CHALLENGES IN BASIC STATISTICS: IMPLICATIONS FOR RESEARCH ACCURACY AND RELIABILITY

1 ENGR. CRISELDA S. FELIX, PhD
2 JOANA T. MOCNANGAN
2 CEASARIA L. LARTEC
2 ISRAELIZA G. HUGO
2 ADAMSON C. PINAS

1 Faculty, Graduate School, Baguio Central University
2 Graduate School Students, Baguio Central University
Baguio City, Philippines 2600

DOI: 10.47760/cognizance.2024.v04i05.001

ABSTRACT:
The study explores the degree of seriousness of problems encountered in utilizing basic statistics in educational research. Data from 86 respondents at Baguio Central University revealed that these problems were moderately serious, with an average weighted mean of 2.76. The primary issues included poor mathematical skills, inadequate application of statistical knowledge in research, lack of content knowledge in statistics and research, and insufficient textbooks on statistics. These findings suggest that graduate and postgraduate students lack sufficient knowledge and skills in basic statistics necessary for their research endeavors. While the identified problems are moderately serious, addressing them is crucial for successful research outcomes. To mitigate these issues, various resources and strategies can be employed. Online platforms offer opportunities for students to enhance their mathematical and statistical proficiency. Additionally, statistical software such as SPSS, R, MATLAB, Excel, SAS, GraphPad Prism, and Minitab provide tools for data analysis and interpretation, catering to diverse research needs. The study confirms the moderately serious nature of problems encountered in using basic statistics in educational research. Addressing these challenges is imperative to equip students with the necessary skills for successful research endeavors.

Keywords: Statistics, Educational research, perceptions, Statistical difficulties
INTRODUCTION

Understanding the application of statistics in educational research presents several challenges. Statistics, as a fundamental tool for researchers, enables the collection, analysis, and interpretation of data, aiding in making informed decisions and drawing valid inferences from research findings (Pal, 2023). However, integrating statistical methods into research practices poses difficulties. Researchers must navigate the systematic collection, description, and analysis of data from diverse sources, including surveys, experiments, and observational studies, ensuring consistency and accuracy throughout the process. Moreover, while statistics serve as the analytical backbone of science, complexities arise in employing appropriate statistical techniques, interpreting results effectively, and presenting findings coherently (Snedecor and Cochran, 1980 as cited by Isotalo, 2006).

Additionally, the inherent variability and uncertainty in data necessitate a rigorous approach to statistical analysis to ensure reliability and validity. Overcoming these challenges requires institutions to prioritize enhancing statistical education, providing adequate learning resources, and offering training programs to improve students’ mathematical and statistical skills (Obiaraije, 2021). Moreover, fostering interdisciplinary collaboration and addressing statistics anxiety among students are essential steps in promoting proficiency in statistical analysis and research methodology (Agarwal, 2021). Ultimately, the effective integration of statistics into educational research practices hinges on overcoming these challenges and equipping researchers with the knowledge and skills needed to navigate the complexities of statistical analysis and interpretation.

In the realm of basic statistics, researchers encounter a myriad of challenges that can impact the accuracy and reliability of their analyses. Foremost among these challenges is the necessity for comprehensive understanding and training in statistical concepts and methodologies, a deficiency which can lead to misapplication or misinterpretation of statistical techniques (Jerjawi, 2012). Moreover, researchers grapple with issues pertaining to bias in data collection and analysis, where selective data gathering or manipulation may distort results to fit desired outcomes. Ensuring the adequacy of sample size and representativeness poses another significant hurdle, as small or non-representative samples may limit the generalizability of findings to larger populations. Furthermore, researchers must navigate complexities related to the interpretation of statistical results, often involving complex mathematical concepts and formulae, as well as data quality issues.
such as missing data, outliers, or errors in data collection (Jerjawi, 2012). Ethical considerations surrounding data collection and analysis, as well as resource constraints including limited access to funding, time, and expertise, further compound the challenges faced by researchers in the field of basic statistics. Addressing these multifaceted challenges requires a concerted effort to enhance training, expertise, and methodological rigor, thereby ensuring the accuracy and validity of statistical analyses in research endeavors.

