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Effects of Systematic and Random Measurement Error Tests on Students' Achievement in Biology

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Abstract

The poor achievement of students in Biology in secondary schools could be attributed to the measurement errors (different responses of students). This study was designed to investigate the effects of systematic, random errors and mistake (control) on SS 2 students' achievement in Biology. The researcher adopted a non-equivalent quasi-experimental design. A sample of 378 SS 2 students was drawn from the three schools in Enugu education zone of Enugu State. In each of the three schools used one intact class was randomly drawn, one intact class was then randomly assigned to the experimental groups 1, 11 and II1 respectively. The three groups were examined using systematic, random measurement errors and mistakes for experimental group I (systematic), experimental group II (random) and group 111(mistake). One research question and one hypothesis guided the study. Relevant data for the study were collected using Biology Achievement Test (BAT). Research question was answered using mean and standard deviation while hypothesis was tested using Analysis of Covariance (ANCOVA). The results showed that the use of systematic test in evaluating Biology in secondary schools was found to achieve higher than those using random error test. The control group (mistakes) had the least achievement. Some recommendations were made based on the findings of the study.

Key words: systematic and random errors, measurement errors, achievement inbiology

Introduction

The usefulness of Biology in every facet of human life is so glaring that there is hool curriculum or a national development planning without emphasis on the use of gy (Maduabum, 1984). The aims of secondary education in her national policy on tion (Federal Government of Nigeria, 2013) are for the preparation for useful and higher education. To achieve the above goals, the policy includes Biology ce) as a core and compulsory subject.

on the national policy on Education and with particular reference to aims and ves of secondary education, Biology enables the individual to think creatively, consecutively in scientific terms, acquire, manipulate skills in Biology, apply gy skills, comprehend the wide applicability of Biology in other disciplines, er, appreciate, admire the beauty and elegance of nature (Federal Government of

Nigeria, 2013).These objectives of the Federal Government can be realized by correcting the errors arising from random and systematic measurement in evaluating Biology in secondary schools.

Measurement errors occur when the response provided differs from the real value, such errors may be attributable to the respondent, the interviewer, the questionnaires, the collection method or the respondent's record - keeping system. Such errors may be random or they may result in a systematic bias if they are not random. Sources of measurement errors are

i. Error in a survey response as a result of respondent confusion, ignorance, carelessness, or dishonesty.
ii. Error attributable to the interviewer, perhaps as a consequence of poor or inadequate training.
iii. Prior expectations regarding respondent's responses
v. Error attributable to the wording of the questions in the questionnaire, the order or context in which the questions are presented, and the method used to obtain the responses.

Types of measurement errors are random, systematic errors and mistake. Random errors are errors that are easier to deal with because they cause the measurements to fluctuate around the true value. It is caused by any measurement of the variable across the sample. Tape measurement made several times under the same conditions is unlikely to give exactly the same value for each measurement judgment of the tape reading will very as will tension on the tape depending on how hard you pull. If you remove the mistake and the systematic errors then some variation in the repeated measurements will still be seen. For instance, each person's mood can inflate or deflate their performance on any occasion. In a particular testing, some children may be feeling in a good mood and others may be depressed. If mood affects their performance on the measure, it may artificially inflate the observed scores for some children and artificially deflate them for others. The important thing about random error is that it does not have any consistent effects across the entire sample. Instead, it pushes observed scores up or down randomly. This means that if we could see all of the random errors in distributions they would have to sum to zero because there would be as many negative error as positive ones. The important property of random error is that it adds variability to the data but does not affect average performance for the group. Random errors are ones that are easier to deal with because they cause the measurements to fluctuate around the true value if we are trying to measure some parameter X, greater random errors cause a greater dispersion of values, but the mean of X still represents the true value for that instrument.

Systematic errors are errors that can be repeated and can be accounted for in processing. If you calibrate a type measure against a known standard and find that it always measures distances that are too long, the difference is a systematic error and can be removed when the measurements are processed Systematic errors in tape and depth measurements can be found by calibrating the tape measures and depth sensors against a known standard.It is also caused by any factors that systematically affect measurement of the variable across the sample. For instance, if there is loud traffic going by just outside of a classroom where students are taking a test, this noise is liable to affect all of the children's scores in this case, systematically lowering them. Unlike random error, systematic errors tend to be consistently either positive or negative because of this,

ematic error is sometimes considered to be bias in measurement. A systematic error e trickier to track down and is often called a bias in the measurement. In chemistry a her tells the student to read the volume of liquid in a graduated cylinder by looking at meniscus. A student may make an error by reading the volume by looking at the d level near the edge of the glass, thus this student will always be off by a certain unt for every reading he makes. Typical mistakesinclude reading the wrong bers from a tape measure, making a measurement with the tape engaged around e ship's structure or reading the wrong values from a form when processing the surements.

