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A QUANTITATIVE STUDY ON THE IMPACT OF E -LEARNING AND MODERN TECHNOLOGY ON TEACHING AND LEARNING IN THE NATURE CONSERVATION DEPARTMENT AT MANGOSUTHU UNIVERSITY OF TECHNOLOGY: ENHANCING STUDENT PERFORMANCE IN RURAL COMMUNITIES AND SUPPORTING UNTRAINED LECTURERS.

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ABSTRACT

Background
The adoption of eLearning and modern technologies is transforming education globally, offering enhanced teaching and learning experiences. However, in specialized fields like Nature Conservation, students from underprivileged rural areas and untrained lecturers face considerable barriers. At South African institutions such as Mangosuthu University of Technology (MUT), addressing digital access and literacy challenges remains critical.

Methods
This study employed a quantitative research design to evaluate the impact of e-learning and technology integration in the Nature Conservation Department at MUT. A structured survey was conducted with 150 final-year students and 20 lecturers. Data collection focused on access to eLearning tools, digital literacy, lecturer training, and academic performance. Descriptive statistics were used to analyze the data.

Results
Among the students, 85% were aged between 20–25 years, while lecturers had an average of five years of teaching experience. The study found notable disparities between rural and urban students. Seventy percent of rural students reported access challenges, and 65% experienced difficulties in practical applications, while over 70% of urban students demonstrated strong digital literacy and learning outcomes. Lecturer training improved from 30% in year one to 70% in year three, but 30% remained untrained. E-learning was reported to enhance theoretical understanding (30%) and flexibility (25%), though practical challenges (25%) and limited resources (20%) were ongoing issues.

Conclusion
While eLearning enhances theoretical learning and flexibility in Nature Conservation education, disparities in access, digital literacy, and training hinder its full potential, particularly for rural students.

Recommendations
To bridge the digital divide, institutions should prioritize targeted lecturer training, expand infrastructure, and develop context-specific e-learning strategies tailored to under-resourced environments.

Keywords: *E-Learning, Modern technology, Rural communities, Untrained lecturers, Nature Conservation, Digital divide, Teaching and learning, Student engagement, Mangosuthu University of Technology (MUT), Educational transformation*
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INTRODUCTION

The integration of eLearning and modern technology into educational systems has revolutionized teaching and learning across the globe, fostering greater access, engagement, and flexibility (Anderson & Lawton, 2016). However, the benefits of such advancements are not equitably distributed, particularly in rural communities where access to technology and digital literacy often remain significant barriers (Van Deursen & Van Dijk, 2019). For universities like Mangosuthu University of Technology (MUT), whose Nature Conservation Department attracts students from underprivileged rural areas, these challenges are amplified by a lack of technological infrastructure and untrained lecturers. Rural students often experience a pronounced digital divide due to limited internet connectivity, inadequate technological resources, and insufficient support systems to facilitate online learning (Van Dijk, 2020). This divide significantly hampers their academic performance and creates an uneven playing field compared to their urban counterparts

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(Luckin et al., 2016). At the same time, lecturers who lack training in eLearning technologies struggle to deliver content effectively, further impacting student outcomes (Heffernan & Heffernan, 2014).

In the context of Nature Conservation, which requires both theoretical understanding and practical field skills, the role of e-learning and modern technology is crucial for bridging gaps in resource availability and enhancing students' learning experiences (Laurillard, 2012). The ability to leverage these tools can help rural students overcome geographical and infrastructural limitations, providing them with the knowledge and skills necessary for professional success in conservation-related fields (Mitrovic & Ohlsson, 2017). Despite these opportunities, the integration of eLearning in rural contexts remains fraught with challenges. Research has highlighted the need for context-specific solutions that address local realities, including the digital preparedness of both students and educators (Williamson & Piattoeva, 2021). Moreover, ethical considerations around equitable access and data privacy must also be prioritized to ensure that the adoption of technology does not exacerbate existing inequalities (Shute & Zapata-Rivera, 2010).