The use of basic statistics in educational research is crucial for obtaining accurate and reliable results. However, there are several problems that researchers may encounter while using basic statistics in educational research. One of the main problems is the lack of proper training and understanding of statistical concepts among educators. This can lead to the misuse or misinterpretation of statistical techniques, which can result in faulty conclusions and undermine the validity of the research study (Jerjawi, 2012). Another problem is the potential for bias in data collection and analysis. This can occur if researchers selectively choose certain data or manipulate the data to fit their desired outcomes.

Additionally, there is the issue of sample size and representativeness. If the sample size is too small or not representative of the population being studied, the results may not be generalizable or applicable to a larger context. Lastly, there is the challenge of ensuring statistical significance and avoiding Type I or Type II errors. These errors can occur if the researcher incorrectly rejects or fails to reject the null hypothesis, leading to inaccurate or misleading results. In conclusion, the problems encountered in using basic statistics in educational research range from a lack of proper training and understanding to issues of bias, sample size representativeness, and ensuring statistical significance. The seriousness of these problems cannot be overstated, as they directly impact the validity and reliability of research findings.

**REVIEW OF RELATED LITERATURES**

Statistics and research are intrinsically linked in scientific inquiry (Sahai & Lovrić, 2011). Statistics provide the necessary tools and techniques for planning, designing, collecting data, analyzing, interpreting, and reporting research findings (Sahai & Lovrić, 2011). Both statistics and research are supported by underlying philosophies and theories that shape their practices (Jerjawi, 2012). For instance, the philosophy of statistics plays a crucial role in drawing appropriate inferences from data and understanding issues of
causality and correlation (Jerjawi, 2012). It is important to note that correlation does not imply causation, and researchers must exercise caution when drawing conclusions from their experiments or studies (Snedecor and Cochran, 1980; Isotalo, 2006; Obiaraije, 2021). The philosophy of statistics influences inferential statistics, which involves making inferences about populations based on sample data (Jerjawi, 2012). Furthermore, philosophy also plays a significant role in guiding research methodology (Jerjawi, 2012). The philosophy of statistics helps researchers determine the appropriate methods and approaches to employ in their studies (Jerjawi, 2012). Understanding the philosophy of statistics allows researchers to make informed decisions about which statistical techniques to use and how to interpret their results (Pal, 2023). Additionally, the philosophy of research underpins the entire process of inquiry (Jerjawi, 2012). It guides researchers in the formulation of research questions, the selection of appropriate study designs, and the interpretation of findings (Jerjawi, 2012). This article delves into the important role that philosophy plays in statistics and research (Jerjawi, 2012).

Statistics is a fundamental component of scientific research, as it encompasses various stages such as planning, designing, data collection, analysis, interpretation, and reporting of research findings (Sahai & Lovrić, 2011). This reliance on statistics underscores its importance in scientific research (Sahai & Lovrić, 2011). Philosophy has a significant impact on the field of statistics, particularly in drawing correct inferences from data and understanding the relationship between correlation and causation (Jerjawi, 2012). Furthermore, the philosophy of statistics influences inferential statistics, which involves making inferences about populations based on sample data (Jerjawi, 2012). In addition, philosophy also guides research methodology by helping researchers determine the appropriate methods to employ in their studies (Jerjawi, 2012). Statistics is an essential aspect of scientific research, playing a vital role in various stages such as planning, design, data collection, analysis, interpretation, and reporting of research findings (Sahai & Lovrić, 2011).

Statistics and research go hand in hand, with both being supported by underlying philosophies and theories (Jerjawi, 2012). Statistics and research are essential components of scientific inquiry, with statistics playing a crucial role in various aspects of the research process (Sahai & Lovrić, 2011). Statistics is a crucial aspect of scientific research as it encompasses important stages such as planning, designing, data collection, analysis, interpretation, and reporting of findings (Sahai & Lovrić, 2011). The philosophy of statistics is significant in scientific research as it allows researchers to draw accurate
inferences from data and consider the complexities of causality and correlation (Jerjawi, 2012). The philosophy of statistics is involved in determining the appropriate inferences to draw from data and understanding the nuances of causality and correlation (Jerjawi, 2012). Additionally, the philosophy of statistics guides researchers in making informed decisions and drawing meaningful conclusions from their experiments or studies (Jerjawi, 2012). Furthermore, the philosophy of statistics emphasizes the importance of using multiple research approaches and theoretical constructs in order to ensure comprehensive and valid research (Jerjawi, 2012). This study is anchored on the philosophy of statistics, which plays a crucial role in drawing accurate inferences and understanding the relationship between correlation and causation (Jerjawi, 2012).

