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Assessment of the Use of Appropriate Statistical Techniques in Undergraduate Educational Research Projects in the University of Benin, Benin City, Nigeria

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Abstract

The study investigated the appropriateness of statistical techniques used in undergraduate educational research projects in the University of Benin, Edo State. The study specifically determined the popular statistical tools employed by undergraduate researchers in project writing, the proportion of projects having appropriate statistical techniques usage, and whether the observed proportion of appropriate statistical techniques is different from what is expected by chance. Two research questions and one hypothesis guided the study. The study employed a descriptive design of a documentary approach. The study population was 1,383 undergraduate research project copies submitted in partial fulfillment of Bachelor of Science/Art Education degree in the 2020/2021, 2021/2022 and 2022/2023 academic sessions in the Faculty of Education, University of Benin library. The sample size was 270 undergraduate projects, comprising 90 projects for each of the three academic sessions selected through a systematic sampling technique. The instrument used for data collection was a statistical tool checklist compiled by the researchers from the literature on the principles and assumptions of statistical tools. It was titled "Statistical Tools Checklist for Appropriate Utilization for Data Analysis (STOCAUDA)". Three experts in Measurement and Evaluation validated the instrument. It was accepted as a valid statistical tool checklist. Data collected were analysed using simple proportion, percentages and simple ranking to answer research questions, while a one-sample binomial test of equal probabilities was used to test the hypothesis at the 0.05 level of significance. The findings from the study revealed that descriptive statistics is the popular statistical tool employed in project writing by undergraduate researchers. The level of appropriateness of statistical techniques usage by the undergraduate researchers in the three academic sessions was 0.64% in 2020/2021, 0.79% in 2021/2022, and 0.84% in 2022/2023. It also reveals that the proportion of appropriate usage of statistical tools in undergraduate educational research projects is significantly different across 2020/2021, 2021/2022 and 2022/2023 academic sessions. It was recommended that undergraduate researchers should utilise inferential statistical techniques in addition to descriptive statistics to make inferences about real-world data. Also, project supervisors should improve on undergraduates' research project

supervision efforts by being conversant with appropriate statistical tools suitable for a particular study.

Keywords: Appropriateness of **statistical techniques**, Undergraduates **in the University of Benin,** students, Educational research projects

Introduction

In Nigeria and globally, universities are the highest institutions for knowledge production and generation and play critical roles in national research. According to Conroy in Ugodulunwa (2015), the roles played by universities in the world include maintaining research infrastructure in all existing academic disciplines and creating new disciplines, maintaining the research excellence in specific areas and training new researchers, and reforming university teaching. Nigerian universities strive for research excellence yearly to achieve quality research output and national and international ranking. As such, there is a need for quality research. Research is a scientific study that analyses facts, observations or existing theories to uncover or learn about new knowledge, relationships between two or more variables or a contribution to specific or general knowledge (The University of Benin Postgraduate School, 2020).

In every research, be it educational, social sciences, pure science or art, some systematic procedures are followed to arrive at a problem solution under investigation. However, research around teaching, learning, and related activities are tagged as educational research. Educational research systematically collects and analyses data for problem-solving in education. The whole system of education needs improvement through research. Research can be concerned with specific or general ideas, social observations or theories, testing of theoretical concept or their intervening/existing relationships (Anol, 2012). The main objective of educational research is to discover general principles that can be utilised in explaining, predicting and controlling educational practices or development issues. As the National Policy on Education (FRN, 2016) stipulated, university research shall be relevant to the nation's developmental goals.

University students are to undertake projects while the institutions disseminate research results to the government and industries for proper utilisation. The curriculum for tertiary institutions stipulates that undertaking project work will be a prerequisite for graduating from any degree programme at the university (Onah & Amaaechi, 2017). Research projects are one of the basic requirements all students in both undergraduate and postgraduate programmes must successfully undertake in the course of study in partial fulfilment of the requirements for the award of the degree of interest. In pursuance of this goal, students of the Faculty of Education, University of Benin, undertake project work at undergraduate and postgraduate degree programmes. All research outputs from her degree programmes are taken as part of academy output. The undergraduate programme in the Faculty of Education is a four-year programme. In the final year, students must conduct research under academic staff's supervision. The written project report is submitted as a prerequisite for the award of a B.Sc.Ed/B.A.Ed degree (Faculty of Education Handbook, 2022).