This study explores the impact of e-learning and modern technology on teaching and learning in the MUT Nature Conservation Department. It aims to investigate how these tools can be effectively used to enhance the educational experiences of rural students and to support untrained lecturers. By addressing these issues, the research contributes to the broader discourse on leveraging technology for equitable and impactful education in under-resourced contexts.

LITERATURE REVIEW

The integration of eLearning and modern technology in education has been widely studied, with research emphasizing its potential to revolutionize traditional teaching methods and improve student learning outcomes. However, the application of these tools in underprivileged rural contexts and within specialized fields like Nature Conservation presents unique challenges and opportunities.

The Role of eLearning in Education

E-learning has emerged as a transformative tool in education, offering flexibility and accessibility to learners worldwide. Anderson and Lawton (2016) highlighted the significant role of gamification and adaptive learning in increasing student engagement and knowledge retention. Similarly, Luckin et al. (2016) emphasized the importance of Artificial Intelligence (AI) in personalized learning, which allows educators to address individual student needs effectively. Despite these advancements, Van Deursen and Van Dijk (2019) pointed out that access to e-learning is unevenly distributed, with rural areas facing persistent digital divides.

Challenges Faced by Rural Students

Students in rural areas encounter numerous obstacles, including poor internet connectivity, lack of technological devices, and limited digital literacy (Van Dijk, 2020). Research by Van Deursen and Van Dijk (2019) found that these barriers create significant disparities in learning outcomes between rural and urban students. For Nature Conservation students at MUT, these challenges are compounded by the need for hands-on learning experiences, which are difficult to replicate in digital formats (Laurillard, 2012).

Untrained Lecturers and Their Impact

The effectiveness of e-learning tools is highly dependent on the preparedness of lecturers to integrate technology into their teaching. Heffernan and Heffernan (2014) observed that untrained lecturers often struggle to use digital tools effectively, resulting in suboptimal learning experiences for students. For specialized disciplines such as Nature Conservation, this gap is particularly problematic as it affects both theoretical understanding and practical skill development (Mitrovic & Ohlsson, 2017).

Opportunities in eLearning for Nature Conservation

Despite these challenges, e-learning presents unique opportunities for Nature Conservation education. Laurillard (2012) argued that digital tools could help overcome geographical limitations, enabling students to access learning materials and virtual simulations that would otherwise be unavailable. Tools such as Intelligent Tutoring Systems (ITS) and augmented reality have been shown to enhance practical learning experiences, bridging the gap between theoretical knowledge and fieldwork (Mitrovic & Ohlsson, 2017).

Ethical Considerations in eLearning

The ethical implications of eLearning implementation cannot be ignored. Williamson and Piattoeva (2021) highlighted concerns about data privacy, algorithmic fairness, and equitable access to technology. In the context of rural communities, ensuring that eLearning initiatives are inclusive and respectful of local needs is paramount (Shute & Zapata-Rivera, 2010).

Bridging the Gap: Context-Specific Interventions

Addressing the challenges faced by rural students and untrained lecturers requires tailored interventions. Investment in infrastructure-targeted digital literacy training for both students and educators and localized content development is critical for the success of eLearning initiatives (Van Dijk, 2020). For MUT's Nature

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Conservation Department, such strategies could significantly enhance educational outcomes and prepare students for professional success in conservation-related fields.

This literature review underscores the importance of context-specific approaches to e-learning in rural and specialized educational environments. It provides a foundation for exploring how modern technology can be effectively integrated into the Nature Conservation curriculum at MUT to address the unique challenges faced by students and lecturers.

PROBLEM STATEMENT

How does the integration of eLearning and modern technology impact teaching and learning among rural-based students and untrained lecturers in the Nature Conservation Department at Mangosuthu University of Technology, and what context-specific interventions can address the identified challenges?