Statistics is vital for scientific research, as it permeates every stage of the research process (Sahai & Lovrić, 2011). It is essential for researchers to have a good understanding of statistical concepts in order to conduct a well-designed study and obtain valid and reliable results (Sahai & Lovrić, 2011). Statistics is a fundamental tool in scientific research, with its influence extending to the planning, design, data collection, analysis, interpretation, and reporting stages (Sahai & Lovrić, 2011). The appropriate use of statistical techniques is crucial in scientific research, as improper application can lead to faulty conclusions, errors, and undermine the significance of the research article (Sahai & Lovrić, 2011). Statistics is an indispensable component of scientific research, playing a pivotal role in various stages of the research process (Sahai & Lovrić, 2011).

Data analysis is a critical aspect of scientific research, as it transforms raw data into meaningful information and knowledge (Jerjawi, 2012). Proper statistical analysis allows researchers to draw accurate conclusions and make informed decisions based on the data collected (Jerjawi, 2012). Data analysis is a crucial step in scientific research, as it involves the systematic application of statistical and logical techniques to describe, summarize, condense, and evaluate data (Jerjawi, 2012). Understanding data analysis procedures is essential for researchers to appreciate the scientific method, which includes hypothesis testing and assessing statistical significance in relation to research questions (Jerjawi, 2012). Researchers must be aware of several key considerations when it comes to data analysis, including selecting the appropriate statistical test for significance (Jerjawi, 2012).

It is important for researchers to consider factors such as the type of data being analyzed, the research question at hand, and the specific objectives of
the study in order to choose the most suitable statistical analysis method (Jerjawi, 2012). The philosophy of statistics guides researchers in making correct inferences from data and understanding the complexities of causality and correlation (Jerjawi, 2012). Statistics serves as a powerful tool in scientific research. It helps researchers draw meaningful conclusions, avoid false assumptions based on correlation, and make informed decisions (Jerjawi, 2012). Statistics plays a vital role in scientific research, influencing every stage of the research process from planning to reporting (Jerjawi, 2012).

Hence, incorporating statistical analysis into fencing research and practice goes beyond mere numerical data; it fosters a profound impact through knowledge empowerment. By advocating for evidence-based decision-making, refining performance, nurturing athlete well-being, and advancing the scientific comprehension of fencing, statistical analysis becomes a catalyst for ongoing improvement and innovation, enhancing the sport and benefiting all involved.

Furthermore, integrating pertinent philosophical viewpoints enriches our comprehension of statistics and amplifies its utility in research. By addressing philosophical considerations concerning knowledge, causality, and inference, researchers can utilize statistical methodologies more efficiently, ensuring the credibility and dependability of their conclusions. Philosophical engagement with statistics not only enhances our grasp of the field but also cultivates critical thinking and introspective examination in statistical research.

**METHODOLOGY**

The research design and methodology of the study are centered on employing a descriptive research approach, utilizing a questionnaire for data collection. The main aim is to uncover the characteristics and trends within Baguio Central University's graduate and post-graduate student community, with a particular emphasis on their perceptions and grasp of basic statistics in educational research. To ensure the questionnaire's reliability and validity, insights from primary sources were integrated, and the final version was endorsed by the Research Committee. Subsequently, the questionnaire was administered to 86 students enrolled in statistics and research courses during the first semester of the 2023-2024 academic year.

Rigorous steps were taken throughout the data collection process. This included obtaining necessary permissions, adequately briefing respondents, administering the questionnaires during Saturday classes, and collecting them
a week later for subsequent analysis. To facilitate analysis, interpretation, and discussion, a four-point arbitrary scale was employed for each question during data processing. This systematic approach aimed to ensure that the collected data could be analyzed effectively, providing comprehensive insights into the student population’s perceptions and comprehension of basic statistics.

