

EXAMINATION OF RESEARCH DESIGNS, STATISTICAL METHODS, AND TYPE OF STATISTICAL SOFTWARE USED IN ARTICLES PUBLISHED BY THE JOURNAL OF ADULT EDUCATION (JAET) IN TANZANIA

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ABSTRACT

This study aimed to identify research designs, statistical methods, and the type of statistical software used in the articles published in the Journal of Adult Education (JAET) in Tanzania. This study analyzed six (6) articles published in the JAET in 2018, 2019, 2021, 2022, 2023 and 2024. The study used documentary analysis as the research method. Frequencies and percentages were calculated according to the type of research design used, the statistical method and the type of statistical software used. A total of 55 articles were evaluated (n=6 in 2018, n=11 in 2019, n=11 in 2021, n=12 in 2022, n=9 in 2023, and n=6 in 2024 in which 16 (34.8%) were descriptive design, 14 (30.4%) were case study designs, 5(10.9%) cross-sectional designs. Others were; 1(2.2%) exploratory design, 1(2.2%) explanatory designs, 2(4.3%) sequential exploratory design, 2(4.3%) multiple case study, 2(4.3%) descriptive case study designs, 1(2.2%) convergent mixed research, 1(2.2%) convergent parallel design and 1(2.2%) a survey design. The three most common statistical methods used were descriptive statistics 17(68%), parametric inferential statistics 3(12%), and predictive statistical correlation 3(12%). Overall, SPSS was the most popular statistical software followed by Excel and other software. Generally, descriptive statistics was the most frequent statistical analysis method in the published articles while descriptive and case study designs were common study designs. This study shows that a diverse variety of statistical methods have been used in JAET and a slight frequency improved from 2018 to 2024. Choosing the appropriate software for any researcher is critical. Software requirements must be assessed based on the nature of applications, objectives of the study statistical, computational, and ease of operation to the common researcher. Knowledge regarding statistical methods related to contingency tables, t-tests- test and ANOVA, and regression needs to be updated for the scholars and researchers at the Institute of Adult Education.

Keywords: Statistical methods, research design, software, JAET, Tanzania.

INTRODUCTION

As a prerequisite for an article to get published in JAET, manuscripts should incorporate appropriate study design and statistical analysis. The article narrates sufficient validity and outcome but utilizing an inappropriate study design and statistics cannot be termed as sound scientifically. A good research design must be comprehensive and should ensure that all the components have been put together with each other in a coherent way. The theoretical and conceptual framework must be in line with the research goals and purposes. In the same way, the data collection method must exclusively be in line with research purposes, conceptual and theoretical framework, and method of data analysis. The research design should be prepared meticulously because any error in it may upset completely the research project. Even then, the necessity for a well-planned design is at times not realized by many researchers. The researchers sometimes do not attach significance which this problem warrants. It is because

of this that many research studies do not fulfill and serve the purpose for which they are undertaken. The fact is they often lead to misleading conclusions. Thoughtlessness in developing the research study is likely to render the research exercise futile. It is, for that reason, crucial that you should prepare an efficient and appropriate design before beginning the research operations. To conduct research, the most important thing is to design its structure. The research design represents the first step in organizing and planning the research process. It refers to the overall strategy that is chosen to integrate the different components of the study in a coherent and logical way. This is not that simple to ascertain the best design available for the research study in question. In establishing a good research design the focus should be on the research objectives and questions as well (Trochim, 2005). Normally, a research design will determine the type of analysis you should carry out to get the desired results. To what extent your design is good or bad will depend on whether you can get the answers to your research questions. If your design is poor, the results of the research also will not be promising (Mitchell & Jolley, 1988). Every researcher has a list of research questions that need to be assessed; this can be done with research design. The sketch of how research should be conducted can be prepared using research design (Blaise, 2000). Research without a pre-drawn plan is like an ocean voyage without a Mariner's compass. The proposition of a research plan for a study aids in establishing the direction of the study and in knowing exactly what has to be done and how and when it has to be done at every stage. It enables the researcher to consider beforehand the various decisions to be made. What are the objectives of the study? What are the investigative questions? What are the sources of data? What is the universe of the study? What sampling method is appropriate? And so on. Without a plan, research work becomes unfocussed and aimless empirical wandering the researcher would find it difficult. The use of a research design prevents such a blind search and indiscriminate gathering of data and guides him to proceed in the right direction. A research plan prescribes the boundaries of research activities and enables the researcher to channel his energies into the right work with clear research objectives in view, the researcher can proceed systematically focus the achievement of the design also enables the researcher to anticipate potential problems of data gathering operationalization of concepts, measurement, etc (Trochim, 2007). According to Akpala et al. (1994), an inappropriate research design may lead to the wrong conclusions or the collection of data that are irrelevant to the objectives of the study.