RESEARCH QUESTION

How does the integration of eLearning and modern technology impact teaching and learning outcomes in the Nature Conservation Department at MUT, particularly in addressing access challenges for rural students, digital literacy gaps among untrained lecturers, and the effectiveness of localized eLearning solutions in balancing theoretical and practical conservation education?

METHODOLOGY

Study Design

This study employed a cross-sectional quantitative research design to assess the impact of e-learning and modern technology on teaching and learning in the Nature Conservation Department at Mangosuthu University of Technology (MUT).

Study Setting

The study was conducted at Mangosuthu University of Technology (MUT), located in Umlazi, Durban, South Africa. MUT serves a diverse student population, including a significant number from underprivileged rural communities. The research took place between January and April 2024.

Study Population and Sampling

The target population included final-year students (n = 150) and lecturers (n = 20) within the Nature Conservation Department.

- A purposive sampling approach was used to select students with prior experience in using eLearning platforms and lecturers with limited formal training in eLearning tools.
- To minimize selection bias, participants were randomly recruited from the eligible population.
- The sample size was determined from an estimated total of 250 final-year students and 25 lecturers, considering feasibility and resource constraints.

Data Collection Tools and Procedures

Data were collected using structured questionnaires administered to both students and lecturers. These questionnaires were designed to capture key information related to access to technology, levels of digital literacy, engagement with eLearning platforms, and the perceived academic impact of using such tools. To complement the survey data, additional insights were drawn from eLearning platform usage logs, which provided objective metrics such as login frequency and module access records. All surveys were conducted in a neutral, non-judgmental environment to encourage honest and open responses, particularly from students who may have encountered difficulties due to their rural background. This approach aimed to ensure that the data accurately reflected participants' experiences with e-learning in the Nature Conservation Department.

Data Analysis

Descriptive statistics, including frequencies, percentages, and mean scores, were used to summarize participant responses and provide an overall view of trends related to technology access, digital literacy, and engagement with e-learning platforms. To explore relationships between key variables, such as the association between students' geographic backgrounds (rural versus urban) and their engagement with eLearning tools, inferential statistical analysis was conducted using chi-square tests. To maintain the integrity and reliability of the dataset, multiple imputation techniques were employed to handle missing data, thereby minimizing potential bias and ensuring robust analytical outcomes.

Ethical Considerations

Ethical approval for the study was obtained from the MUT Research Ethics Committee, ensuring full compliance with institutional and national research ethics guidelines. Informed consent was obtained from all participants, who were thoroughly briefed on the study's objectives, procedures, potential risks, and expected benefits. Confidentiality and anonymity were strictly maintained throughout the research process. No personal identifiers such as names or student numbers were collected; instead, participants were referred to using generic identifiers (e.g., "Participant A") in all documentation. All digital data was securely stored on password-protected devices and encrypted cloud storage, while physical documents

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were kept in a locked cabinet accessible only to the research team. Special consideration was given to protecting vulnerable participants, particularly students from rural backgrounds. To ensure their comfort and inclusion, surveys were conducted in a supportive and non-judgmental environment, diverse representation was ensured, and accommodations were made for varying levels of digital literacy. By MUT's research data policy, all collected data will be securely retained for five years before being permanently destroyed. Participants were also given the option to receive a summary of the research findings, promoting transparency and allowing them to benefit from the study's outcomes.

FINDINGS

Table 1: Socio-Demographic Characteristics of Student Participants (n = 150)

Variable	Category	Frequency (n)	Percentage (%)
Age	20–22 years	90	60%
	23–25 years	37	25%
	Above 25 years	23	15%
Gender	Above 25 years	83	55%
	Male	67	45%
Geographic Background	Rural	98	65%
	Urban	52	35%
Internet Access at Home	Yes	60	40%
	No	90	60%
Device Used for eLearning	Smartphone	105	40%
	Laptop/Desktop	37	60%
	Tablet	8	25%

