UNETHICAL USAGE OF STATISTICAL TOOLS IN SCIENCE EDUCATION RESEARCHES: THE WAY OUT

Boris, O .O
Ilugbusi, O.O

School of Education, College of Education,
Ikere- Ekiti, Ekiti State, Nigeria

ABSTRACT

This paper critically examined the technicalities involved in choosing and using the appropriate statistical techniques accurately in integrated Science research. The choice of statistics to use in any integrated science research is dictated by the design and type of data to be collected. Hence any research endeavour has to incorporate the statistical method to be used right from the on set. Efforts are then made to identify the conditions for the selection of statistics, as well as the scale to be employed in making such selections. These were then used to design the strategy for the choice of appropriate statistics techniques to use in integrated science research.

Keywords: Unethical usage, statistical tools, science education researches

INTRODUCTION

The Concept of Research and Integrated Science Research Research in Integrated Science could be very interesting if the researcher is given proper orientation. Researching however becomes difficult, burden-some and uninteresting where individual feels that the challenges of research are not worth any effort. Research work should be of interest not only to academicians but also to professionals in various fields since researches are directed toward keeping knowledge fresh and up to date. Leady (1989) defines research as "the manner with which we sole knotty problems in our attempt to push back the frontiers of human ignorance and advance the frontiers of human knowledge.

Integrated Science research however can be defined as the process of arriving at dependable solution(s) to Integrated Science Problems(s) through planned and systematic, collection, organization, analysis and interpretation of data. Although, there are various types of research but most of the time, Integrated Science researches use to be experimental in nature.

Experimental research according to Campbell and Stanley (1963) refers to that portion of research in which variables are manipulated and their effects upon other causality, the cause and effect relationship between, two or more phenomena. For example, poor performance in Integrated Science Examination is a phenomenon (Effect), while possible reasons for the observed effect are the causes. It is therefore the duty of the researcher to establish probable links between the cause(s) with a view to suggesting solutions to the problems. This procedure however relies heavily on information or data gathering. There is a great variability in the world of information or data gathering. This variability calls for the use of a power tool-statistics for managing the jumble or data collected.

This paper specifically examined the issues involved in the choice of the appropriate statistics to be used in Integrated Science research. Attempts were also made to critically examine the various stage involved in making the choice. The computational procedures of the chosen statistics were deemed unnecessary as the computer displays the analyses of results in interpretable forms.

Statistics in Integrated Science Research

Statistics is a common kit of tools for describing and analyzing data of various disciplines (including Integrated Science.) It is concerned with scientific methods for collecting, organizing, summarizing, presenting and analyzing data. In this conservative sense, statistics is   neutral, that is the same sampling technique may be used in Business, Economics, Integrated Science, Education and other disciplines. But however, according to Dyer (1979), statistics has developed certain techniques peculiar to the field of application. Mundane techniques like graphs, charts, averages, percentages and frequency distributions among others may be used for description. But however, the most important utility of statistics is in the analysis of numerical data by statistical techniques. Statistical techniques are methods or tests available for carrying out research.

There is hence the need for the consideration of what statistical techniques to be used in the analysis of the jumble of information gathered, and it should be noted that the issue of the choice and use of statistical tests is not facial. It requires that an Integrated Science researcher should understand why he is doing what he is doing, how he is doing it and what results he intends to get out of tit and where such result will land or crash land him. (Llugbusi, 2003)

Generally, it is when one comes to the section on analysis that one mentions the statistics to be used, although the statistics to be used is part of the main design of a research effort. Wolf

(1972) asserted that at the onset of any Integrated Science research the researcher must decide how he would analysis the data to be obtained. It is only logical that this decision must e made before beginning the study if appropriate data are to be collected. Goode and Hatt (1981) stated that the design and collection of data alone cannot ensure that answers are provided to the original hypothesis until all relevant factors are considered in advance so that there will be no serious problem in analysis.

Generally, knowing the statistical procedure to be used in a study ensures that one chooses the appropriate methods for the collection of data, and also ensures that there is consistency between the objectives of the study as well as the research design. It is then obvious that appropriate analysis, predicated in appropriate choice of statistics which in turn is predicated on appropriate designs and data collection is what the Integrated Science researcher needs in providing the desired answers.

