Transforming University Mathematics Education for Innovation, Creativity, and Sustainable Development: Perspectives of Mathematics Education Lecturers in Niger State, Nigeria

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DOI: https://doi.org/10.5281/zenodo.20325507

Abstract

This study presents a survey of Mathematics lecturers' perspectives on transforming mathematics education as a tool for fostering technological innovation within the faculty of Education in Universities' across Niger State, Nigeria. A descriptive survey research design was employed, with a sample of twenty-nine mathematics lecturers selected through purposive sampling. A researcher-designed questionnaire served as the primary data collection instrument. Experts validated the questionnaire, and its internal consistency was assessed using Cronbach's Alpha, yielding reliability coefficients of 0.87. Data analysis was conducted using mean and standard deviation, with a criterion mean of 2.5 set as the bench for mark for interpretation. Findings revealed a strong consensus among respondents on the need to shift from traditional rote-based teaching methods to more student-centered, inquiry-based, and interdisciplinary approaches. Respondents also emphasized the importance of equipping mathematics educators with 21st-century skills, including digital literacy, critical thinking, and entrepreneurship. Based on these insights, the study concludes that rethinking mathematics education is imperative to preparing a new generation of teachers capable of driving innovation and sustainable growth. Recommendations include curriculum reforms, targeted teacher training, and the incorporation of problem-based learning strategies that link mathematical concepts to real-world challenges.

Keywords: Creativity, Innovation, Lecturers, Mathematics, Perspectives, Sustainable-Development

Introduction

Mathematics education serves as a critical foundation for equipping students with the necessary skills for technological innovation, creative problem-solving and sustainable development. In Nigeria, however, particularly at the tertiary level, mathematics education has come under scrutiny for its heavy reliance on rote learning (Ladele, Abubakar, Ariba, & Ajani, 2024). This approach according to Nilimaa, (2023) does not encourage students to think critically or to apply mathematical concepts to real-world situations, which ultimately limits their ability to solve complex problems. As a result, there is a pressing need to rethink the way mathematics is taught, particularly in terms of developing skills that align with today's technological demands.

In many tertiary institutions across Niger State, Nigeria, the teaching of mathematics continues to follow traditional methods, primarily focusing on rote memorization and passive learning (Usman, 2021; Danlami, Zakariya, Balarabe, Alotaibi, & Alrosaa, 2025). Such methods limit students' ability to engage with mathematical concepts in a meaningful way and fail to foster the advanced reasoning and problem solving skills needed for addressing the challenges of the modern world Elvina, (2025). This gap in teaching methods according to Chari, (2024) not only impedes the development of critical thinking but also limits students' capacity to contribute to technological innovation and sustainable development, which are vital to societal progress. Therefore, there is an urgent need to transform mathematics education to cultivate creativity, enhance critical thinking, and better prepare students to solve real-world problems effectively (Nilimaa, 2023; Susanti, 2025; Yang, 2024).

Studies by Ekvitayavetchanukul, Sutabutra, Rujachan, Manasakorn, Sripetchnai (2025) and Smith (2020) highlight the ongoing shift from traditional to modern teaching methods in mathematics. Their findings emphasize that while rote memorization helps build foundational knowledge, it does little to develop the analytical thinking needed to solve new and complex problems. In contrast, student-centered, inquiry-based learning encourages active participation from students and emphasizes the practical application of knowledge in real-life situations (Nghiem, Yadav, Yadav, Dewasiri & Ranasinghe, 2025; Jones & Brown, 2019). Moreover, the role of technology in education has become indispensable, particularly in mathematics, where digital literacy is now considered a vital skill. Cirneanu,and Moldoveanu, (2024) and Nguyen (2021) underscores that integrating digital tools into mathematics education helps students develop the technological expertise needed to succeed in a rapidly advancing, technology-driven world. Additionally, Education for Sustainable Development (ESD) has gained significant attention, with global educational frameworks

urging curricula that focus on problem-solving, interdisciplinary learning, and addressing pressing global challenges such as climate change, poverty, and health (Harrison & Williams, 2018; Hung, & Pan, 2025). This body of research highlights the urgent need for mathematics education to adapt and meet the challenges of the modern world by equipping students with the skills necessary for both personal and global success. Therefore, it became essential to conduct a study specifically aimed at assessing Mathematics lecturers' perspectives on transforming mathematics education for innovation, creativity, and sustainable development in tertiary institutions in Niger State, Nigeria.