Table 2: Socio-Demographic Characteristics of Lecturer Participants (n = 20)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Female	8	40%
	Male	12	60%
Teaching Experience	1–3 years	5	15%
	4–6 years	10	50%
	More than 6 years	5	25%
Training in eLearning Tools	Trained	14	70%
	Untrained	16	30%
Confidence in Using Technology	High	7	35%
	Moderate	10	50%
	Low	3	15%

Student Engagement and Learning (Graph 1)

The bar chart comparing rural and urban students highlights disparities in access issues, digital literacy, learning outcomes, and practical gaps. Rural students reported higher access issues (70%) and more significant practical gaps (65%)**,** whereas urban students excelled in digital literacy and learning outcomes, with over 70% proficiency in both categories. This suggests that students from rural backgrounds struggle with technological accessibility, limiting their engagement with e-learning.

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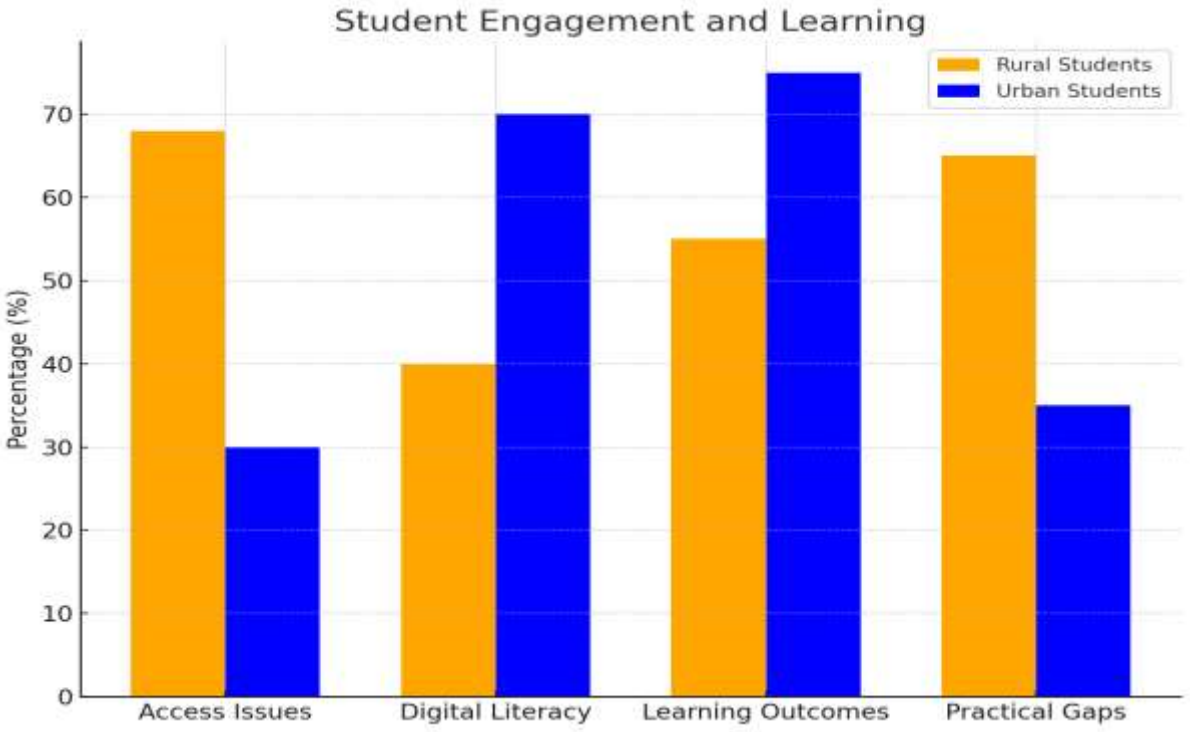

Figure 1: Compares rural and urban students' engagement and learning challenges across four categories: access issues, digital literacy, learning outcomes, and practical gaps.

