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ASSESSING STATISTICAL MODELLING KNOWLEDGE IN TERTIARY EDUCATION IN ANAMBRA STATE

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Abstract
This study investigates the knowledge levels of statistical modelling among students in Tertiary Education in Anambra State, Nigeria, highlighting significant variances in comprehension and engagement. A convenience sample of one hundred and forty-eight (n = 122) first-year undergraduates comprising 71 females (65.5%) and 51 males (34.5%) aged 16 to 28 years old participated in the study. The data reveals that a large proportion of students fall within the low (39.34%) and very low (20.49%) knowledge categories, while only a small fraction demonstrates high (11.48%) or very high (7.38%) proficiency. These findings underscore the critical need for enhanced educational strategies to improve students' understanding of statistical modelling. The implications suggest that students can apply statistical concepts in real-world scenarios with targeted interventions, impacting their academic and professional success. This study provides a foundation for further exploration into improving statistical education in Nigeria, ensuring students are better equipped to meet academic and professional demands.

Keywords: Statistics modelling, knowledge, gender

Background
Statistics represents one of the essential subjects in the school curriculum in contemporary society (Eichler & Zapata-Cardona, 2016). Statistics denotes the science of learning from data (Lieten, 2005). Statistical methods are crucial to the quality and rigor of any scientific endeavor (Annapurna, 2017; Olivier & Bell, 2018). Statistics has emerged as a distinct discipline (Garfield & Ben-Zvi, 2007; Groth, 2015; Jose, 2017). Statistics play a crucial role in society and the workplace and have received increased attention from scholars (Ben-Zvi & Garfield, 2008; Chew & Dillon, 2014; Sharma, 2017). Perhaps, attention has been directed to the method of teaching and learning statistics in many countries (Fioravanti Pereira et al., 2019; Veloo et al., 2018). The importance of statistics has been widely highlighted (Frost, 2017; Gupta & V., 2020; Wiberg, 2009). For example, researchers have emphasized the relevance of statistics in psychology (Verma & Verma, 2019), health research (Coggon, 2015), national development (Shangodoyin & Lasisi, 2011), biophysical context (Tamm, 2019), data mining (Ribeiro et al., 2017). Statistics is essential in scientific discoveries, decision-making, and predictions based on data (Lieten, 2005). There are many common misapprehensions about statistics (Currey et al., 2009). Statistics has been widely perceived as a challenging course, and this has presented a significant challenge for higher education students and is consequently associated with anxiety, which further inhibits performance (Sandoz et al., 2017). Research has attested that students commonly perceive learning statistics negatively (Gopal et al., 2020).

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Statistics is widely considered a difficult subject to learn due to the complexity of the concepts and given that most students enrolled in non-science classes do not necessarily have a solid mathematical background (Dempster & McCorry, 2009). A significant amount of past studies also revealed anxieties associated with statistics(Cui et al., 2019; Faber & Drexler, 2019; Huang, 2018; Malik, 2015; Najmi et al., 2018; Onwuegbuzie, 2004; Siew et al., 2019; Smith & Capuzzi, 2019; Tonsing, 2018; Vahedi et al., 2012; Walsh & Ugumba-Agwunobi, 2002; Williams, 2010). Accordingly, Lavldas et al. (2020) reported the effect of perceived competence in mathematics on students' performance in the statistics course. The unsatisfactory perception of students in statistics is well documented (Field, 2002; Murtonen & Lehtinen, 2003), and the trend is experienced globally. Many non-statistics students most often do not see the relevance of statistics within their discipline (Bilgin et al., 2020).

Among the statistical concepts that students often need help learning is statistical modelling. It involves using mathematical equations to represent, analyze, and make predictions about real-world data. It is like creating a mathematical version of reality to help you understand patterns and relationships within data sets. Statistical modelling refers to the use of statistical techniques to identify or eliminate the variable that does not affect the determination of a particular phenomenon. The term model refers to a representation of reality. A model refers to a simplified version of something that helps understand the system. It is a mathematical framework designed to exhibit the salient features of an object, a process, or a feature of reality. Over the years, attitude toward statistics has received increased attention, especially as it relates to performance (Arumugam, 2014; Ashaari et al., 2011; Budé et al., 2012; Gerald & Allan, 2018; Gómez et al., 2012; Judi et al., 2011; Koparan & Güven, 2008; Mustam et al., 2020; Nguyen et al., 2016; Saidi & Siew, 2018). Performance in statistics assessments is clearly related to students' attitudes toward statistics (Dempster & McCorry, 2009; Rosli & Maat, 2017). However, their understanding of the modeling concept is lacking since many students have difficulties explaining it.

This research aimed to assess the level of students' understanding of statistical modeling among undergraduates in Anambra State, Nigeria. The research was also conducted to ascertain whether there was any significant difference in students' understanding of the statistical modelling based on gender. Regarding this research, an operational definition of understanding statistical modeling refers to Definition, Properties, Problem and Representation, Procedure, and Argument and Proof about mean, mode, and median data. The research questions guiding this research were:

1. What is the level of student's understanding of statistical modelling?
2. Is there a difference in students' understanding of the statistical modelling based on gender?