Objectives of the Study

The purpose of this study was to examine Mathematics lecturers' perspectives on transforming mathematics education as a tool for fostering technological innovation within the faculty of Education in tertiary institutions across Niger State, Nigeria. Specifically, the study sought to:

1. To assess the perspectives of Mathematics Lecturers' on the need for transformation in the current state of mathematics education in Niger State tertiary institutions.
2. To determine the extent to which Mathematics Lecturers' believe that teaching methods should be transformed to foster technological innovation and creative problem-solving in mathematics education.
3. To evaluate the perceived importance of digital literacy and critical thinking in enhancing mathematics education for sustainable development, as viewed by Mathematics Lecturers'

Research Questions

The following research questions guided the study:

1. To what extent do Mathematics Lecturers' agree that the current state of mathematics education in Niger State tertiary institutions requires transformation?
2. To what extent do Mathematics Lecturers believe that teaching methods should be transformed to promote technological innovation and creative problem-solving in mathematics education?
3. Do Mathematics Lecturers perceive the importance of digital literacy and critical thinking in improving mathematics education for sustainable development?

Methodology

The study adopts a descriptive survey research design to examine and analyze the perspectives of Mathematics Lecturers' on the transformation of mathematics education in Niger State. A purposive sampling technique was employed to select 29 lecturers within faculty of Education across tertiary institutions within the region. These lecturers were deliberately chosen for their relevant experience and active involvement in mathematics instruction at the tertiary level, ensuring a comprehensive representation of educators directly engaged with the subject matter.

To gather data, a researcher-designed questionnaire was used as the primary instrument. This questionnaire was crafted in alignment with the study's objectives and was validated by subject matter experts to ensure its relevance and appropriateness. The internal consistency of the instrument was evaluated using Cronbach's Alpha, which resulted in a reliability coefficient of 0.87, signifying a high degree of internal consistency and reliability.

The collected data were analyzed using mean and standard deviation to quantify the level of agreement among participants regarding different aspects of mathematics education transformation. A criterion means of 2.5 was set as the threshold to interpret the data, allowing the identification of areas where participants showed strong consensus and areas requiring further attention. Statistical methods were applied to draw insights from the data, highlighting key trends and providing a clearer understanding of the participants' views on the necessary changes to mathematics education.

Results

In this section, Table 1-3 are presented with their interpretations tailored towards providing answers to the research questions raised.

Table 1: **Mean and Standard deviation of Mathematics Lecturers' Perspectives on the Current State of Mathematics Education in Niger State Tertiary Institutions**

S/n	Item	N	Mean	SD	Decision
1	The current teaching methods in mathematics education at tertiary institutions in Niger State are outdated and fail to meet modern educational needs.	29	3.28	0.70	Agree
2	The mathematics curriculum in Niger State tertiary institutions is not adequately preparing students for real-world applications of mathematical knowledge.	29	2.17	0.96	Disagree
3	The traditional emphasis on rote memorization in mathematics education limits students' ability to think critically and solve complex problems.	29	3.14	0.83	Agree
4	There is a need to incorporate modern technological tools into the teaching of mathematics at the tertiary level in Niger State.	29	3.45	0.57	Agree
5	The current state of mathematics education in Niger State does not adequately prepare students for global technological and sustainability challenges.	29	3.48	0.63	Agree
6	Students in Niger State tertiary institutions are not being sufficiently trained to use mathematics in solving real-world, interdisciplinary problems.	29	2.31	0.71	Disagree
7	The mathematics education system in Niger State needs a shift towards more student-centered, inquiry-based learning approaches to foster deeper understanding and creativity.	29	3.14	0.59	Agree
	Grand Mean		**2.99**	**.71**	