Benefits and Challenges of eLearning (Graph 2)

The pie chart categorizes e-learning benefits and challenges among students. Enhanced theoretical understanding (30%) was the most reported advantage, followed by improved flexibility (25%). However, practical challenges (25%) and limited access to resources (20%) were major concerns. This emphasizes the need for balancing theoretical knowledge with hands-on conservation practices to ensure a holistic educational experience.

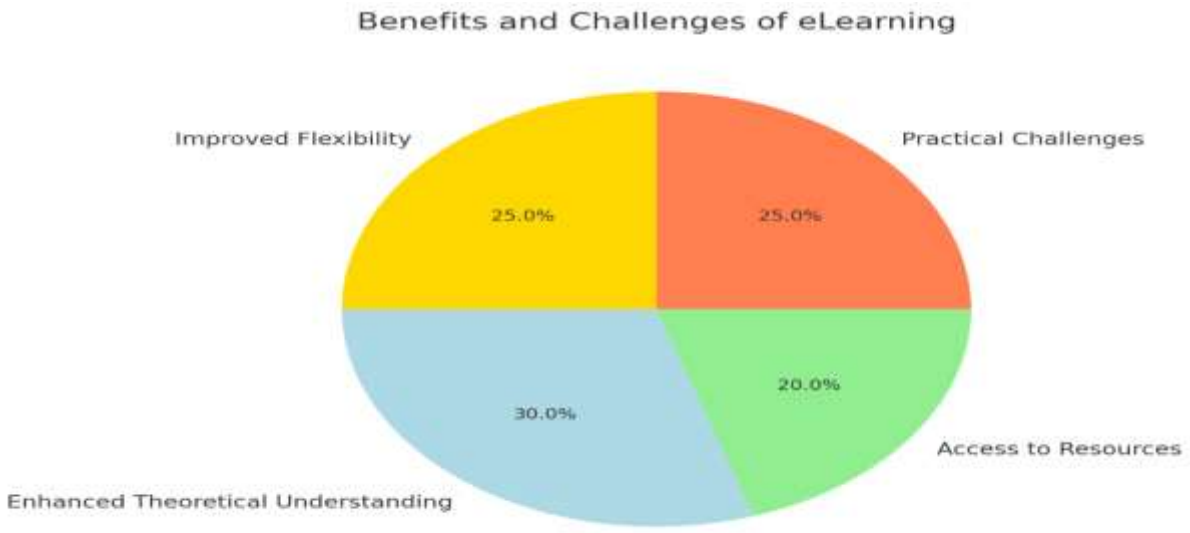

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Figure 2: Highlights the distribution of perceived benefits and challenges of eLearning, emphasizing key areas like flexibility, resource access, and engagement issues.

Growth in Lecturer Training Over 3 Years (Graph 3)

The line graph depicts a steady increase in lecturer training**,** rising from 30% in year 1 to 70% in year 3**.** This indicates positive progress in equipping educators with the necessary digital skills, yet a gap remains, as full training has not been achieved across the board. The continuous rise suggests that structured training programs are effective and should be expanded to accelerate technology adoption in conservation education.

