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LEVERAGING STATISTICAL MODELLING KNOWLEDGE IN HIGHER EDUCATION

***Runyi E. Francis, Uba James Uba, PhD, Owor Effiom Owor, PhD, Adeyiola Ibidapo**
**Corresponding email: ***runyiemmanuel@gmail.com*

Abstract
This study investigates the knowledge levels of statistical modelling among students in higher education, 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 without targeted interventions, students may struggle with applying statistical concepts in real-world scenarios, 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.
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Keyword: Statistics Modelling, Knowledge, Gender

Introduction
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 an essential component 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 have negative perceptions of learning statistics (Gopal et al., 2020).

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Statistics is widely considered as 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) had 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 have difficulty learning is the statistical modelling. It involves using mathematical equations to represent, analyze, and make predictions about real-world data. It's like creating a mathematical version of reality that can help you understand patterns and relationships within data sets. The term statistical modelling refers to the use of statistical techniques to identify or eliminate the variable that does not have any effect on the determination of a particular phenomenon. The term model refers to a representation of reality. A model refers to a simplified version of something, which helps to 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 towards 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 shown to be related to students' attitudes toward statistics (Dempster & McCorry, 2009; Rosli & Maat, 2017). However, their understanding towards the modelling concept is found to be lacking, since many students have difficulties in explaining this concept.

The purpose of this research was to assess the level of students' understanding of the statistical modelling among undergraduates in higher education. 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 of the statistical modelling 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 students' understanding of the statistical modelling?
2. Is there a difference in students' understanding of the statistical modelling based on gender?

Method

The present research was conducted in Cross River State, Nigeria, between July and October 2024. A convenience sample of one hundred and forty-eight (n = 148) first-year undergraduates comprising 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

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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 on the meaning/ understanding of mathematical/statistical concepts proposed by Godino and Batanero (1997), where the meaning of concept was distinguished into five interrelated components, which are students' understanding of the problem, representation, procedures, definition and properties, and argument and proof. The questionnaire consisted of 14 multiple-choice items and 4 subjective items.

Results

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 students' 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). Correct response will be given 1 mark, while 0 mark for 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 shows 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 students' understanding of the measures of central tendency was in the 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.

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Discussion

The study found that students' understanding of statistical modelling was situated within the low level. This indicates that the students may not understand the mode concept, and are confused with the knowledge of statistical modelling. 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 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 struggle 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 exposure to statistical modelling but lack the depth of understanding needed to effectively apply these concepts. 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. The lack of comprehensive understanding among a significant portion of students 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 not fully 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 aim to include a larger and more diverse group of students to ensure broader representation. Conduct longitudinal studies to track changes in students' 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.

References

Annapurna, M. I. (2017). Importance of Statistics and Mathematical Models in the Field of Social Sciences Research. *Imperial Journal of Interdisciplinary Research*, *3*(4).

Cite this article as:
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Arumugam, R. N. (2014). Student's attitudes towards introductory statistics courses at public universities using partial least square analysis abstract. *Interdisciplinary Journal of Contemporary Research in Business*, *6*(4).

Ashaari, N. S., Judi, H. M., Mohamed, H., & Tengku Wook, T. M. (2011). Student's Attitude Towards Statistics course. *Procedia - Social and Behavioral Sciences*, *18*. https://doi.org/10.1016/j.sbspro.2011.05.041

Ben-Zvi, D., & Garfield, J. (2008). Introducing the Emerging Discipline of Statistics Education. *School Science and Mathematics*, *108*(8). https://doi.org/10.1111/j.1949-8594.2008.tb17850.x

Bilgin, A. A. B., Bulger, D., & Fung, T. (2020). Statistics: Your ticket to anywhere. *Statistics Education Research Journal*, *19*(1).

Budé, L., van de Wiel, M. W. J., Imbos, T., & Berger, M. P. F. (2012). The effect of guiding questions on students' performance and attitude towards statistics. *British Journal of Educational Psychology*, *82*(2). https://doi.org/10.1111/j.2044-8279.2011.02031.x

Chew, P. K. H., & Dillon, D. B. (2014). Statistics Anxiety Update: Refining the Construct and Recommendations for a New Research Agenda. In *Perspectives on Psychological Science* (Vol. 9, Issue 2). https://doi.org/10.1177/1745691613518077

Coggon, D. (2015). The importance of statistics in health research. *Cogitare Enfermagem*, *20*(1). https://doi.org/10.5380/ce.v20i1.40626

Cui, S., Zhang, J., Guan, D., Zhao, X., & Si, J. (2019). Antecedents of statistics anxiety: An integrated account. In *Personality and Individual Differences* (Vol. 144). https://doi.org/10.1016/j.paid.2019.02.036

Currey, J. D., Baxter, P. D., & Pitchford, J. W. (2009). Significance and importance: Some common misapprehensions about statistics. In *Cell Biochemistry and Function* (Vol. 27, Issue 8). https://doi.org/10.1002/cbf.1620