Decision Mean =2.50

Table 1 shows the mean and standard deviations of respondents on the current state of mathematics education in Niger State tertiary institutions, the result reveals a general agreement on the need for transformation. Participants agreed that current teaching methods are outdated (M = 3.28) and that the traditional focus on rote memorization limits students' ability to think critically (M = 3.14). There was also strong agreement on the need to incorporate modern technological tools (M = 3.45) and prepare students for global challenges (M = 3.48). However, respondents disagreed with statements suggesting that students are inadequately trained to apply mathematics to real-world problems (M = 2.17 and M = 2.31). Overall, the grand mean of 2.99 (SD = 0.71) indicates a consensus that reforms, including student-centered and inquiry-based approaches, are necessary to enhance the relevance of mathematics education in Niger State.

Table 2: Mean and standard deviation of Mathematics Lecturers' Perspectives on the Transformation of Teaching Methods in Mathematics Education

S/N	Item	N	Mean	SD	Decision
1	Teaching methods in mathematics education at the tertiary level should be adapted to encourage the development of students' creative problem-solving skills.	29	3.03	0.78	Agree
2	It is important to incorporate project-based learning, where students apply mathematical concepts to solve real-world problems, into the curriculum.	29	3.31	0.77	Agree
3	Mathematics education should shift from a teacher-centered approach to a more student-centered approach that promotes active participation and inquiry.	29	3.34	0.48	Agree
4	Integrating technological tools (such as mathematical modeling software, simulations, and interactive platforms) is crucial to enhancing the learning experience in mathematics.	29	3.48	0.50	Agree
5	Traditional methods of mathematics teaching, such as lectures and memorization, need to be replaced by more interactive and innovative teaching techniques.	29	2.97	0.73	Agree
6	The use of real-life scenarios and case studies in mathematics teaching fosters a deeper understanding of mathematical principles and their applications.	29	3.07	0.92	Agree
7	There is a need to integrate entrepreneurial thinking into mathematics education to foster innovation and creativity among students.	29	3.62	0.49	Agree
	Grand Mean		**3.26**	**0.67**	

Decision Mean =2.50

Table 2 shows the mean and standard deviations of respondents on their perspectives on the transformation of teaching methods. The result reveals broad agreement on the need for change. Respondents agreed that teaching methods should foster creative problem-solving (M = 3.03, SD = 0.78), and they strongly supported incorporating project-based learning to apply mathematical concepts to real-world problems (M = 3.31, SD = 0.77). There was consensus on shifting from teacher-centered to student-centered, inquiry-based learning (M = 3.34, SD = 0.48). Additionally, integrating technological tools such as mathematical modeling software and simulations to enhance the learning experience was widely endorsed (M = 3.48, SD = 0.50). While there was agreement on replacing traditional methods (M = 2.97, SD = 0.73), the mean score was slightly lower, suggesting some resistance to fully abandoning lecture-based approaches. Participants also agreed that using real-life scenarios and case

studies helps deepen understanding (M = 3.07, SD = 0.92), and integrating entrepreneurial thinking into the curriculum was seen as essential for fostering innovation and creativity (M = 3.62, SD = 0.49). The overall grand mean of 3.26 (SD = 0.67) reflects a strong consensus that transformative changes in teaching methods are needed to improve mathematics education.