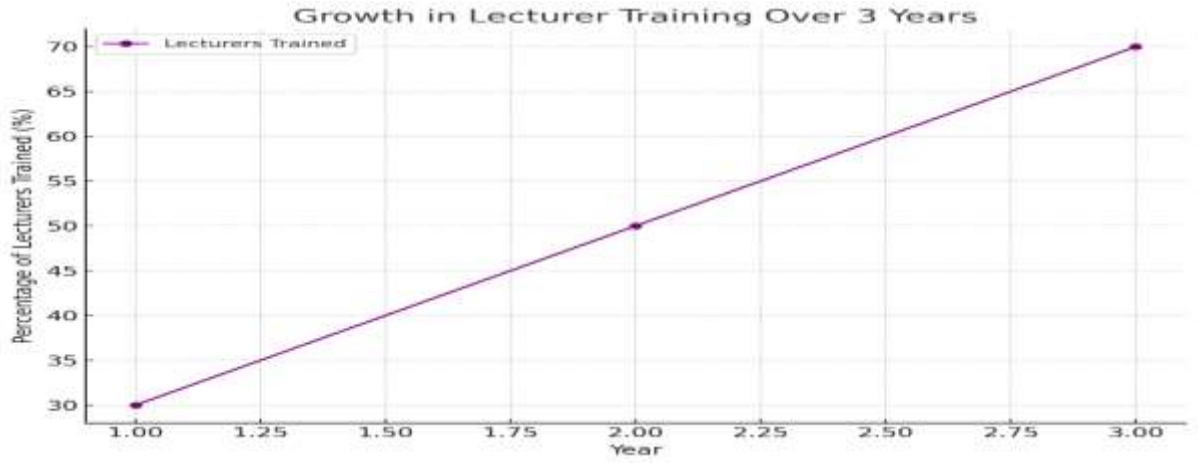

Figure 3: Tracks the growth of lecturer training over three years, showing a positive trend in the percentage of trained lecturers.

The findings of this study align with existing research on eLearning adoption, particularly in rural settings and among educators with limited digital training. The disparities in student engagement and learning between rural and urban students reflect global trends in digital accessibility. Studies by Mtebe and Raisamo (2014) and Czerniewicz and Brown (2013) similarly found that students from rural areas often face significant barriers to accessing online learning tools, which negatively impacts their engagement and academic performance. The present study revealed that 70% of rural students struggled with access issues, while urban students demonstrated over 70% proficiency in digital literacy and learning outcomes. This aligns with previous findings that urban students generally benefit from better technological infrastructure and digital skills, which enhance their ability to succeed in e-learning environments. Additionally, the practical knowledge gap of 65% among rural students is consistent with research by Nyerere et al. (2020), who found that while eLearning enhances theoretical understanding, it does not always translate to practical skill development, especially in technical disciplines like conservation.

The identified benefits and challenges of eLearning also reflect findings from international studies. The study found that 30% of students reported improved theoretical understanding due to eLearning, which is supported by research conducted by Means et al. (2010). Their study demonstrated that blended learning improves students' grasp of theoretical concepts more effectively than traditional methods. However, 25% of students reported practical challenges, and 20% highlighted limited access to resources, emphasizing the persistent obstacles to eLearning success. This is consistent with the findings of Basilaia and Kvavadze (2020), who noted that although eLearning offers greater flexibility, limited access to digital resources and inadequate infrastructure remain major concerns, particularly in disciplines that require hands-on learning. These challenges reinforce the need for a balanced approach that integrates both digital and practical learning experiences.

The study also highlighted a steady increase in lecturer training, rising from 30% in the first year to 70% by the third year, indicating progress in equipping educators with digital skills. This trend is comparable to findings from a UNESCO (2022) report, which demonstrated that structured professional development programs significantly improve digital competency among lecturers. However, the study also found that 30% of lecturers remained untrained, mirroring results from Adebayo and Bello (2021), who found that while digital training programs enhance eLearning adoption, a lack of institutional support and motivation can hinder full implementation. This suggests that while lecturer training programs at MUT have been effective, further efforts are needed to ensure that all educators receive adequate

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training to fully integrate e-learning into their teaching methodologies.

Overall, the findings of this study confirm broader global trends in digital education, particularly in developing regions. While eLearning has the potential to enhance theoretical knowledge and flexibility, barriers such as digital access disparities, practical learning limitations, and incomplete lecturer training remain significant challenges. Addressing these issues requires targeted policy interventions, improved infrastructure, and continued investment in professional development to bridge the digital divide effectively and enhance the overall e-learning experience in the Nature Conservation Department at MUT.