Dempster, M., & McCorry, N. K. (2009). The role of previous experience and attitudes toward statistics in statistics assessment outcomes among undergraduate psychology students. *Journal of Statistics Education*, *17*(2). https://doi.org/10.1080/10691898.2009.11889515

Eichler, A., & Zapata-Cardona, L. (2016). *Empirical Research in Statistics Education*. https://doi.org/10.1007/978-3-319-38968-4_1

Faber, G., & Drexler, H. (2019). Predicting education science students' statistics anxiety: The role of prior experiences within a framework of domain-specific motivation constructs. *Higher Learning Research Communications*, *9*(1). https://doi.org/10.18870/hlrc.v9i1.435

Field, A. (2002). Discovering Statistics Using SPSS for Windows. *Turkish Online Journal of Distance Education*, *3*.

Fioravanti Pereira, R., Greca Dufranc, I. M., & Meneses Villagra, J. A. (2019). Ways of teaching statistics for the health area. *Revista Latinoamericana de Investigacion En Matematica Educativa*, *22*(1). https://doi.org/10.12802/RELIME.19.2213

Frost, J. (2017). *The Importance of Statistics - Statistics By Jim*. Statisticsbyjim.Com.

Garfield, J., & Ben-Zvi, D. (2007). How students learn statistics revisited: A current review of research on teaching and learning statistics. In *International Statistical Review* (Vol. 75, Issue 3). https://doi.org/10.1111/j.1751-5823.2007.00029.x

Gerald, B., & Allan, M. (2018). Effect of Cooperative Learning on Students' Attitude and Performance towards Probability Distributions in Statistics. *Journal of Education and Practice*, *9*(14).

Gómez, E., Repetto, A., & Mattinello, G. (2012). Exploration and analysis of the attitude towards statistics in psychology students. *Liberabit. Revista de Psicología*, *18*(1).

Gopal, K., Salim, N. R., & Ayub, A. F. M. (2020). Malaysian undergraduates' perceptions of learning statistics: Study on attitudes towards statistics using fuzzy conjoint analysis. *ASM Science Journal*, *13*. https://doi.org/10.32802/ASMSCJ.2020.SM26(2.15)

Griffith, J. D., Adams, L. T., Gu, L. L., Hart, C. L., & Nichols-Whitehead, P. (2012). Students' Attitudes Toward Statistics Across the Disciplines: A Mixed-Methods Approach. *Statistics Education Research Journal*, *11*(2).

Groth, R. E. (2015). Working at the boundaries of mathematics education and statistics education communities of practice. In *Journal for Research in Mathematics Education* (Vol. 46, Issue 1). https://doi.org/10.5951/jresematheduc.46.1.0004

Gupta, P., & V., N. (2020). The Impact and Importance of Statistics in Data Science. *International Journal of Computer Applications*, *176*(24). https://doi.org/10.5120/ijca2020920215

Huang, L. (2018). A mixed-method investigation of social science graduate students' statistics anxiety conditions before and after the introductory statistics course. *International Journal of Higher Education*, *7*(3). https://doi.org/10.5430/ijhe.v7n3p156

Jose, P. E. (2017). Observations about how we learn about methodology and statistics. In *Monographs of the Society for Research in Child Development* (Vol. 82, Issue 2). https://doi.org/10.1111/mono.12303

Judi, H. M., Ashaari, N. S., Mohamed, H., & Tengku Wook, T. M. (2011). Students profile based on attitude towards statistics. *Procedia - Social and Behavioral Sciences*, *18*. https://doi.org/10.1016/j.sbspro.2011.05.038

Koparan, T., & Güven, B. (2008). The effect on the 8th Grade Students' Attitude towards Statistics of Project-Based Learning. *European Journal of Educational Research*, *3*(2).

Lavldas, K., Barkatsas, T., Manesis, D., & Gialamas, V. (2020). A structural equation model investigating the impact of tertiary students' attitudes toward statistics, perceived competence at mathematics, and engagement on statistics performance. *Statistics Education Research Journal*, *19*(2).

Lieten, G. K. (2005). The importance of statistics. In *Child Labour*. Amsterdam University Press. https://doi.org/10.1515/9789048520992-005

Malik, S. (2015). Undergraduates' statistics anxiety: A phenomenological study. *Qualitative Report*, *20*(2).