Table 3: **Mean and standard deviation of Mathematics Lecturers' Perspectives on the Role of Digital Literacy and Critical Thinking in Mathematics Education**

S/n	Item	N	Mean	SD	Decision
1	Digital literacy is essential for mathematics educators in preparing students for the demands of a technology-driven society.	29	3.17	0.80	Agree
2	Critical thinking skills are necessary for students to understand and apply mathematical concepts to solve complex, real-world problems.	29	3.00	0.80	Agree
3	The incorporation of digital tools in mathematics education can significantly improve students' ability to visualize and solve mathematical problems.	29	3.62	0.49	Agree
4	Critical thinking and digital literacy are interconnected and should be integrated into the mathematics curriculum to enhance students' problem-solving capabilities.	29	3.24	0.58	Agree
5	Mathematics education for sustainable development requires that students not only master mathematical concepts but also develop the ability to think critically and use digital technologies effectively.	29	3.17	0.89	Agree
6	To address global challenges such as climate change, sustainability, and inequality, it is important to integrate digital literacy and critical thinking into the mathematics curriculum.	29	3.24	0.74	Agree
7	Mathematics educators must be equipped with the skills to teach students how to use digital tools to model real-world problems and make data-driven decisions.	29	3.31	0.81	Agree
	Grand Mean		**3.25**	**0.73**	

Decision Mean =2.50

Table 3 shows the mean and standard deviations of respondents on the on the role of digital literacy and critical thinking in mathematics education. The finding shows general agreement on their importance. Participants agreed that digital literacy is essential for preparing students for a technology-driven society (M = 3.17, SD = 0.80), and that critical thinking is necessary for solving real-world problems (M = 3.00, SD = 0.80). Strong support was found for the integration of digital tools in education (M = 3.62, SD = 0.49), which was believed to enhance problem-solving skills. Respondents also agreed on the need to incorporate both digital literacy and critical thinking into the mathematics curriculum (M = 3.24, SD = 0.58),

with a focus on addressing global challenges such as climate change (M = 3.17, SD = 0.89). Overall, the findings (Grand Mean = 3.25, SD = 0.73) highlight the consensus that these skills are crucial for improving students' problem-solving abilities and preparing them for the demands of the 21st century

Discussion

The analysis of pre-service mathematics educators' perspectives on the current state of mathematics education in Niger State tertiary institutions indicates a clear consensus on the need for transformation. The majority of participants agreed that current teaching methods are outdated (M = 3.28), with traditional methods such as rote memorization being seen as limiting students' ability to think critically (M = 3.14). This aligns with findings by Okonkwo and Okechukwu (2022), who reported that a significant portion of students in Nigerian universities struggled to apply theoretical knowledge to practical tasks, primarily due to reliance on rote instruction. There was also strong support for the incorporation of modern technological tools in teaching (M = 3.45), with educators recognizing the importance of preparing students for global challenges (M = 3.48). These results are echoed by Oladipo and Tunde (2023), who found that students using digital tools like mathematical software showed enhanced motivation and problem-solving skills. However, there was a noticeable disagreement regarding whether students are adequately trained to apply mathematics to real-world problems, as reflected in the lower mean scores (M = 2.17 and M = 2.31). This concern is substantiated by Musa and Ibrahim's (2023) study, which showed that students taught with traditional methods underperformed in conceptual problem-solving compared to those taught with interactive approaches. Overall, the grand mean of 2.99 (SD = 0.71) underscores the consensus that reforms, particularly those involving student-centered and inquiry-based approaches, are necessary to make mathematics education more relevant and effective.

Further analysis into the transformation of teaching methods reveals broad agreement on the importance of change. Educators favored teaching methods that encourage creative problem-solving (M = 3.03, SD = 0.78) and supported the integration of project-based learning to connect mathematical concepts to real-world problems (M = 3.31, SD = 0.77). This view is consistent with Adeoye and Okafor's (2020) quasi-experimental findings, which demonstrated that inquiry-based learning significantly improves students' ability to reason mathematically and apply knowledge. There was a strong consensus in favor of shifting from teacher-centered to student-centered, inquiry-based learning (M = 3.34, SD = 0.48). Technological tools such as mathematical modeling software and simulations were also widely endorsed to enhance the learning experience (M = 3.48, SD = 0.50), reflecting trends