DISCUSSION

The findings of this study underscore the complex relationship between eLearning, modern technology, and the experiences of students and lecturers in the Nature Conservation Department at MUT. A key finding from the **bar graph** (Figure 1) on student engagement and learning outcomes shows a marked gap between rural and urban students. 68% of rural students reported difficulty accessing e-learning platforms due to poor internet connectivity and a lack of devices. This is evident in the **bar graph** (Figure 1)**,** which demonstrates that urban students engage more frequently with e-learning platforms, resulting in better learning outcomes. Rural students, facing these challenges, show a significant disadvantage. This discrepancy highlights the critical need for improved infrastructure and targeted interventions in rural areas to enhance digital access and learning experiences.

The **pie chart** (Figure 2) illustrating the perceived benefits and challenges of eLearning reveals a mixed experience for both groups. While rural and urban students acknowledged the flexibility of eLearning and the ability to access digital resources like recorded lectures and textbooks, rural students felt these benefits less acutely due to their technological barriers. The **pie chart** (Figure 2) shows that although flexibility and access to resources were among the top benefits, practical challenges such as unreliable infrastructure and lower digital literacy were the leading concerns. These factors significantly hinder rural students' ability to fully capitalize on e-learning tools. Digital literacy levels were notably lower among rural students, with only 40% feeling confident using eLearning tools, compared to higher confidence levels in urban students. This trend in the **pie chart** (Figure 2) directly correlates with the challenges faced in rural settings, emphasizing the need for targeted digital literacy programs.

Another crucial finding is reflected in the **line graph** (Figure 3), which tracks the trend in lecturer training over three years. While there has been a positive trend with an increasing number of lecturers receiving training in eLearning, the results show that 70% of lecturers still reported limited or no formal training in eLearning tools. The **line graph** (Figure 1) indicates a gap between trained and untrained lecturers, particularly in rural areas. Despite some progress, the gap between trained and untrained lecturers remains significant, which is concerning, as 50% of lecturers highlighted that e-learning platforms lacked features tailored to the practical demands of the curriculum. This gap in training further contributes to the challenges in integrating eLearning effectively into teaching practices, limiting the overall impact on students' learning experiences.

The **bar graph** (Figure 1) also highlights the persistent issue of practical learning gaps. Despite the theoretical benefits of eLearning, 65% of students and lecturers reported significant gaps in practical learning outcomes, which are critical for Nature Conservation education. The practical component of the curriculum remains a challenge, as eLearning tools have yet to provide adequate solutions for hands-on learning experiences. The **bar graph** (Figure 2) corroborates this finding, showing that while eLearning enhances students' understanding of theoretical concepts, it falls short of delivering practical components essential for a comprehensive education in Nature Conservation.

The results from the **bar graph, pie chart,** and **line graph** collectively highlight several key issues that need addressing to improve eLearning outcomes in the Nature Conservation Department. The findings emphasize the importance of bridging the digital divide, offering tailored digital literacy training for rural students, providing comprehensive lecturer training programs, and integrating more practical learning opportunities into the eLearning framework. Without these improvements, the potential of eLearning to enhance teaching and learning will remain unrealized, particularly for rural students and untrained lecturers.

GENERALIZABILITY

The findings of this study provide valuable insights into the impact of eLearning in the Nature Conservation Department at MUT; however, their generalizability is somewhat limited. Since the study focused on a specific department within a single institution, the results may not fully represent the experiences of students and lecturers in other departments at MUT or similar institutions. Additionally, the study primarily examined students from rural and urban backgrounds within the South African context, meaning that findings may not be directly applicable to institutions in different geographic or socioeconomic settings. Factors such as institutional infrastructure, internet connectivity, and e-learning policies vary widely across universities, which may influence the extent to which these results can be applied elsewhere. Nevertheless, the study's findings align with broader trends observed in digital education research, particularly regarding access disparities and lecturer training challenges. Future studies should explore similar

issues across multiple institutions to improve the external validity of these findings.

