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RESEARCH ARTICLE

INFLUENCE OF TEACHING METHODOLOGIES IN MATHEMATICS/STATISTICS IN TERTIARY INSTITUTIONS

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ABSTRACT

This study aims to evaluate the influence of different teaching methodologies; traditional lecture-based, project-based, and technology-enhanced on student learning outcomes in mathematics and statistics within Nigerian tertiary institutions. Recognizing the critical role of effective pedagogical strategies in enhancing academic performance, the research seeks to compare the effectiveness, student perceptions, and identify the preferred learning method of students in Mathematics /Statistics.. Utilizing a questionnaire based research involving 150 students, the study will analyse engagement levels with each method. The findings are expected to provide valuable insights for educators and policymakers, guiding the adoption of pedagogical strategies that improve student understanding, satisfaction, and overall educational quality. Ultimately, this research will contribute to enhancing mathematics and statistics education, fostering better preparedness of students for professional challenges and advancing higher education reforms in Nigeria.

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INTRODUCTION

Mathematics and Statistics are compulsory subjects for all Science and Technology based courses in our schools at both secondary and Tertiary levels of education. This is as a result of its application in almost every area of life. The foundation of the subject when not clearly understood by the students, creates a gap which may not be filled hence the lack of interest in the subjects by the students going forward. The methodology used in delivering the lecture becomes very important for students engagement and understanding to be achieved. The effectiveness of teaching methodologies significantly impacts student learning outcomes in tertiary education. Particularly in Mathematics and Statistics, the choice of instructional approach can influence students' conceptual understanding, problem-solving skills, and overall performance (Boaler, 2016). With the evolving landscape of education technology and pedagogical strategies, it is pertinent to explore how different teaching methodologies; traditional lecture-based, project-based, and technology-enhanced affect student outcomes in higher education settings.

Problem statement and Justification: Mathematics and Statistics are foundational disciplines in numerous academic and professional fields. Traditional lecture-based methods have dominated classrooms for decades; however, they often face criticism for fostering passive learning (Freeman *et al*, 2014). Conversely, project-based learning encourages active

engagement and practical application, potentially leading to better comprehension (Bell, 2010). The integration of technology, such as educational software and online resources, offers additional avenues to enhance learning (Tucker, 2018). Despite these developments, there remains limited empirical data comparing these methodologies and determining their cost effectiveness within Nigerian tertiary institutions. With the increase in technological advancements and use of digital tools, it has become inevitable to review the methodology of delivery of the curriculum in our Tertiary institutions in order to achieve the set out goals and objectives of the curriculum through the proper engagement of students during lecture hours. The cost effectiveness of the appropriate methodology to be adopted is also important for accountability and affordability in view of dwindling resources.

Objectives of the Study: To compare the effectiveness of traditional lecture-based, project-based, and technology-enhanced teaching methodologies on students' academic performance in mathematics/statistics.

- To assess students' perceptions and attitudes towards each teaching approach.

Significance of Study: This research when completed, will inform Nigerian tertiary institutions on the efficacy and cost-efficiency of diverse teaching methodologies in Mathematics and Statistics education. The findings will contribute to

pedagogical reforms aimed at enhancing student engagement, comprehension, and performance, ultimately improving higher education quality in Nigeria.

Literature Review: Effective teaching methodologies are pivotal in shaping student learning outcomes, particularly in challenging disciplines such as mathematics and statistics. Over the years, researchers have examined various instructional approaches, highlighting their strengths and limitations in promoting academic achievement.

Traditional Lecture-Based Instruction: The conventional lecture method has long been the dominant pedagogical approach in higher education. It involves instructor-led delivery of content, emphasizing passive absorption of information by students (Ramsden, 2003). While efficient for covering extensive material, studies indicate that traditional lectures often result in limited student engagement and passive learning, which can negatively impact conceptual understanding (Freeman *et al.*, 2014). For instance, Freeman *et al.* (2014) conducted a meta-analysis across STEM disciplines, finding active learning techniques significantly outperform traditional lectures in improving student performance and retention.

Project-Based Learning: Project-based learning (PBL) encourages active participation by involving students in real-world problems that require critical thinking and collaboration (Bell, 2010). In mathematics and statistics, PBL fosters experiential understanding and enhances problem-solving skills (Wang *et al.*, 2018). A study by Sung and Hwang (2019) demonstrated that students engaged in project-based tasks exhibited higher motivation and better understanding of statistical concepts compared to traditional instruction. PBL aligns with constructivist theories, emphasizing learning as an active and contextually meaningful process (Scott *et al.*, 2015).