The project allows the student to examine some problems in his or her area of specialisation and follow scientific methods to systematically proffer solutions to an identified problem (Ifedili & Omiunu, 2012). The aforementioned scientific methods involve the collection of data. The term 'data' in research is generally viewed as organised information collected by different means about subjects, individual(s) or organisations of interests by a researcher. All educational research involves one form of data collection. Research can be concerned with

specific or general ideas, social observations or theories, testing of theoretical concept or their intervening/existing relationships (Anol, 2012). All data collected in a research study must be analysed for meaningful interpretation as well as the drawing of conclusions. The various computational/mathematical-based processes ruled by assumptions and principles, which researchers apply in data analysis during a research study to arrive at decisions about data collected in a study, are usually referred to as 'Statistical Techniques.'

The word techniques could mean methods, tools or skills of doing something. Statistical techniques are various quantitative and pictorial devices which make use of mathematical procedures to explain data in a concise and precise manner. Owie (2020) describes statistical techniques as different analytical/mathematical procedures employed based on principles and statistical assumptions in a clearer way. Statistical techniques are simply the methods used in analysing the data collected in the study. Asim and Eni (2015) stated that every statistical technique has its underlying assumptions based on the level of data, number of variables involved and the proposed relationship stated in the statistical hypotheses. Violating such assumptions affects the internal and external validity of such studies. The use of statistical techniques in education suggests to the investigator the directions of observation and decision-making and the empirical claims to be reported.

In the Universities' Faculties of Education, the student teachers are beginners and inexperienced researchers. However, they are still expected to contribute, at least to some extent, to the overall goals of scientific research. Thus, assessing the research project at this level will aim to ascertain the validity of these research findings, which depend on the appropriateness of the statistical tools employed in data analysis. In a University, all network of Schools/ Faculties/ Colleges usually tailor their vision to correspond to their host Universities' visions.

Educational research in a university should employ appropriate statistical techniques to validate research findings as the appropriateness of statistical techniques are sine quo non to quality research. Educational researchers could apply over twenty statistical techniques in a research design. Some of the statistical techniques are merely descriptive in nature and are used to answer research questions. In contrast, others are inferential and are used to test hypotheses, leading to inference and conclusion about samples from a defined population. The descriptive statistics commonly used in education include percentages, means, graphs, charts, percentile ranks, and correlation coefficients. The inferential statistical techniques may include: t-test, z-test, analysis of variance (s), chi square, regression analyses, fisher z-test, binomial test, chi-square, Mann Whitey test, Friedman test, Kruskal-Wallis, Sign test among others. Some statistical techniques are appropriate for a normally distributed population, while others are not. Some may be appropriate for categorical or binary variables; others may be suitable for either interval, ordinal, or ratio scales data (Owie, 2020). The selection and usage of the appropriate statistical tools is central to the accuracy and meaningfulness of the results and inferences made for a given set of data (Achimugo & Mohammed, 2019).

When an educational researcher employs a statistical technique incorrectly, the research result is misleading. This can lead to falsehoods, faulty conclusions, and incorrect decision-making/reporting in the field of education that do not support the university's research goal. Educational research reports should not be distorted because it is on record that educational research output has played key roles in providing excellent teaching, theorising, gap-filling and community advancement benefitting individuals, organisations, schools and the Government over time (Osunde, 2021). Statistical techniques in educational research studies must be appropriate to support a university vision and academic research goal. Some form of statistical courses taught to education students in the University is to equip them with statistical knowledge

needed to apply in research studies that should be submitted as a project in partial requirement for the award of a university degree for a B.Sc/B.Ed degree programme. Most of these students often mismatched statistical techniques in their research designs, indicating a lack of mastery/understanding of the principles and assumptions of the various statistical techniques. The issue of inappropriateness or mismatched statistical technique in a research threatens the validity of research findings or produces incorrect research information, and as such, the aim of research report writing in the university may be defeated. It is, therefore, crucial to examine statistical techniques used in the B.Sc/B.Ed degree programme research carried out as partial fulfillment for the award of degrees in the Faculty of Education in the University.