Performance in Biology has worried scholars in the area of Biology. A study ed out on achievement in Biology (science) by Ike (1985) showed that achievement iology consistently becomes poor at secondary school level. The West African mination Council (2013) report on students' performance showed a progressive ne in Biology. The achievement of students in Biology is closely related to the f evaluation technique. For instance, Mcluchan (1990) pointed out that no real ssment may take place without appropriate educational measures. Consequently, the nt work will investigate the level of students' achievement when systematic and m measurement errors are corrected during the evaluation of Biology in Secondary ols in Enugu Education Zone of Enugu State.

Many observations have been made by scientists and Biology teachers on the ct of the use of vital evaluation techniques in our primary and secondary schools in ria. This ugly trend has led to the students' poor performance in Biology in senior ndary school certificate examinations in Nigeria. Furthermore, this unfortunate ion of not correcting the systematic and random measurement errors has buted to the students dwindling performance in Biology. Consider for instance, (in) out of 11, 120 candidates who sat for senior secondary school certificate nations in Biology in the Zone only 13% passed at credit level (West African mination Council, 2013). It appears that there is no empirical study so far that studied lative effectiveness of systematic and random measurement error tests in assessing gy in senior secondary schools in Enugu Education Zone of Enugu State. ever, it is not certain which educational measure is associated with student's higher vement in senior secondary school Biology.The purpose of the study is to find out ffects of systematic and random measurement error tests on students' achievement ology.

The findings of this study will be useful to students, teachers, authors and shers. The findings of this study if applied will also be useful to curriculum ers, and researchers. It will be useful to students because it enhances students' vement in Biology due to its novelty, which in turn may lead to higher achievement ology. The findings of this study will be useful to Biology teachers especially those ior secondary schools. It will provide them with additional educational measures aluating certain Biology topics for better assimilation which in turn will enhance nt's achievement. It will be useful to authors and publishers because it will serve as ional educational measures of assessing their Biology skills in Nigerian school gy text books. This finding will be beneficial to curriculum planners in drawing up structuring Biology curriculum of senior secondary schools by making Biology ment at this level more resourceful and practical oriented. Lastly, the result of this

study could be beneficial to researchers as a point of reference for further studies in other related disciplines.

This study was delimited to find out the effects of using systematic, random measurement error tests and mistake on senior secondary school students' achievement in Biology in Enugu Education Zone of Enugu State. It will find out the level of difference in the mean achievement scores of students assessed using systematic, random measurement error tests and control (mistake) in Biology.

Research Question

What are the differences in the mean achievement scores of students assessed in Biology using systematic, random measurement error tests and control (mistake) on senior secondary school students' achievement?

Null hypothesis

There is no significant difference in the mean achievement scores of students in Biology using systematic, random measurement error tests and control (mistake) on senior secondary school students' achievement.

Method

The design for this study is quasi-experimental. The design is specifically a pretest –post-test, non equivalent group design. The choice of this design agrees with Abimbade (1997) who observed that this design is often used in classroom experiment when experimental and non-control groups are naturally assembled groups, such as intact classes will be randomly assigned to experimental groups I, II and control III respectively.

Table 1: Diagrammatic Representation of Pre test – Post test Control group design:

Group	Pre-test	Research condition	Post-test
E_1	O_A	X_1	O_B
E_2	O_A	X_2	O_B
C_3	O_A	X_3	O_B

Where;

E_1 =Represents experimental treatment group on systematic measurement error tests

E_2 =Represents experimental treatment group on random measurement errors tests

C_3= Represents control (mistake) group.

O_A = Represents pre test on achievements

O_B = Represents post test on achievements

X_1 =Represents treatment condition on systematic measurement errors

X_2 = Represents treatment condition on random measurement errors

$-X_3$ = Represents no treatment/control (mistake) group.

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