CONDITIONS FOR SELECTION OF STATISTICS

The decision as to the statistics to be used in any research, depends on the characteristics of the data to be collected, these include (a) the type of variables, (b) the number of variables and the scale of measurement of the variables. According to wolf (1972), a variable is any characteristic having two or more mutually exclusive properties or values. Hence attitude to Integrated Science (whether poor/moderate/good) sex (male/female), test performance in Integrated Science and age and others are notable variables.

Generally, there are two categories of variables according to wolf (1972). These are; the variety, popularly called the independent variable and the criterion variable also known as the dependent variable. A criterion variable represents an outcome or objective. It is generally referred to as dependent variable. Test scores of performance, behavioural response on exposure to

treatment are examples of criterion variables while a variety is a characteristic or experience shared in common by a group of individuals. It is used as a basis for classifying individuals into groups for study (Wolf, 1972). for example, teachers; methods of teaching Integrated Science, reading styles of Integrated Science students and the like are all notable variable is commonly informed to as an independent variable.

The next thing to consider is the number of independent and dependent variables involved in the Integrated Science research. An Integrated Science research topic like the effect of teaching styles on Students outcome in Integrated Science involve the use of two or more different styles (varieties or independent variables). Students' performance in turn be of varying types - Immediate achievement and long tem or delayed achievement (retention) or simple put-Short term and long term memory respectively. It should be noted that if the varieties (independent variables) are many, one needs to specify the levels of each of them if these levels are identified right from the onset; it therefore becomes easier for the researcher to choose what statistical method to apply.

LEVELS OF QUANTIFICATION

These are also called scales or levels of measurement. We measure many things at our day to day activities: the length of cloths in meters, amount of money in Naira and so on. This measurement process assumes that a unit of measurement exists. These measured variables, say length, weights and distances are said to be Quantifiable. Some variables in education and social sciences are not quantifiable, that is they are Quantitative and some are Semi-quantifiable. According to Bandela (1999), there are four types of scales or levels of measurement or there are four levels or qualification, namely,

(i)   Nominal scale or level
(ii)   Ordinal scale or level
(iii)   interval scale or level
(iv)   Ratio scale or level
(i)   Nominal Scale/Level:

This is the lowest level of measurement and is better understood as labels, numberings and classifications for identification purposes only. (ii)   Ordinal Scale/Level: This has all tile qualities of the nominal scale but has the added merit that the unit of measurement is rank ordered. (iii)   Interval Scale: This combines the properties of the nominal and ordinal scales and in addition has equal interval between the units of measurement (iv)   Ratio scale: This is the highest level of measurement or quantification. It combines all the properties of the nominal, ordinal and interval scales, and in addition has an absolute or natural zero point. Selecting the appropriate Statistics to be used in an Integrated Science Research

The previous discussions had highlighted what one needs to do to be able to make good choice of the statistics to be employed in an integrated Science Research. These factors are used in the preparation of table 1 as shown below:

Table 1: Statistical Techniques Classified According to Types, Numbers and Scales of Measurement of Variables.

CRITERION (DEPENDENT) VARIABLE					
One			**Two or More**		
Nominal	**Ordinal**	**Interval**	**Nominal**	**Ordinal**	**Interval**
Chi-Square test for independence contingency co-efficient, cochrom Q Test, fishers exact probability tables test for 2×2	Sign Test, mann whitney u-test, kruskal wallis one- way ANOVA by ranks Median Test	ANOVA			Multiple Discrimnant Analysis
	Spearman rank's correlation, Kendall rank's correlation	ANOVA with trend Analysis			
ANOVA			Multiple Regression Analysis Correlation Analysis	ANOVA	Multiple Rregression Analysis
	Frideman Two way analysis	ANOVA (factorial design)			ANOVA
Multiple Discriminant Analysis			Multiple Regression Analysis	Multiple Discrimnant Analysis	Canonical correlation

Source: Choosing an appropriate statistical procedure Wolf, R. M (1972)

To be able to operate this flow-chart, Wolf (1972) suggested that the researcher must be able to answer the following questions.