Appropriateness of statistical techniques in educational research studies must be upheld to support a university vision and academic research goal. Some form of statistical courses taught to education students in the University is to equip them with statistical knowledge needed to apply in research studies that should be submitted as a project in partial requirement for the award of a university degree for a B.Sc/B.Ed degree programme. Most of these students often mismatched statistical techniques in their research designs, indicating a lack of mastery/understanding of the principles and assumptions of the various statistical techniques. The issue of inappropriateness or mismatched statistical technique in a research threatens the validity of research findings, undermining the article's significance and as such the aim of research report writing in the university may be defeated. It is therefore crucial to examine statistical techniques used in the B.Sc/B.Ed degree programme researches carried out as partial fulfillment for the award of degrees in the Faculty of Education in the University.

Statement of the Problem

Research has become an important tool for making decisions and judgments relating to educational development. At the undergraduate level, student teachers' research prepares them for related challenges in their careers. However, evaluating the research project at this level relies upon expanding the frontier of knowledge in education. The researchers would like to describe the final-year education students as ‘New Researchers in Training’ who could become future educational researchers in various universities. Therefore, the statistical techniques employed in the research carried out by education students as completion of a degree should be appropriate. When inappropriate statistical techniques are utilised in any educational research, it distorts the information provided, leading to false decisions in the educational system. Any distorted educational research finding could not support the goal of Nigerian University education and would hinder the needed innovations and development of teaching and learning (Owie, 2020). This directly implies that the inappropriateness of statistical techniques applied by educational researchers in the academic environment in the universities and the University of Benin in particular would distort research findings, and the aim of research writing may be defeated.

A glance at the undergraduates' bound projects suggests that most statistical techniques used in such research may not be appropriate for the research questions and hypothesis. Again, documented studies revealed that many studies employ inappropriate statistical techniques due to a lack of proper statistical knowledge. Inappropriate utilisation of statistical techniques in a research study threatens the validity of research findings in education. If the undergraduate student's research studies submitted as projects are found to employ inappropriate statistical techniques, inferences made from their findings may be compromised. In this light, the study seeks to assess the appropriateness of statistical techniques in undergraduate educational research projects in the University of Benin, Benin City, Nigeria.

Research Questions

1. What are the prevailing Statistical Techniques applied in Undergraduate Educational Research Projects across 2020/2021, 2021/2022 and 2022/2023 academic sessions in the Faculty of Education, University of Benin?
2. What is the proportion of undergraduate educational research projects with appropriate statistical techniques applied in Undergraduate Educational Research Projects across 2020/2021, 2021/2022 and 2022/2023 academic sessions in the Faculty of Education, University of Benin?

Hypothesis

1. The proportion of undergraduate educational research project usage is not significantly different from what is expected by chance assuming equal proportions of 50% at 0.05 level of significance across 2020/2021, 2021/2022 and 2022/2023 per academic sessions in Faculty of Education, University of Benin.

Methodology

The study adopted the descriptive survey designs using the documentary approach because only a sampled part of the population of undergraduate education students across the 2020/2021, 2021/2022 and 2022/2023 academic sessions was studied. The study population was 1,383 final-year undergraduate projects submitted to the Faculty of Education, University of Benin library from 7th January 2019 to 20th July 2023. It cut across education undergraduate students in the 2020/2021, 2021/2022 and 2022/2023 academic sessions who submitted bound undergraduate B.Sc/B.A.Ed academic research projects to the Faculty of Education, University of Benin. The choice of students for the period across 2020/2021, 2021/2022, and 2022/2023 academic sessions were deemed suitable because they represent the most recent sets of graduates who contributed to the research knowledge bank in the Faculty of Education of the University of Benin. The sample for the study was two hundred and seventy (270) submitted bound undergraduate B.Sc./B.A.Ed academic research projects accessible in the Faculty of Education, University of Benin Library. The instrument used for data collection was a statistical tool checklist compiled by the researchers from the literature on the principles and assumptions of statistical tools. It was titled "**Statistical** tools checklist for appropriate utilisation in data analysis (STOCAUDA)". It contains 28 statistical tools with five columns. Columns 1-5 consist of named statistics, their purpose, the appropriate scale level, the appropriate variable type, and the corresponding assumptions of each named statistic. The instrument was validated by three experts in Measurement and Evaluation and subjected to a postgraduate Board of examiners in a seminar. It was accepted as a valid statistical tools checklist. The instrument was not tested for reliability because it is a checklist that does not require a reliability coefficient for validation. The data collected by the researchers was analysed by first coding the data collected by each author into either any of the four-measurement scale of per 2020/2021, 2021/2022 and 2022/2023 per nominal, ordinal, interval and ratio depending on the instrument utilised in data collection by individual researchers as documented in each bound project copy. The variables in each bound project were also coded into any of the variable types of either discrete, continuous, dichotomous, binary, categorical, categorical-binary and dichotomous categorical in line with the nature of research variables investigated by each researcher. The data was further analysed afterwards using frequency count, simple proportion, percentages and a one-sampled binomial test of equal probabilities. The researchers computed the data using SPSS IBM Statistical Software Packages.