Murtonen, M., & Lehtinen, E. (2003). Difficulties experienced by education and sociology students in quantitative methods courses. *Studies in Higher Education*, *28*(2). https://doi.org/10.1080/0307507032000058064

Mustam, A. A., Adnan, M., Johnny, J., & Setambah, M. A. B. (2020). Attitude towards statistics among pre-service teachers of the institute of teacher education. *Journal of Physics: Conference Series*, *1521*(3). https://doi.org/10.1088/1742-6596/1521/3/032011

Najmi, A., Raza, S. A., & Qazi, W. (2018). Does statistics anxiety affect students' performance in higher education? The role of students' commitment, self-concept, and adaptability. *International Journal of Management in Education*, *12*(2). https://doi.org/10.1504/IJMIE.2018.090705

Nguyen, T. U. H., Charity, I., & Robson, A. (2016). Students' perceptions of computer-based learning environments, their attitude towards business statistics, and their academic

achievement: implications from a UK university. *Studies in Higher Education*, *41*(4). https://doi.org/10.1080/03075079.2014.950562

Olivier, J., & Bell, M. L. (2018). The Importance of Statistics in Cancer Research. *World Journal of Cancer Research*, *1*(1). https://doi.org/10.1166/wjcr.2013.1004

Onwuegbuzie, A. J. (2004). Academic procrastination and statistics anxiety. *Assessment and Evaluation in Higher Education*, *29*(1). https://doi.org/10.1080/0260293042000160384

Ribeiro, V., Rocha, A., Peixoto, R., Portela, F., & Santos, M. F. (2017). Importance of statistics for data mining and data science. *Proceedings - 2017 5th International Conference on Future Internet of Things and Cloud Workshops, W-FiCloud 2017*, *2017-January*. https://doi.org/10.1109/FiCloudW.2017.86

Rosli, M. K., & Maat, S. M. (2017). Attitude towards statistics and performance among postgraduate students. *AIP Conference Proceedings*, *1847*. https://doi.org/10.1063/1.4983881

Saidi, S. S., & Siew, N. M. (2018). Assessing Students' Understanding of the Measures of Central Tendency and Attitude towards Statistics in Rural Secondary Schools. *International Electronic Journal of Mathematics Education*, *14*(1). https://doi.org/10.12973/iejme/3968

Sandoz, E. K., Butcher, G., & Protti, T. A. (2017). A preliminary examination of willingness and importance as moderators of the relationship between statistics anxiety and performance. *Journal of Contextual Behavioral Science*, *6*(1). https://doi.org/10.1016/j.jcbs.2017.02.002

Shangodoyin, D. K., & Lasisi, T. A. (2011). The Role of Statistics in National Development with Reference to Botswana and Nigeria Statistical Systems. *Journal of Sustainable Development*, *4*(3). https://doi.org/10.5539/jsd.v4n3p131

Sharma, S. (2017). Definitions and models of statistical literacy: a literature review. *Open Review of Educational Research*, *4*(1). https://doi.org/10.1080/23265507.2017.1354313

Siew, C. S. Q., McCartney, M. J., & Vitevitch, M. S. (2019). Using network science to understand statistics anxiety among college students. *Scholarship of Teaching and Learning in Psychology*, *5*(1). https://doi.org/10.1037/stl0000133

Smith, T. F., & Capuzzi, G. (2019). Using a Mindset Intervention to Reduce Anxiety in the Statistics Classroom. *Psychology Learning and Teaching*, *18*(3). https://doi.org/10.1177/1475725719836641

Tamm, M. V. (2019). Importance of extreme value statistics in biophysical contexts. *Physics of Life Reviews*, *28*. https://doi.org/10.1016/j.plrev.2019.03.001

Tonsing, K. N. (2018). Instructor immediacy and statistics anxiety in social work undergraduate students. *Social Work Education*, *37*(2). https://doi.org/10.1080/02615479.2017.1395009

Vahedi, S., Farrokhi, F., Farahnaz, G., & Ali, I. (2012). The relationship between procrastination, learning strategies and statistics anxiety among Iranian college students: A canonical correlation analysis. *Iranian Journal of Psychiatry and Behavioral Sciences*, *6*(1).

Veloo, A., Krishnasamy, H. N., & Ali, R. M. (2018). Reflection on teaching' statistics in education' for postgraduate students. *Indian Journal of Public Health Research and Development*, *9*(11). https://doi.org/10.5958/0976-5506.2018.01641.8

Verma, J. P., & Verma, J. P. (2019). Importance of Statistics in Psychology. In *Statistics and Research Methods in Psychology with Excel*. https://doi.org/10.1007/978-981-13-3429-0_1

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Walsh, J. J., & Ugumba-Agwunobi, G. (2002). Individual differences in statistics anxiety: The roles of perfectionism, procrastination, and trait anxiety. *Personality and Individual Differences*, *33*(2). https://doi.org/10.1016/S0191-8869(01)00148-9

Wiberg, M. (2009). Teaching statistics in integration with psychology. *Journal of Statistics Education*, *17*(1). https://doi.org/10.1080/10691898.2009.11889509

Williams, A. S. (2010). Statistics anxiety and instructor immediacy. *Journal of Statistics Education*, *18*(2). https://doi.org/10.1080/10691898.2010.11889495.

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