Method

The present research was conducted in Anambra State, Nigeria, between July and October 2024. A convenience sample of one hundred and forty-eight (n = 148) first-year undergraduates comprised 97 females (65.5%) and 51 males (34.5%) aged 16 to 28 years old. The students were approached with the help of research assistants and asked to participate in the study. Those who consented and passed the inclusion criteria were briefed on the study's purposes. Also, all ethical considerations were observed. After that, the study instruments were given to them to fill on the spot. A cross-sectional research design was adopted in the study. A questionnaire was used to assess students' understanding of the statistical modelling. The scale was developed by the researchers based on the theoretical model of the meaning/ understanding of mathematical/statistical concepts proposed by Godino and Batanero (1997), where the meaning of a concept was distinguished into five interrelated components, which are students'

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understanding of the problem, representation, procedures, definition, and properties, and argument and proof. The questionnaire consisted of 14 multiple-choice items and four subjective items.

Result

The analysis of the test and questionnaire was done by using "Statistical Package for Social Science (SPSS)" version 20.0. In this study, descriptive statistics and inferential statistics were used to analyze the data and to answer the research questions. The student's level of understanding of the measures of central tendency was determined based on their marks (percentage, %). Students' level of understanding was categorized into five levels based on categories suggested by Tarmimi and Kadri (2016), which are very high (80-100), high (60-79), moderate (40-59), low (20-39) and very low (0-19). The correct response will be given one mark, while 0 mark for an incorrect response or no answer.

Table 1. Descriptive Statistical Analysis for the Level of Students' Understanding of Statistical Modelling (n=122)

Category	F	(%)	M	SD
Very High	9	7.38	2.46	1.15
High	14	11.48		
Moderate	26	21.31		
Low	48	39.34		
Very Low	25	20.49		
Total	122	100		

The results from the descriptive statistics analysis in Table 1 show that the level of students' understanding of the statistical modelling: 'Very High' level (7.38%), 'High' level (11.48%), 'Moderate' level (21.31%), 'Low' level (39.34%), and 'Very Low' level (20.49%). Therefore, this shows that the student's understanding of the measures of central tendency was at a moderate level (51.4%, M=2.46, SD=1.15).

Table 2 showing Independent Sample T-Test Analysis for the Differences in Students' Understanding of statistical modelling based on Gender.

Study major	*n*	*m*	*sd*	*t*	*df*	*p*
Female	71	2.04	3.09	2.18	7.53	.031
Male	51	0.26	2.41			

Based on Table 2, the result of the Independent Sample t-Test analysis shows that there was a significant difference in students' understanding of statistical modelling based on gender ($t = 2.18$, $df = 7.53$, $p = .031$). Generally, male students held a higher understanding of statistical modelling compared to the female students.

Discussion

The study found that students' understanding of statistical modelling was at a low level.This indicates that the students may need help understanding the mode concept and clarification with statistical modeling knowledge.Only a small proportion of students (7.38%)have a very high level of knowledge in statistical modelling. These students likely possess strong analytical skills and a deep understanding of statistical concepts and applications.Slightly more students(11.48%)fall into the high knowledge category. These students have a good grasp of statistical modelling, but there may be areas where further

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learning and practice could enhance their understanding.A significant portion of students (21.31%) have a moderate level of knowledge. These students can comprehend and apply basic statistical concepts but may need help with more advanced topics or complex applications.The largest group of students (39.34%) falls into the low knowledge category. These students likely have some statistical modeling exposure but need more understanding to apply these concepts effectively. Additional support and targeted instruction could benefit this group.A considerable number of students (20.49%)have a very low level of knowledge in statistical modelling. These students may find the subject intimidating or difficult to grasp, indicating a need for foundational teaching and more engaging instructional methods.The distribution suggests varying levels of engagement and comprehension among students. Most students fall into the lower knowledge categories, highlighting a potential area for curriculum improvement.

Implications

These findings suggest a pressing need to enhance the teaching and learning of statistical modelling in Nigerian educational institutions. A significant portion of students lack a comprehensive understanding, which could impede their academic progress and ability to apply statistical concepts in real-world scenarios. Enhancing students' statistical skills is crucial for fields that rely heavily on data analysis and interpretation, such as economics, social sciences, and natural sciences.

Conclusion

This analysis indicates a significant opportunity to enhance student learning and engagement in statistical modelling through targeted educational strategies and support systems. Providing additional resources, such as tutoring, workshops, and online modules, can help students with lower levels of knowledge to catch up and build confidence in their abilities.This study is subject to certain limitations. The sample size of 122 students may only partially represent the diverse student population in Nigeria. Additionally, the categorization of knowledge levels is based on assumed numerical values, which may not capture the nuances of individual learning experiences and capabilities.Future research should include a more extensive and more diverse group of students to ensure broader representation.Conduct longitudinal studies to track changes in student knowledge and engagement over time. There is a need for differentiated instruction tailored to the varying levels of student knowledge. Interactive and practical teaching methods could help improve understanding and interest in statistical modelling.

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