**DISCUSSIONS**

**Degree of Seriousness of the Problems Encountered in Using Basic Statistics in Educational Research**

Table 1 presents the data gathered on the degree of seriousness of the problems encountered in using basic statistics in educational research as observed by the respondents. The results indicated that the problems encountered in using basic statistics in educational research were found moderately serious as evidenced by the obtained average weighted mean of 2.76. This means that the problems were not extremely or completely serious, but within reasonable degree or extent of severity.

The first and foremost problem encountered in dealing with basic statistics is poor mathematical skills which got the highest weighted mean of 3.00, followed by inadequate actual application of statistical knowledge in research, 2.72; Lack content knowledge in statistics & research, 2.71; and Inadequate textbooks in statistics, 2.63.

The implication of these findings is that the graduate and postgraduate students have no sufficient knowledge and skills in basic statistics which they can use in the conduct of their research studies. Though, the problems were assessed as moderately serious, the students and the concerned professors of the graduate and postgraduate who teach research statistics are encouraged to find ways and means to address them in order that the students can successfully apply them in their research studies.
Table 5
Degree of Seriousness of the Problems Met in Basic Statistics in Educational Research

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Degree of Seriousness</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>VMS</td>
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<tr>
<td>. Lack content knowledge in statistics &amp; research</td>
<td>22</td>
</tr>
<tr>
<td>. Inadequate actual application of statistical knowledge in research</td>
<td>20</td>
</tr>
<tr>
<td>. Poor in mathematical skills</td>
<td>32</td>
</tr>
<tr>
<td>. Inadequate textbooks in statistics</td>
<td>18</td>
</tr>
<tr>
<td><strong>Average Weighted Mean</strong></td>
<td><strong>2.76</strong></td>
</tr>
</tbody>
</table>

Legend:

<table>
<thead>
<tr>
<th>Arbitrary Scale</th>
<th>Numerical Limits</th>
<th>Descriptive Interpretation</th>
<th>Symbols</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3.51 – 4.00</td>
<td>Very Serious</td>
<td>VS</td>
</tr>
<tr>
<td>3</td>
<td>2.51 – 3.50</td>
<td>Moderately Serious</td>
<td>MS</td>
</tr>
<tr>
<td>2</td>
<td>1.51 – 2.50</td>
<td>Slightly Serious</td>
<td>SS</td>
</tr>
<tr>
<td>1</td>
<td>1.00 – 1.50</td>
<td>Not Serious</td>
<td>NS</td>
</tr>
</tbody>
</table>

Relatively, the study of Perez Lopez et al (2006) of the graduate students and their use of statistical knowledge in educational psychology at the University of Pedagogical University in Mexico, has found that the graduate students had problems in using statistical tools, erroneous data interpretation, confusion about statistical concepts, use of non-valid instruments, and inadequate design. The use of statistics in a practical, professional situation (writing a thesis) turns out to be complicated for graduate students in the field of educational psychology at the National Pedagogical University, Ajusco Campus. It was found that, in a number of the theses, the use of statistics was
itself a problem that prevented the thesis writer from reasoning according to statistical standards. Although the analysis of the internal coherence of the tasks (consistency with objective, methodology, results and conclusions) does not allow us to know accurately the type of statistical reasoning that graduate students use when they made their theses, it is possible to deduce that, in some cases, their reasoning was elementary or almost nonexistent. Likewise, the research of Perepiczka et al (2011) indicated that graduate students experienced problems on statistics efficacy, statistics anxiety, attitude towards statistics and social support. The graduate students who believed they were incapable of achieving success in a statistics course demonstrated higher levels of anxiety.

This anxiety was pervasive among the 75% to 80% of graduate students in the social sciences profession in previous research studies, as well as to the 53% of the graduate students in this study. Additionally, the graduate students hold off from taking a statistics course due to their negative attitudes towards the subject matter. Teaching graduate students how to reduce their anxiety and improve their attitude will likely enhance their value of statistics and further encourage their professional development in their knowledge and skills. Makwakwa (2012) also explored the problems encountered in the teaching and learning of statistics among grade 11 students in the University of South Africa and found that the following: 1) the students’ lack of statistics content knowledge; 2) inadequate textbooks; 3) in-service programs which did not cover statistical topics, or which did not pay adequate attention to probability.