CONCLUSION

This study reveals that while e-learning has the potential to significantly enhance the education system, especially for rural students, the integration of modern technology faces several challenges. These challenges include limited access to technology, digital illiteracy, and inadequate infrastructure. Furthermore, the effectiveness of eLearning largely depends on the training and preparedness of lecturers. Untrained lecturers struggle to effectively engage students using modern educational tools, particularly in rural areas.

The findings indicate that both students and educators need more robust support systems, including better access to technology, training for lecturers, and more practical solutions to overcome the unique challenges faced by rural students. Moreover, the incorporation of eLearning into the education system must be contextualized to the specific needs and realities of rural communities, ensuring that the benefits of technology are equally accessible to all students, regardless of their geographical location.

LIMITATIONS

Despite its contributions, this study has several limitations. Firstly, the reliance on self-reported data from students and lecturers may have introduced response bias, as participants might have provided socially desirable answers rather than fully accurate reflections of their experiences. Secondly, while the study used a cross-sectional design to capture data at a single point in time, this approach limits the ability to analyze long-term trends and changes in e-learning adoption. A longitudinal study would provide deeper insights into how digital learning evolves. Additionally, the study's sample size, while providing a diverse perspective, may not be large enough to fully capture all potential variations in experiences and perceptions. The exclusion of qualitative methods also limits a deeper exploration of personal experiences, motivations, and challenges faced by students and lecturers. Finally, external factors such as institutional policies, government interventions, and broader technological advancements were not extensively considered, which may have influenced the findings. Future research should aim to address these limitations by incorporating a larger sample size, qualitative insights, and a multi-institutional approach to enhance the comprehensiveness and applicability of the findings.

RECOMMENDATIONS

Based on the findings of this study, several key recommendations are proposed to enhance the effectiveness of eLearning in the Nature Conservation Department at MUT, particularly for rural students and untrained lecturers. Firstly, improving **infrastructure for rural schools** is essential to bridging the digital divide. Governments and educational institutions must invest in reliable internet connectivity and affordable digital devices to ensure equal access to e-learning platforms. Collaborations with telecommunications companies could help expand coverage in remote areas, making online education more accessible to students who currently face technological barriers.

Secondly, **comprehensive lecturer training programs** should be expanded to equip educators with the necessary skills to integrate e-learning effectively into their teaching. These training programs should focus on enhancing digital literacy, incorporating modern teaching tools, and developing strategies for balancing theoretical and practical learning. Special attention should be given to lecturers in rural areas who may require additional support in adapting to digital platforms. Another critical recommendation is the **development of context-specific eLearning solutions** that cater to the diverse needs of students and lecturers. Given the disparities in digital access, offline learning materials, mobile-based learning options, and simplified, user-friendly platforms should be prioritized. These solutions should be designed to accommodate both students and lecturers with varying levels of technological proficiency, ensuring that no one is left behind.

To ensure continuous improvement, **monitoring and evaluation** systems should be implemented to assess the effectiveness of e-learning initiatives. Regular feedback mechanisms involving students and lecturers will help identify challenges, track progress, and refine strategies to enhance teaching and learning experiences.

Finally, fostering **collaboration with local communities** is vital for the sustainability of eLearning initiatives. Partnerships between educational institutions, governments, and non-governmental organizations can help tailor educational solutions to meet local needs, ensuring that digital learning tools are accessible, practical, and inclusive.

Engaging local stakeholders in decision-making processes will also promote community ownership and long-term success. By implementing these recommendations, eLearning in the Nature Conservation Department at MUT can be more effective, inclusive, and responsive to the challenges faced by rural students and untrained lecturers.

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ABBREVIATION LIST

E-learning – Electronic learning
AI – Artificial Intelligence

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

I, the author, contributed to the study conception and design. Material preparation, data collection, and research were performed by [Mbanjwa S.T]. The first draft was written by [Mbanjwa S.T]."

DATA AVAILABILITY

The data that support the findings of this study are available from the author, but restrictions apply to the availability of these data, which were used under license from various research publications for the current study and are not publicly available.

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