ERROR-ANALYSIS AS AN EFFECTIVE INNOVATION FOR ENHANCED STUDENTS' PERFORMANCE IN PRACTICAL BIOLOGY

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Abstract

This experimental study investigated the effect of using error analysis as a method of assessing students practical work. This study explores the relationship between students achievement and frequency of errors committed in practical biology. A null hypothesis of no significant relationship between the frequency of occurrence of error types and students overall achievement in practical biology guided the study, A sample of 317 SS III biology students from five different schools in Okene, Kogi State were randomly selected and used for the study. The result of the analysis of the error types i.e. r - 0.71 at 0.05 level of confidence using Pearson Product Moment Correlation Coefficient suggested the existence of a relationship between the overall achievement in practical test and the frequency with which errors were committed. The value of the coefficient of determination r2 = 0.504 further indicated that about 50% of the achievement is accounted for by errors committed. The implication of this was discussed and the paper recommended that teachers need to spend time to introduce students to various errors identified by the examining bodies to improve their achievement in biology practical work and in the subject as a whole

Despite the high enrolment in biology, the performance in this subject has been depressingly very poor. (Turton, 2003, Jegede, 2006). The role of practical work in developing the psychomotor or manipulative skill as well as enhancing better understanding of products and processes in science cannot be over-emphasized. It has been noted that the practical nature of a subject is commonly regarded as an important source of pupils motivation (Bryce and Robertson 2003).

Practical experiences that utilize hands-on inquiry have also been considered as one of the most effective methods of learning about science and developing the higher order thinking skills necessary to do science. Hotter, Radke and Lord 2002, Shymansky, Kyle and Alport 2003). If active learning described by the National Science Education Standards (National Research Council, 2006) implies "hands on" and "minds-on" learning which takes place in an inquiry-based laboratory, then the need arises for the science teachers to spend more time with the students on this "hands-on" learning.

Various studies and methodology on science teaching such as inquiry, discovery and process approach have shown that students learn more from science lesson by doing rather than mere observation (Betty and Woolnough, 2002). With reference to biology, a lot of emphasis has been placed on this by the experimental science curriculum projects at both the international and local levels. But despite the amount of efforts and emphasis, science teachers (biology inclusive) in Nigerian schools still revert to the use of "chalk and talk" or traditional method of teaching rather than the process and enquiry method (AN, 1996).

No wonder with the high enrollment in Biology subject in Nigeria, the performance of students at the high school level is depressingly poor (Jegede 2006, Turton 2001). The low percentage passes in biology has been attributed to the errors students make in practical biology among other factors (Aramide 2005, Kumari and Aliyu 2005, Ogunsola-Bandele and Lawan 2006). This signifies the need for error analysis.

Purpose of the Study

Error analysis, according to Olayemi (2000) shows the teacher areas where his teaching has been deficient. Akinobi (2006) on the other hand, claimed that the learner could be a source of error. This could be true where the learner is unable to represent correctly what is observed or identify correctly any specimen given. The effects of these on the learner are faulty representation. Practical biology being an area for development of psychomotor skills provides proper understanding of the content of the subject. An error analysis of the work done by the learner can be carried out and its findings can be of great value to the learner. For, according to Bryce and Robertson (2003) and Sand (2001), error analysis can be used as a method of assessing students practical work. The purpose of this study therefore, is to assess some high school biology students practical work through an innovative measure of error analysis.

Research Hypothesis

A criterion level of 0.05 was set to test the null hypothesis of no significant relationship between the frequency of occurrence of error types and student overall achievement in practical biology.

Sample and Procedure

Three hundred and seventeen, year three senior secondary (SS III) biology students were randomly drawn from five different schools in Okene. The students responded to the instrument during one of the biology lessons in order to avoid undue disruption of the school programme.

The test was administered to the 317 students directly by the researchers with the aid of a research assistant. The researcher went round and ensured that all the subjects were responding to the test questions in accordance to the instructions.

At the end of test, the answer scripts and test question papers were collected and the answer scripts and test question papers were collected and the answer scripts scored. Two other experts, who were biology teachers with experience in marking biology practical at the external level, vetted the marked scripts. This was to ensure that no mistakes were made in the marking, scoring and summation of scores in each of the questions.

Instruments for the Study

The two instruments used for data collection and analysis are hereby stated and explained:

1. ***The* West African *Examination Council (WAEC)* Questions and Marking Scheme:**

The West African Examination Council is the body responsible for the drawing of examination syllabuses for the Senior Secondary Certificate (SSCE) as well as conducting the examination leading to the award for this certificate. For data gathering purpose practical biology examination test question of WAEC (2000-2012) for SSCE were randomly sampled. The test consists of two sections. Section A is made up of short answer questions and section B is made up of long answer questions requiring the use of certain instruments, drawing, identification of specimen, etc. A total of ten short answer questions and 3 long answer questions were randomly selected out of 45 and 15 questions respectively for sections A and B. These 10 short answer questions and marking schemes were selected in line with the number of questions set by WAEC every year. These questions and marking schemes were however not validated since the WAEC questions and marking schemes are assumed valid being the only central and recognized examination body in West Africa.