Results

Research Question One: What are the prevailing Statistical Techniques applied in Undergraduate Educational Research Projects across 2020/2021, 2021/2022 and 2022/2023 academic sessions in the Faculty of Education, University of Benin?

Table 1: Description of Statistical Techniques Applied in Undergraduate Educational Research Projects

S/N	Statistic	2020/2021	2021/2022	2022/2023	Rank
1.	ANOVA	01	02	-	8th
2.	Bar Chart	01	-	-	10th
3.	Chi-Square	-	-	01	10th
4.	Freq. distribution	66	44	47	1st
5.	Fisher Z Correlation	-	01	01	9th
6.	Mean	34	32	30	3rd
7.	Pearson r	09	03	01	6th
8.	Percentage	59	58	49	2nd
9.	Percentile Rank	01	03	01	7th
10.	Pie Chart	01	-	-	10th
11.	Regression	-	-	01	10th
12.	Ratio	01	-	-	10th
13.	Standard Deviation	23	20	20	4th
14.	T-test	08	01	10	5th

Table 1 shows that the statistical tools applied by undergraduate researchers in the three academic sessions are understudied. The most prevailing statistical tools applied by undergraduate researchers are Frequency distribution, which ranked first, percentage ranked second, mean ranked fourth, and Standard deviation ranked fifth. While Pearson r, Percentile Rank, Analysis of variance (ANOVA), Fisher Z Correlation, Bar Chart, Chi-Square, Pie Chart, Regression, Ratio, and T-test ranked sixth, seventh, eighth, ninth and tenth, respectively. Consequently, the table shows that the descriptive statistical techniques are frequently used in undergraduate research projects across the studied academic sessions in the Faculty of Education, University of Benin.

Research Question two: What is the proportion of undergraduate educational research projects with appropriate statistical techniques applied in Undergraduate Educational Research Projects across 2020/2021, 2021/2022 and 2022/2023 academic sessions in Faculty of Education, University of Benin?

Table 2: Proportion of Undergraduate Educational Research Projects that have Appropriate Statistical Techniques by Academic Session

Session	Level	Frequency (F)	Proportion (P)
2020/2021			
	Appropriate	32	0.36
	Inappropriate	58	0.64
	Subtotal	**90**	**1.0**
2021/2022			

	Appropriate	71	0.79	
	Inappropriate	19	0.21	
	Subtotal	**90**	**1.0**	
2022/2023				
	Appropriate	76	0.84	
	Inappropriate	14	0.16	
	Subtotal	**90**		**1.0**

Table 2 shows the proportion of appropriateness of statistical techniques applied by undergraduate researchers in the Faculty of Education in Nigeria sampled for three academic sessions. The table shows the proportion of 0.36 (35.6%) appropriate, 0.64 (64.44%) inappropriate, and .79 (78.89%) appropriate.21 (21.1%) inappropriate; .84 (84.44 %,) appropriate and .16 (15.56%) inappropriate for 2020/2021, 2021/2022 and 2022/2023 academic sessions, respectively. It indicates a progressive improvement by trend for the three academic sessions sampled. There was an improvement in appropriate statistical application from 64.44% in 2020/2021 to 78.89% in 2021/2022 to 84.44% in 2022/2023 academic session.

Hypothesis

The proportion of undergraduate educational research project usage is not significantly different from what is expected by chance, assuming equal proportions of 50% at the 0.05 level of significance across 2020/2021, 2021/2022, and 2022/2023 per academic session in the Faculty of Education, University of Benin.