Statistical methods also play a critical role in the design of scientific studies, analysis of scientific data, interpretation of results, and drawing of conclusive statements. There is consensus that inappropriate study designs and statistical methodology lead to incorrect results, poor interpretation of study findings, and wrong conclusions. Many journals provide authors with statistical guidelines and have a dedicated statistical committee, which analyses the methods used. Therefore, appropriate statistical reasoning is gaining increasing importance in the field of scientific research. Scientific journals need a general self-assessment in the field of published articles to improve the quality level receive valid scientific indexes and increase citations and impact factor. In this way, they can identify strengths and weaknesses, as well as necessary policies for accepting various future articles, and determine the journal policy. As misused statistics and inadequate interpretation may lead to an erroneous conclusion in a scientific study, many previous studies have investigated the occurrence of statistical errors in various fields of scientific health research (Kim et al., 2011). Studies exploring the reporting of research design and statistical methods in articles published in various Western journals have already been done. This study aimed to identify research designs, statistical methods, and the type of statistical software used in the articles published in the Journal of Adult Education (JAET) in Tanzania. Research findings could

assist researchers, educators, and practitioners in the education field in understanding how statistical methods are used and to which research areas statistical methods are applied, understanding the patterns in the implementation of statistical methods, choosing a suitable research methodology, and making an appropriate decision on statistical method selection for their research problems. Similarly, this study will help the readers and researchers to understand the level of statistics that have been published in JAET. Similarly, describing statistical methods with enough details could enable a knowledgeable reader with access to the original data to verify the reported results. Again, the results of the investigation should be of concern not just to the publishers of educational research journals and the practitioners of educational research, but also to the instructors of research methodology as well. More specifically, this study was designed to address the following questions:

- a) What are the frequently used research designs in JAET?
- b) What are the frequently used statistical techniques and analyses used in JAET?
- c) What is the frequently software used in JAET?

Material and Methods

This study was content analysis with a document scanning method used as the research method. In this study, the articles analyzed were downloaded from the websites of JAET in Tanzania. Content analysis stems from quantitative methods, and it is mainly focused on gaining frequency and counting patterns (Hancock et al., 2007). To perform the analysis, a total of 55 articles were downloaded from the JAET website in the year 2018, 2019, 2021, 2022, 2023, and 2024 (manuscript published from January to September for the year 2024). For each selected article, the study design, statistical methods, and the statistical software employed were identified by reading the title and abstract of each article. If none of the statistical software was found, then the article's full text was examined. Similarly, the study design was checked in the title and the abstract, and if not evident, the full text was reviewed if available. If two or more study designs were reported in the article, then the main study design was considered. An Excel spreadsheet was used to record the required information from the articles.

Findings

Research design used in the JAET in 2018, 2019, 2021, 2022, 2023 and 2024

A total of 55 articles were evaluated (n=6 in 2018, n=11 in 2019, n=11 in 2021, n=12 in 2022, n=9 in 2023, and n=6 in September 2024 in which 16 (34.8%) were descriptive design, 14 (30.4%) were case study designs, 5(10.9%) cross-sectional designs. Others were; 1(2.2%) exploratory design, 1(2.2%) explanatory designs, 2(4.3%) sequential exploratory design, 2(4.3%) multiple case study, 2(4.3%) descriptive case study designs, 1(2.2%) convergent mixed research, 1(2.2%) convergent parallel design and 1(2.2%) a survey design. This study also noted that (n=9, 16.4%) manuscripts did not mention a very clear research design. A summary of the research design used in the JAET in 2018, 2019, 2021, 2022, 2023, and 2024 is presented in Table 1.