Technology-Enhanced Teaching: The integration of digital tools and resources—such as online modules, educational software, and virtual labs—has transformed instructional practices in higher education. Technology-enhanced teaching allows for personalized learning experiences, immediate feedback, and interactive engagement (Tucker, 2018).

Research indicates that technology-assisted instruction can significantly improve learning outcomes in mathematics and statistics. For example, Cavanaugh, Gillan, and Wurr (2016) found that students using statistical software and online simulations displayed improved comprehension and application skills. Additionally, studies suggest that technology fosters flexible, self-paced learning, accommodating diverse learner needs (Hwang *et al.*, 2020).

Contextual Relevance in Nigerian Tertiary Education: While much research supports active and technology-enhanced learning, studies within the Nigerian educational context remain limited.

Existing literature suggests that resource constraints, infrastructural challenges, and pedagogical resistance hinder widespread adoption of innovative teaching strategies (Obanya, 2019). Therefore, evaluating the effectiveness and cost-efficiency of these methodologies locally is essential for informed pedagogical reforms.

Research Questions: Which teaching methodology leads to the highest student academic performance in Mathematics and Statistics?

How do students perceive the engagement and satisfaction levels associated with each teaching approach?

Research Design: A quasi-experimental design with three groups corresponding to each teaching approach will be employed over one academic semester. Approximately 150 students enrolled in core mathematics/statistics courses at a tertiary institution were randomly assigned to one of the three groups (50 students per group).

The questionnaire was grouped into three with each group testing the preferred teaching methodology.

Group 1: Traditional lecture-based instruction

Group 2: Project-based learning involving collaborative, real-world projects

Group 3: Technology-enhanced instruction utilizing educational software and online modules

Data Collection: Only 138 questionnaires were correctly filled and returned

RESULTS

Preferred teaching methodology	No of respondents	Percentage (%)
Traditional lecture based	25	18.1%
Project based	46	33.3%
Technology enhanced	67	48.6%

Analysis: From the above table, 25 students (18.1%) of the students still preferred the traditional lecture based method of teaching currently being used. It involves the usual sitting to listen to to take notes while the lecturing is going on. They argued that they had become accustomed to that method of teaching. However they accepted that it could be boring particularly when a difficult and abstract topic was being taught. This position is not surprising as some people are averse to change and would rather stick to a usual method of doing things even when productivity is low. Project based method of teaching involves grouping the students and giving them topics to prepare and deliver. 46 students (33.3%) opted for project based method of teaching. The reason being that the very academically sound ones would assist the struggling students for better understanding. The project method is equally engaging and will ensure remembrance being that it is engaging. This method is equally cost effective as the cost of the project would be shared by the group members. This method however has a disadvantage of encouraging laziness as not everyone in the group may be involved in the project. Some students may be doing the work while the others will rely solely on the active members of the group. 67 (48.6%) students opted for technology enhanced method of teaching. This is not surprising with the increase in introduction of different types digital tools and Artificial Intelligence which have aided learning and easy recall of taught lessons. This is in line with the study by Akabuike and Okechukwu (2026) which confirmed that Digital tools make Mathematical problems easier particularly in complex equations thus reducing the boredom and lack of interest experienced when an Equation is

not understood. Digital tools have not only made new and old information reachable and available thus easing the pressure of research, they have also made data analysis, calculations easier and with in-depth understanding.

CONCLUSION

Strong foundation in Mathematics and Statics in technology based institutions is a very compulsory and important requirement if the the objectives of TVET based institutions are to be met. It is thus important that all efforts and infrastructure necessary to achieve the in-depth knowledge and understanding of Mathematics and Statistics should be put in place. One of such infrastructure is the use of technology based tools to teach the students for easier understanding and retentiveness. Technology based method is engaging and improves attentiveness making the grasping of the foundation of Mathematics and Statistics easier to achieve. Empirical comparisons of these methodologies indicate that active and technology-supported approaches consistently outperform traditional lecture-based methods in promoting understanding and retention (Freeman *et al.*, 2014; Bell, 2010). However, the effectiveness often depends on implementation quality, instructor training, and student receptiveness (Khan *et al.*, 2017). Notably, integrating multiple approaches, such as combining project-based tasks with technological tools, can yield synergistic benefits (Wang *et al.*, 2018).

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