Table 3: Binomial Test of difference between the Proportions across the Academic Sessions

Usage Level per Session		Category	N	Observed Proportion.	Test Proportion.	Sig
2020/2021	Appropriate	<= .05	32	.36	.50	.008
	Inappropriate	> .05	58			
	Total		90	1.00		
2021/2022	Appropriate	<= .05	71	.21	.50	.000
	Inappropriate	> .05	19	.79		
	Total		90	1.00		
2022/2023	Appropriate	<= .05	76	.16	.50	.000
	Inappropriate	> .05	14	.84		
	Total		90	1.00		

Table 3 shows a binomial test of statistical techniques usage per academic sessions 2020/2021, 2021/2022 and 2022/2023 academic sessions. With a sample size (N) = 90 for each academic session, Testing at an alpha level of 0.05, the p-values is less than the alpha level ($p<0.05$) Therefore, the null hypothesis which states that "the proportion of undergraduate educational research project usage is not significantly different from what is expected by chance assuming

equal proportions of 50% at 0.05 level of significance across 2020/2021, 2021/2022 and 2022/2023 per academic sessions in Faculty of Education, University of Benin" is rejected.

Discussion of Findings

The findings from the study revealed that the statistical tools applied by undergraduate researchers in project writing in the three academic sessions understudied were: analysis of variance (ANOVA), bar chart, chi-square, frequency distribution, Fisher Z correlation mean, Pearson r, percentage, percentile rank, pie chart, regression, ratio, standard deviation and t-test. However, frequency distribution is the most predominant compared to other statistical tools applied in Undergraduate Educational Research Projects across 2020/2021, 2021/2022 and 2022/2023 academic sessions in the Faculty of Education, University of Benin. Also, the findings revealed that the students popularly used descriptive statistics to analyse their research data compared to inferential statistics. This could result from the undergraduate researchers' inability to collect data inconsistent with the study objectives raised from the title of the research embarked on. The finding complements the report of Achimugo and Mohammed (2019), who observed that most undergraduate research projects do not use inferential statistics even when needed. This study did not support the findings of Kanu (2017), who reported that descriptive and inferential statistics were well employed in data analysis by researchers in journal publications. This contradiction might be because of the population used in the studies. The population of this study is undergraduate research projects, while the population used by Kanu was published in journal articles.

The findings from the study also revealed that the proportion of appropriate statistical techniques applied in undergraduate research projects for the 2020/2021, 2021/2022 and 2022/2023 academic sessions were 0.64, 0.79 and 0.84, respectively. The analysis revealed an observed progressive improvement by trend for the three academic sessions studied. In the 2020/2021 academic session, the appropriate usage of statistical techniques was 64.44%; it improved from 64.44% to 78.89% in 2021/2022 and 84.44% in the 2022/2023 academic session. The observed improvement could be in teaching and learning educational research and statistics courses, which the students undertake in the penultimate year before the research project. The findings from the study support the findings of Ali and Bhaskar (2016) and Naskar and Das (2018), who reported that some research studies employ statistical techniques wrongly due to a lack of knowledge of the appropriate application of statistical tools. However, it contradicts Ibe's (2008) findings, who reported that 83.6% of B.Ed projects use inappropriate statistical tools in project writing. 35.6%, 21.1% and 16% inappropriate usage of statistical tools in undergraduate project writing found in this study is small compared to 83.6% of Ibe's (2009) report. Time, location and improved quality assurance may be the reason for this discrepancy. Furthermore, the findings of the study reveal a significant difference in the proportion of undergraduate educational research project usage from what is expected by chance assuming equal proportions of 50% at 0.05 level of significance based on appropriate and inappropriate categories across 2020/2021, 2021/2022 and 2022/2023 per academic sessions in Faculty of Education, University of Benin. This implies that the proportion of undergraduate educational research project statistical tools appropriate usage is significantly different from what is expected by chance across the studied academic sessions.

Conclusion and Recommendations

Based on the findings from the study, it was concluded that descriptive statistics is more frequently used in the undergraduate research projects compared to the inferential statistics with frequency distribution as the most predominant statistical tools applied in the projects across the

studied academic sessions in faculty of Education, University of Benin across the studied academic session. Whereas there is symmetrical improvement by proportion-appropriate usage of statistical tools in research projects across the studied academic session, there is a need for the students to acquire skills to select statistical tools appropriate to the study objectives. Based on the findings of the study, the following recommendations were made:

1. Undergraduate researchers should utilise inferential statistical techniques and descriptive statistics to make inferences about real-world data.
2. Project supervisors should improve on undergraduate research project supervision by being thorough and conversant with the appropriate statistical tool for a particular study.
3. The university should increase efforts to train new researchers on the appropriate application of statistical tools in project writing. This will help them become familiar with the principles, usefulness, and assumptions of statistical tools. The purpose is to ensure continuous quality assurance in project writing and reduce project supervisors' workload.

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