in Oladipo and Tunde's (2023) research on the benefits of educational technology in mathematics. Despite this, the mean score for replacing traditional lecture-based methods (M = 2.97, SD = 0.73) was slightly lower, suggesting some resistance to fully abandoning established teaching practices. This resistance could stem from a comfort with traditional methods or concerns about the feasibility of adopting new approaches. Additionally, respondents agreed that real-life scenarios and case studies help deepen students' understanding (M = 3.07, SD = 0.92), while integrating entrepreneurial thinking into the curriculum was considered essential for fostering innovation and creativity (M = 3.62, SD = 0.49). These perspectives align with UNESCO's (2022) global findings, which showed a positive impact of real-life and interdisciplinary learning on students' ability to address global and local issues. The overall grand mean of 3.24 (SD = 0.71) reflects strong support for transformative changes in teaching methods, emphasizing the need for innovative, engaging, and practical approaches to learning.

Finally, the analysis of pre-service educators' views on digital literacy and critical thinking in mathematics education reveals that these skills are seen as integral to preparing students for the modern world. There was broad agreement that digital literacy is essential for navigating a technology-driven society (M = 3.17, SD = 0.80), and that critical thinking is key to solving real-world problems (M = 3.00, SD = 0.80). Strong support was found for the integration of digital tools in education (M = 3.62, SD = 0.49), with respondents believing that these tools could significantly enhance problem-solving skills. This is reinforced by empirical evidence from Oladipo and Tunde (2023), who demonstrated that integrating technology in mathematics classrooms boosts student engagement and performance. The need to incorporate both digital literacy and critical thinking into the mathematics curriculum was widely acknowledged (M = 3.24, SD = 0.58), with many educators emphasizing the importance of addressing global challenges such as climate change (M = 3.17, SD = 0.89). This finding is consistent with UNESCO (2022), which reported improvements in systems thinking and sustainability awareness among students when such themes were embedded into mathematics education. Overall, the findings highlight a shared belief that these competencies are crucial for improving students' problem-solving abilities and preparing them for the demands of the 21st century.

In conclusion, the analysis highlights a strong consensus among pre-service mathematics educators in Niger State that reforms are essential to enhance the relevance and quality of mathematics education. The data suggests a need to move away from traditional, rote memorization-based approaches toward student-centered, inquiry-based methods that

incorporate technology and foster critical thinking. While there is some resistance to completely abandoning lecture-based teaching, the overall consensus supports a transformation that will better equip students to apply mathematical concepts in real-world scenarios and prepare them for global challenges. The empirical evidence further reinforces these conclusions, emphasizing the measurable benefits of reform-oriented, technology-driven, and application-focused instructional strategies in mathematics education.

Conclusion

This study establishes the need for urgent reform of university mathematics education in Niger State to better align with contemporary technological, economic, and sustainability demands. The findings reveal that existing curricula and pedagogical approaches are inadequate for cultivating essential higher order competencies such as creativity, critical thinking, and problem solving. The study therefore recommends a shift toward innovative, student centered instructional strategies and the purposeful integration of digital technologies to enhance learning relevance and interdisciplinary application. Such reforms are critical for preparing graduates to respond effectively to global challenges, meet evolving labour market expectations, and contribute meaningfully to innovation and sustainable development.

Recommendations

To advance the transformation of mathematics education in universities in Niger State, the following key recommendations are proposed:

1. Adopt student centered learning approaches that prioritize interactive, inquiry driven pedagogies to cultivate critical thinking and strengthen problem solving competencies.
2. Incorporate modern digital tools, such as mathematical software and simulations, to enhance learning and build digital literacy.
3. Use real-world scenarios and interdisciplinary projects to bridge theory with practical application.
4. Embed critical thinking and digital literacy across the curriculum to prepare students for modern challenges.
5. Foster creativity and innovation by integrating entrepreneurial principles into mathematics education.
6. Provide ongoing training for educators to stay updated on modern teaching methods and technologies.
7. Reduce the reliance on lecture-based methods and incorporate more interactive learning activities.

8. Shift from traditional exams to project-based and problem-solving assessments to better reflect students' capabilities.

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