDC Press

Fisher R.A. (1936). The use of multiple measurements in taxonomic problems. Ann Engen, 7, 179- 188.

James A. Holdnack, ... Grant L. Iverson, in WAIS-IV, WMS-IV, and ACS, 2013.

Megan K. Moore, in Research Methods in Human Skeletal Biology, 2013.

Ogbeba J, Enemarie V. and Ajayi V.O. Students' Achievement in Basic Science and Technology as a Predictor of Quality Science Education ICSHER JOURNAL Vol. 4, No. 2 JUNE, 2019: 178-187.

Symons, T.H(1983) The cultural impact of *industrialization and technological* innovation; University Notes, Birmingham Commonwealth University Congress.

Urevbu, A.O. (2001). Methodology of Science Teaching. Juland Education Publishers. Lagos.

Usoro A.E. (2006). Discriminant analysis and its application to the classification of students on the basis of their academic performance. J.Res. Phy. Sci. 2(3): 53-55.

Van vliet PK and Gupta, JM (1973). Prophylactic antibiotics in umbilical artery catheterization in the Newborn. Achives of disease in Childhood. 48(4): 296-300.