Table 1: Descriptive statistics summary of research design used in the JAET in 2018, 2019, 2021, 2022, 2023 and 2024

| Type of Research designs | 2018 (n=6) | | 2019 (n=11) | | 2021 (n=11) | | 2022 (n=12) | | 2023 (n=9) | | 2024(Jan-Sept (n=6) | | Total |
|---|------------|-----|-------------|-----|-------------|------|-------------|----|------------|------|---------------------|------|----------|
| | Articles | % | Articles | % | Articles | % | Articles | % | Articles | % | Articles | % | |
| 1.Case study design | 3 | 60 | 2 | 20 | 1 | 11.1 | 5 | 50 | 1 | 16.7 | 2 | 33.3 | 14(30.4) |
| 2.Descriptive design | 2 | 40 | 3 | 30 | 5 | 55.6 | 5 | 50 | 1 | 16.7 | 0 | 0 | 16(34.8) |
| 3.Exploratory design | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 16.7 | 1(2.2) |
| 4.Explanatory/Analytical design | 0 | 0 | 1 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1(2.2) |
| 5.Sequential exploratory design | 0 | 0 | 1 | 10 | 1 | 11.1 | 0 | 0 | 0 | 0 | 0 | 0 | 2(4.3) |
| 6.Cross-sectional design | 0 | 0 | 2 | 20 | 1 | 11.1 | 0 | 0 | 1 | 16.7 | 1 | 16.7 | 5(10.9) |
| 7.Multiple case study | 0 | 0 | 0 | 0 | 1 | 11.1 | 0 | 0 | 0 | 0 | 1 | 16.7 | 2(4.3) |
| 8.Descriptive case study design | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 16.7 | 1 | 16.7 | 2(4.3) |
| 9.Convergent mixed method research design | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 16.7 | 0 | 0 | 1(2.2) |
| 10.Convergent parallel design | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 16.7 | 0 | 0 | 1(2.2) |
| Survey design | 0 | 0 | 1 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1(2.2%) |
| Total | 5 | 100 | 10 | 100 | 9 | 100 | 10 | 0 | 6 | 100 | 6 | 100 | 46(100) |

As shown in Table 1, descriptive design was the most common research design, accounting for 34.8% of all articles. The case study design is the second most popular, accounting for 30.4% of the total.

Statistical methods used in articles published in the Journal of Adult Education

Twenty-five (25) different types of statistical methods were used in 55 articles (0.46 per article). Out of these the most common methods were descriptive statistics 17 (68%) followed by parametric inferential statistics 3(12%) and non-parametric inferential statistics 3(12%). Other statistical methods were predictive statistical regression 1(4%) and other statistical methods accounted for 1(4%) (Table 2).

Table 2: Frequency of articles reporting use of Statistical methods used in articles published in the Journal of Adult Education

| Statistical methods | Frequency | Percentage (%) | Examples of common terms in each statistical method group |
|---------------------------------------|-----------|----------------|---|
| Descriptive statistics | 7 | 68 | Frequency and percentage, Mean, Median, Mode, Standard Deviation, Quartile deviation, Coefficient of Variation, Variance etc. |
| Parametric Inferential Statistics | 3 | 12 | Independent/paired t-test, Pearson correlation, ANOVA |
| Non-parametric Inferential statistics | 3 | 12 | Chi-square tests, Wilcoxon, Mann-Whitney test, Kruskal-Wallis tests |
| Predictive Statistical regression | 1 | 4 | Multiple regression |
| Other* | 1 | 4 | NViVO |
| Total | 25 | 100 | |

Values are presented as numbers (%).

* Other: AMOS

As illustrated in Table 2, in 17(68%) of 25 articles, descriptive statistics was the most commonly used method (68%), indicating that most research focused on summarizing and presenting basic data trends. The purpose of descriptive design is to describe and document aspects of a situation as it naturally occurs and sometimes to serve as a starting point for hypotheses generation or starting point for hypotheses generation or theory development.

Inferential statistics (parametric and non-parametric combined) are used in only 24% of articles, reflecting the journal's engagement with hypothesis testing and exploring relationships between variables, though not as frequently as descriptive approaches. Predictive and other methods are rare; each appearing in only 4% of the articles, suggesting that advanced predictive analytics and qualitative research play a smaller role in the journal's publications. This pattern suggests a focus on descriptive analysis with occasional use of inferential techniques, while predictive modeling and qualitative approaches are less emphasized. Frequencies and percentages regarding parametric and non-parametric techniques used in 25 articles are presented in Table 3.