1. What are the variates in the study?
2. What are the criterion variables?
3. How many variates are there in the study?
4. How many criterion Variables are there?
5. What Scale of measurement is appropriate for each criterion variables? The answers to these questions will then be fed into flow-chart and the completed chart will serve as a useful device for entering the table of statistics in table 1.

PRACTICAL EXAMPLES AND ILLUSTRATIONS

Example I: A researcher is interested in finding out the relative effects of using two methods of teaching on learning outcomes of some students in integrated Science

Example II: A researcher wants to find out the relationship between the SSCE grade and JAMB Scores on students' ability to cope with University education.

Example III: A researcher wants to find out the effect of parental influence on students' performance in Integrated Science.

The summary flow-chart in respect of these example are as presented on table II.

The summary flow-chart above then serve as a guide to enter the table of statistics. Hence, in respect of example I above, the two variates row nominal scale of measurement intersects the one-criterion variable column under interval. This then suggests the use of Analysis of variance (factorial design). Similarly, multiple regression analysis and analysis of variance are suggested (by consulting table I) for example II and III respectively.

CONCLUSION AND RECOMMENDATIONS

Attempts were made in this paper to critically examine how

Table II: Summary Flow-Chart.

Variates			Criterion Variables		
Name	No	Measurement	Name	No	Measurement
Methods of Teaching	2	Nominal	Learning outcome	1	Interval
SSCE and JAMB Scores	2	Ordinal	Ability to cope with University education		Nominal
Parental influence	1	Nominal	Performance in integrated Science	1	Interval

to chose and use appropriate statistical techniques accurately din Integrated Science Research. The computational procedures or manipulations of the statistical techniques were deemed unnecessary as the computer displays the analyses of results in interpretable forms. The use made to a particular statistics technique will determine the quality of contribution it has made to the body of knowledge in the area investigated in Integrated Science. A wrong choice of statistical techniques is as bad as a matter of priority endeavour to choose and use/apply appropriate statistics technique accurately in Integrated Science Research.

This paper does not pretend to include all available statistics in research. It is only an effort to simplify the process of searching for the statistics to be used. Other statistics tests, tools and or technique not mentioned are not declared irrelevant and un-useful

Since statistical techniques are tools used to answer research questions and to test research hypothesis, and according to Bandele (1999), there are three types of research questions:
1. Descriptive questions
2. Association questions and
3. Causal questions
Consequently the following Statistical tests or procedures are therefore recommended for use in the above three cases.

Studies of descriptive questions
Binomial test, chi-square goodness of fit, t-test, f-test for variances manna Whitney u-test and median test, Kruskal-wallis ANOVA by ranks, sign test, Friedman rank sum test and will coxon matched pairs test among others.

Studies of Association questions
- Finding Indices of Association between two variables: - point Biserial correlation, Cramer's V statistic, Eta-square, product moment correlations, Rho-Tetrachronic correlation etc.
- Assessing the Relationship between a set of variable and a

criterion variable: - Analysis of variance, factorial, multiple regression Analysis and multiple correlation, factor analysis, multivariate and canonical variate analysis etc.

Studies of causal questions

Analysis of variance, analysis of covariance, Discriminant analysis, multiple classification analysis, path analysis and so on.

REFERENCES

Band, O. S. O. (1999). *Intermediate Statistics: Theory and Practice* Ado-Ekiti: PETOA Educational Publishers.

Campbell, D. T. and **Staniay, J.C.** (1963). *Experimental and Quasi-Experimental Desions for Research.* Chicago: Rand McNally College publishing Company.

Dyer. J. R. (1979). *Understanding and Evaluating Educational Research.* London: Addission - Wesley Publishing Coy

Goode, W. J. and **Hatt, P. K.** (1981). *Methods of Social Research.* Japan: McGraw Hill Book Company.

Ilugbusi, A. A. (2003). *Essentials of Educational Research and Statistics.* Lagos: Bolay-Bay Publications.

Leedy, P. O. (1989). *Practical Research, Planning and Design.* New York. Macmillan Publishing Comp81ny Inc.

Wolf, R. M. (1972). *Choosing an Appropriate Statistical Procedure.* In Baker, R. L and Schuctz, R. E.(eds) *Instructional Product Research.* New York: America Book Company.