The findings of the study were that the probable causes of learners’ difficulties were inadequate teaching of statistics topics in previous grades; teachers’ lack of content knowledge in statistics meant they had difficulty explaining concepts to learners; inadequate learning material and learners’ inability to use the statistics function mode on their calculators; and learners’ lack of conceptual knowledge of certain aspects of statistics. The study suggested that the possible ways to address the problems in the teaching and learning of statistics in grade 11 were: the teachers should receive financial support from their schools/districts to attend in-service education and training programs; textbooks should be well written (provide thorough explanations) and contain all the information necessary to teach data handling and probability.

These problems encountered by students on statistics, they are encouraged to explore in the internet many ways to sharpen his/her
mathematical skills and statistical knowledge. Sirisilla (2023) suggests that researchers in the educational or biological field find statistical analysis in research as the scariest aspect of completing research. However, statistical tools in research can help researchers understand what to do with data and how to interpret the results, making this process as easy as possible. These are: 1) Statistical Package for Social Science (SPSS) - It is a widely used software package for human behavior research. SPSS can compile descriptive statistics, as well as graphical depictions of results. Moreover, it includes the option to create scripts that automate analysis or carry out more advanced statistical processing; 2) R Foundation for Statistical Computing - This software package is used in human behavior research and other fields. R is a powerful tool and has a steep learning curve. However, it requires a certain level of coding. Furthermore, it comes with an active community that is engaged in building and enhancing the software and the associated plugins; 3) MATLAB (The Mathworks) - It is an analytical platform and a programming language. Researchers and engineers use this software to create their own code and help answer their research questions. While MatLab can be a difficult tool to use for novices, it offers flexibility in terms of what the researcher needs; 4) Microsoft Excel - This is not the best solution for statistical analysis in research, but MS Excel offers a wide variety of tools for data visualization and simple statistics. It is easy to generate summary and customizable graphs and figures. MS Excel is the most accessible option for those wanting to start with statistics; 5) Statistical Analysis Software (SAS) - This is a statistical platform used in business, healthcare, and human behavior research alike. It can carry out advanced analyzes and produce publication-worthy figures, tables and charts; 6) GraphPad Prism - This is a premium software that is primarily used among biology researchers but, it offers a range of variety to be used in various other fields. Similar to SPSS, GraphPad gives scripting option to automate analyses to carry out complex statistical calculations; 7) Minitab - This software offers basic as well as advanced statistical tools for data analysis. However, similar to GraphPad and SPSS, Minitab needs command over coding and can offer automated analyses.

The fifth and last assumption of the study which states that the problems encountered in using basic statistics in educational research are moderately serious is accepted and confirmed because this study has found that the problems encountered in using basic statistics in educational research were moderately serious as proven by the obtained average weighted mean of 2.76.
CONCLUSION

This study reveals that graduate and postgraduate students encounter moderately serious challenges in utilizing basic statistics for educational research, with an average weighted mean of 2.76. Primary concerns include inadequate mathematical skills, limited practical application of statistical knowledge, lack of content understanding, and insufficient availability of textbooks. Comparative studies support these findings, emphasizing similar struggles among graduate students in using statistical tools effectively. Addressing these challenges necessitates diverse approaches, including refining teaching methods, augmenting learning resources, and promoting a positive attitude toward statistics. Ultimately, by addressing these hurdles, stakeholders in education can empower students to navigate statistical complexities more effectively, thereby improving the quality and reliability of educational research outcomes.

RECOMMENDATIONS

Based on the findings highlighting the moderately serious problems encountered in utilizing basic statistics in educational research, several recommendations are proposed. Institutions should prioritize enhancing statistical education by providing comprehensive courses taught by educators with sufficient content knowledge and pedagogical skills. Efforts should be made to ensure students have access to adequate textbooks and learning materials on statistics, and institutions can organize training programs and workshops to enhance students' mathematical and statistical skills. Encouraging self-directed learning through online resources and tutorials can further reinforce students' understanding of statistical concepts. Integrating statistical software into the curriculum and promoting interdisciplinary collaboration can provide practical experience in data analysis and its application across various fields. Additionally, addressing statistics anxiety through counseling services and supportive learning environments is essential to help students manage stress associated with statistics coursework. These recommendations aim to better support students in overcoming challenges related to basic statistics, thereby enhancing their research skills and academic success.
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