Table 3: Distribution by parametric and non-parametric statistical techniques in data analysis

| Parametric statistical Techniques | Frequency | Percentage | Non-parametric statistical Techniques | Frequency | Percentage |
|-----------------------------------|-----------|------------|---------------------------------------|-----------|------------|
| t-test | 2 | 50 | Chi-square | 1 | 33.3 |
| Pearson correlation | 1 | 25 | Kendall's Tau | 1 | 33.3 |
| Regression | 1 | 25 | Friedman | 1 | 33.3 |
| Total | 4 | 100 | Total | 3 | 100 |

As shown in Table 3, 2 (50%) of these parametric statistical techniques were t-tests, 1(25%) was Pearson correlation, and 1(25%) was regression analysis. Likewise, for non-parametric statistical techniques, 33.3% was chi-square, 33.3% Kendall's Tau, and 33.3% was the Friedman test. The t-test is the most commonly used method to evaluate the differences in means between two groups. For example, the t-test can be used to test for a difference in test scores between a group of patients who were given a drug and a control group who received an injection. Theoretically, the t-test can be used even if the sample sizes are very small (e.g.,

as small as 10) as long as the variables are normally distributed within each group and the variation of scores in the two groups is not reliably different.

Appropriateness of interpretations of statistical Techniques

In 25 articles, in 19(76%) of the 25 articles, interpretations of statistical analysis were found appropriate, while in 6 articles (24%) , there was a mismatch between statistical techniques and interpretations. A few such interpretations are as follows: a no-significant p-value ($p=0.50$) was interpreted as significant.

Statistical Software Packages Used for Data Analysis in Journal of Adult Education

SPSS was found to be the most commonly used statistical software in the JAET articles (Figure 1). SPSS was the most commonly used statistical software for data analysis with 17 (85%) articles, followed by Microsoft Excel 1 (5%), Amos 1(5%), and NViVO (5%). Other software packages like Excel, AMOS, NVivo, and others each represent only 5% of the articles, suggesting that they are used for more specialized purposes or in fewer studies. This distribution indicates that the majority of researchers in the journal focus on quantitative analyses, where SPSS offers the necessary tools, while more specialized software is used only when the research design requires it.

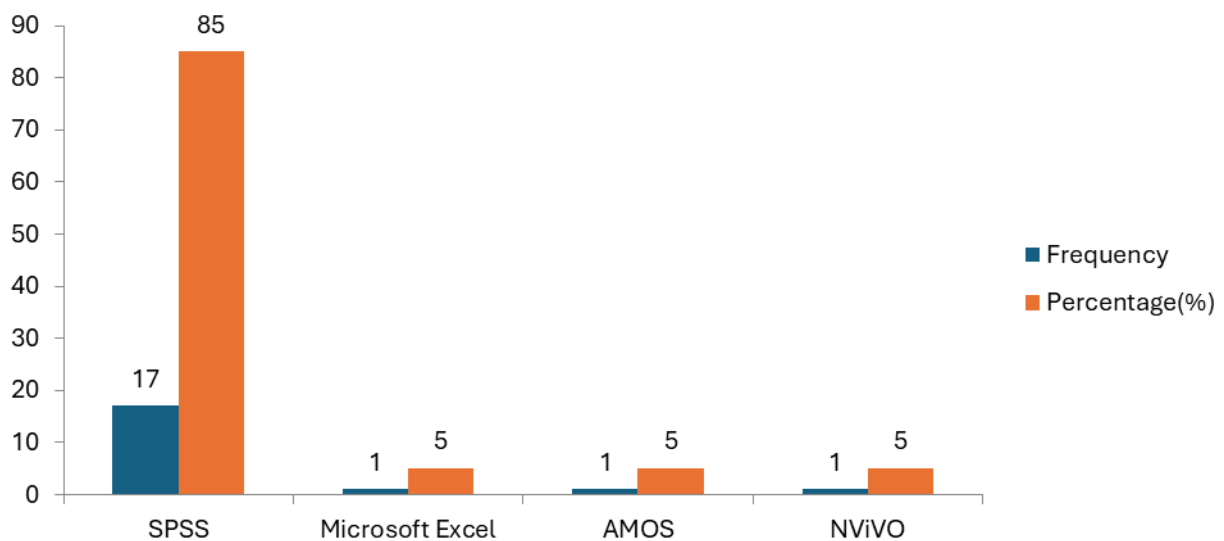


Figure 1: Percentages of the statistical software used in the reviewed JAET articles

Note: AMOS is a program that allows you to specify and estimate structural equation models. Structural equation models are published widely, especially in the social sciences. In basic terms, structural equation models are a fancy way of combining multiple regression analyses and interaction effects.