2. **Error Types:**

A list of ten error types in the SSCE Biology Practicals as stated by the WAEC 2001/2002 Regulations were selected in line with questions set (Sorunke and Olafimihan 2008).

i. **Drawing Errors;** This is further classified into magnification, label lines, drawing lines, labels, shading, accuracy of drawing, spelling and title

ii. **Spelling of Technical Terms**: Technical terms must be correctly spelt most especially where it is just a one word answer, e.g. Hepatic portal vein, variegated leaf, etc.

iii. **Inability to Follow Instruction Accurately**: This occurs where a student fails to follow instructions given systematically, e.g. where cross-section of a fruit is required, the student draws longitudinal section.

iv. **General Neatness of Drawing**: *Smudges and dirty marks are not acceptable.* Drawing must be neat,

v. Techniques of answering Questions: Answers must be direct and accurate. The student may have the idea, but having no technique of answering the question,

vi. Identification and Classification of Specimen: Specimen must be correctly identified and classified where necessary,

vii. Inability to Observe parts Identified: Parts identified where necessary *Features* of biological significance should be clearly stated, e.g. webbed *hind limb* to toad for swimming in water,

viii. No Knowledge of the Subject Here completely wrong answers are given by the students (wrong idea),

ix. **Inability to compare and contrast**: Here is where students cannot draw a *Simple* table to show similarities and differences between specimens (e.g.fruits) provided

x. Poor Knowledge of Mathematics: Where student cannot add, subtract and compute simple figures to come out with simple interpretations.

Reliability of the instrument

The questions set were administered to a sample of students similar to the sample to be used and test-retest conducted. The reliability coefficient of the test-retest was calculated to be r=0.97 at 0.05 level of significance using Pearson product moment Coefficient of Correlation.

Treatment of Data and Analysis

The questions set were administered to a sample of students similar or the sample to be used and test-retest conducted. The reliability coefficient of the test-retest was calculated to be r=0.97 at 0.05 level of significance Using Pearson Product Moment Coefficient of Correlation.

The responses of the subjects were scored based on the marking scheme. Section A carried a total of 30 marks while Section B with three long answer questions each had 24, 20 and 10 marks respectively. Overall total mark 84 and maximum obtainable score is 80. These marks represented the student's achievement.

For the errors made, each of the scripts was taken and each question analyzed to find out why students failed in area where they had no scores. The error made was thus recorded for each question. Failure by a subject to obtain a score for a particular number was marked as wrong with a tallying mark against the criterion concerned. The total number of errors in each of the 10 criteria for the error type was them added up to give the total errors for each student.

Results

The results to the analysis mean scores and standard deviations to each of the error types of school are indicated on

Table 1 Table 1: Mean Scores and Standard Deviation of Error Types by School.

School										
	i	ii	iii	iv	v	vi	vii	viii	ix	x
A3	10.19	3.97	0.04	0.86	6.78	3.62	2.82	6.12	0.72	1.39
(74)	(2.94)	(1.94)	(0.2)	(0.78)	(2.64)	(2.24)	(2.2)	(3.2)	(1.26)	(0.86)
B	8.73	3.19	0.79	0.77	3.52	3.44	3.6	8.0	2.85	1.6
(48)	(2.66)	(1.45)	(0.41)	(0.78)	(1.82)	(1.50)	(1.99)	(4.05)	(1.05)	(1.45)
C	9.05	2.30	0.37	0.90	3.3	4.33	3.92	9.95	2.33	2.02
(63)	(3.59)	(1.83)	(0.55)	(0.73)	(2.14)	(2.16)	(2.24)	(5.3)	(1.87)	(1.57)
D	11.46	3.25	0.76	0.87	3.08	3.23	3.48	13.62	2.13	1.73
(71)	(21.48)	(1.36)	(0.43)	(0.88)	(1.67)	(1.19)	(1.54)	(4.99)	(1.72)	(1.32)
E	10.10	2.45	0.03	0.35	1.47	2.42	3.33	10.55	1.15	1.87
(61)	(2.87)	(1.41)	(0.18)	(0.66)	(1.74)	(1.32)	(2.34)	(4.89)	(1.99)	(1.77)

Figure in bracket ( ) are standard deviation and { } are number of subjects in each school.

In order to test the hypothesis of no significant relationship between frequency of occurrence of error types and student's overall achievement in practical biology, Pearson product Moment Correlation Coefficient was used. The result obtained is shown as Table

Table 2: Result of Correlation of Errors and Score of subjects

ΣX	ΣY	ΣXY	ΣX^2	ΣY^2	*r
12036	6936	251826	*488793*	196652	0.71

*r=0.71

Where ΣX = sum of errors
ΣX = sum of scores
ΣXY = Total number of subjects
Significant, P>0.05

The values of r=0.71 is significant at 0.05 Hence the null hypothesis is rejected. The value or r was further converted to r^2 (coefficient of determination) and in this case, it is 0.504 which is 50.4%.

The results obtained as a result of the analysis of the error types suggest the existence of a relationship between the overall achievements in practical test the frequency with which errors were committed.

Discussion

The data collected from the test administered was analyzed and the result of the analysis showed that all the subjects committed certain degree of error in each of the ten groups of error types, although the degree differ from school to school. This is shown on Table 1 where the mean scores for each of the error types is indicated by school.

The Pearson Product moment Correlation Coefficient conducted on the frequency of occurrence of error types and students overall achievement indicated that there is a significant relationship at P=0.05 level. That is the more the errors committed, the less the achievement. The value of the coefficient of determination r^2=O.54 (50.4%) further explains that about 50% of the achievement is accounted for by errors committed. Thus, it could be gathered that frequency of errors had depressing effect on achievement in practical biology.

This finding agrees with lloeje (1991), who stated that the performance of a student in practical biology is directly related to how well the learner can represent his observations.

According to Escaladar and Zoiiman (2006), practical or laboratory experience have always been important components for the reinforcement and understanding of science concepts and there is great need for the biology teachers to spend more time on "hand on"

Recommendation

Since the results from this study reveal that (SS III) Senior Secondary School students generally commit a number of errors in practical biology which affect their performance in the practical examination and hence the subject biology as a whole, the teacher needs to spend more time introducing students to various errors identified by the examining bodies.

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