Discussions

Based on the research design, descriptive research design and case study designs were the most common designs found in articles published in JAET. Similar findings that descriptive research designs used commonly in various educational research reports are supported by Karadag (2010). The present study indicated that a descriptive statistics technique was mostly used by authors (68%) in the articles published by JAET. Similar results were reported by Goktas et al. (2012) and Uzunboylu and Asiksoy (2014) who stated that descriptive analysis methods are the most commonly used data analysis. Elmore & Woehlke (1988) reported that descriptive statistics is frequently used in journal articles in education in the United States. Furthermore, Magembe et al. (2021) indicated that a descriptive statistics technique was

mostly used by students (89.6%) in their research-based project at the Institute of Adult Education in Tanzania. This finding is also consistent with other studies globally, for example in Indonesia, Hassal (2003) found that, from the study of 30 articles published in various journals in language teaching, the writer found a number of titles developed from descriptive research. Banger and Bamberger (2005) stated that descriptive statistics and Pearson product-moment correlation coefficient were frequently used in the articles published in the *Journal of Cancelling and Development* over 11 years. Descriptive statistics are used to describe the basic features of the data in a study. They provide simple summaries of the sample and the measures. Together with simple graphics analysis, they form the basis of virtually every quantitative analysis of data. Descriptive statistics is the most fundamental way to summarize data and it is a prerequisite for interpreting the results of quantitative research, while inferential statistics are commonly used in reporting results (McMillan, & Schumacher, 2001). Similarly, in the context of analyzing quantitative data using statistical techniques, Creswell (2005) explains that descriptive statistics summarize a single variable in a data set or compare how one score relates to all others, while inferential statistical tests are used to assess the differences, relationships, and correlations among variables in the data set. Of parametric techniques, t-test, correlation, and regression analysis were most frequently used.

Also, a case study was found to be mostly used in the JAET articles. With the evolution of the scientific circle and the use of the case study method growing intensively, many scientific papers are written and published on a case study or using a case study design. A case study is a specific research method that is frequently designed to illustrate a more general principle. It is 'the study of an instance in action' (Adelman et al., 1980). Case studies are significantly important when the researcher has very little or no control over events. The objective of the case study method is to examine the factors that cause the behavioral patterns of a given unit and its relationship with the environment. The data for a study are always gathered with the purpose of tracing the natural history of a social or economic unit, and its relationship with the social or economic factors, besides the forces involved in its environment. Thus, a researcher conducting a study using the case study method attempts to understand the complexity of factors that are operative within a social or economic unit as an integrated totality.

Additionally, the qualitative case study research method is viewed as adaptable, making the method flexible (Merriam, 2009; Meyer, 2001; Stake, 1995). Thus, case studies from the published literature are multiform (Hyett et al., 2014). The choice of the appropriate study design depends upon the way the research question is stated Checkoway et al.(2007). It is important to note here that different study designs may be applicable to the same research problem, but it is the way that the research question is framed that determines which study design is most appropriate. It should also be added that there are many grey areas in which researchers may differ in opinion about the type of study design, but the important factors to consider include the research question as well as the way the subjects were selected for the study (Williams & Nelson, 2007; Bickman & Rog, 2009). Case study data are collected by observation or by the personal interview method. Generally, analysis in case study design does not involve sophisticated quantitative and statistical techniques.

Overall, Statistical Package for the Social Sciences (SPSS) was found to be the most popular statistical software followed by Excel and other software. These research findings are similar to other studies conducted in Pakistan which included articles published in two local journals that found that SPSS was the most commonly used statistical software (Shaikh, 2015).

Similarly, Dembe et al. (2011) and Shaikh (2015) found that SPSS was the most used software worldwide. SPSS, originally termed Statistical Package for the Social Sciences, was released in 1968 as software designed for the social sciences. Since then, IBM has replaced SPSS Inc. as the owner, and the software has expanded its user base past this one area. The software's former acronym has been replaced with Statistical Product and Service Solutions to reflect the greater diversity of its clients. Arguably, it remains the leading statistical analysis software package for the social sciences. An advantage of this specialized design is that SPSS "keeps calculated statistics and graphs separate from the raw data but still easily accessible" (Robbins, 2012). SPSS software furthermore has a much more convenient platform for performing statistical tests. For instance, performing a one-sample *t-test* in Excel requires some independent calculations by the user, whereas, with SPSS, the user only needs to "select a variable and supply the value to compare with [the] sample" and click "Ok" (Robbins, 2012). Another advantage of SPSS is that it links numerically coded data to its original meaning (Robbins, 2012). With most data being electronically stored in a numerical fashion, this feature of SPSS is highly valuable. Norusis (2009) described SPSS Statistics as a comprehensive system for analyzing data. SPSS can provide data from almost any type of file and use them to generate tabulated reports, charts, and plots of distributions and trends, descriptive statistics, and complex statistical analyses. SPSS makes statistical analysis more accessible for the beginner and more convenient for the experienced user. Simple menus and dialog box selections make it possible to perform complex analyses without typing a single line of command syntax. The data editor offers a simple and efficient spreadsheet-like facility for entering data and browsing the working data file.

Conclusion

The purpose of this study was to assess the trend in the use of research designs, statistical methods, and statistical software in the published articles by the Journal of Adult Education (JAET) in Tanzania. Most of the published articles continue to use descriptive design and a case design while other research designs still require more attention as compared to journals of advanced countries. It is also noted that a variety of statistical methods were found in the published articles but the frequency of advanced statistical methods was quite low as compared to advanced countries journals. To accomplish these goals, sound training for academicians in statistical concepts and methods of analysis is crucial to overcome the documented inadequacies in reporting important aspects of research design and statistical analyses. The need for a research design arises out of the fact that it facilitates the smooth conduct of the various stages of research. It contributes to making research as efficient as possible, thus yielding the maximum information with minimum effort, time, and expenditure. A research design helps to plan in advance, the methods to be employed for collecting the relevant data and the techniques to be adopted for their analysis. This would help in pursuing the objectives of the research in the best possible manner, provided the available staff, time, and money are given. Hence, the research design should be prepared with utmost care, so as to avoid any error that may disturb the entire project. Thus, research design plays a crucial role in attaining the reliability of the results obtained, which forms the strong foundation of the entire process of the research work.

In fact, action research, ethnographic studies, historical studies, grounded theory, and phenomenological studies were not found in the articles analyzed in this study. This condition actually can be an opportunity for other prospective researchers to explore the realm of qualitative research in Tanzania. Qualitative research designs were still rarely found in published articles in JAET. Qualitative research designs are by definition exploratory. Often, they are used when the researchers are not able to ascertain their expectations, define the

research problem, or develop an approach to the problem. These research designs are also used to analyze in-depth the issues of interest and explore differences related to the problem at hand. In addition, none of the research published from 2018 to 2024 used multivariate analysis as a technique of data analysis.

The descriptive statistical method was most employed, followed by the inferential statistical methods and other statistical methods. It is important that a researcher knows the concepts of the basic statistical methods used for conducting a research study.

SPSS (IBM SPSS Statistics, IBM Corp., Armonk, NY) was found to be the most widely used statistical software throughout the whole study period in 2018, 2019, 2021, 2022, 2023, and 2024. The data shows a clear preference for SPSS, with occasional use of other tools when specific statistical or qualitative methods are required. Statistical software makes data analysis much more efficient and less prone to errors in calculation. However, it is the responsibility of the researcher to understand what the software is doing to the data and not blindly click the mouse on a series of buttons.

Based on these findings, the following recommendations could be made: authors in JAET should have sufficient knowledge of statistical techniques. Secondly, authors are encouraged to use multivariate analyses in order to attain more comprehensive findings. Thirdly, while selecting appropriate statistical techniques, research designs, types and levels of variables need to be determined correctly.

An essential component of ensuring data integrity is the accurate and appropriate analysis of research findings. Improper statistical analyses distort scientific findings, mislead casual readers and may negatively influence the public perception of research. Integrity issues are just as relevant to the analysis of non-statistical data as well. In deciding which test is appropriate to use, it is important to consider the type of variables that you have (i.e., whether your variables are categorical, ordinal, or interval and whether they are normally distributed).

Future Research

The relationship between the use of statistical software and the type of research designs in JAET articles is not well understood. A further study must be carried out on the association between the statistical software used and the study design employed in the JAET articles.

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Kija S. Magembe, has contributed to the design of the study, interpretation of the data, formatting, and editing of the manuscript and approval for publication after reviewing it for significant intellectual content, and nobody else has any role in article preparation.

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