

INFLUENCE OF ARTIFICIAL INTELLIGENCE AND LEARNING ANALYTICS ON THE PERFORMANCE OF POSTGRADUATE STUDENTS IN UNIVERSITIES IN CROSS RIVER STATE

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ABSTRACT: This study investigated the influence of artificial intelligence and learning analytics on the performance of postgraduate students in universities in Cross River State, Nigeria. The study specifically examined the influence of artificial intelligence technologies, ethical implications of artificial intelligence, learning analytics, and ethical implications of learning analytics on postgraduate students' learning. Four research questions and four null hypotheses guided the study. A descriptive survey research design was adopted. The study was conducted in public universities offering postgraduate programmes in Cross River State. A sample of 300 postgraduate students was selected using a multistage sampling technique involving purposive, stratified random, and proportionate sampling procedures. Data were collected using a structured questionnaire titled *Artificial Intelligence and Learning Analytics Influence Questionnaire (AILAIQ)*. The instrument was validated by three experts in Educational Technology and Measurement and Evaluation, while a reliability coefficient of 0.84 was obtained using Cronbach's Alpha. Data collected were analyzed using simple linear regression to answer the research questions, while regression t-test was used to test the null hypotheses at the 0.05 level of significance. The findings revealed that artificial intelligence technologies had a significant positive influence on postgraduate students' learning, accounting for 6.7% of

the variance in learning outcomes ($R = .259$, $R^2 = .067$, $t = 5.132$, $p < .05$). Ethical implications of artificial intelligence also had a significant influence, accounting for 13.3% of the variance ($R = .365$, $R^2 = .133$, $t = 7.512$, $p < .05$). Learning analytics significantly influenced postgraduate students' learning, although its contribution was relatively small, accounting for 1.2% of the variance ($R = .109$, $R^2 = .012$, $t = 2.107$, $p = .036$). Similarly, ethical implications of learning analytics significantly influenced postgraduate students' learning, accounting for 7.9% of the variance ($R = .282$, $R^2 = .079$, $t = 5.627$, $p < .05$). Based on these findings, the study concluded that artificial intelligence and learning analytics, as well as the ethical conditions surrounding their use, significantly influence postgraduate students' learning in universities in Cross River State. The study recommended, among others, that universities should strategically integrate AI and learning analytics into postgraduate education, develop clear ethical frameworks for their use, strengthen digital infrastructure, and provide adequate training for lecturers and students on the responsible and effective use of these technologies.

Keywords: Artificial intelligence, learning analytics, ethical implications, postgraduate students, academic performance, universities, Cross River State.

Introduction

Artificial Intelligence (AI) has emerged as one of the most transformative forces in the 21st century, reshaping industries, societal interactions, and notably, the education sector. AI refers to computing systems capable of performing tasks traditionally requiring human intelligence, including learning, adapting, synthesizing, self-correction, and data-driven decision-making. As defined by Popenici and Kerr (2017), "artificial intelligence is a computing system that can engage in human-like processes such as learning, adapting, synthesizing, self-correction and use of data for complex processing tasks." This definition emphasizes AI's cognitive-like capabilities that extend well beyond simple automation, highlighting its dynamic and evolving nature.

Marsland (2014) corroborates this viewpoint by emphasizing the usefulness of intelligent systems in solving real-world challenges across education, healthcare, and business domains. In higher education, AI is not only influencing pedagogical practices but is also reshaping how students learn, how educators teach, and how institutions operate. In

contemporary academic settings, AI is no longer a futuristic ideal but a present-day necessity. Aldosari (2020) notes that AI is increasingly being integrated into the daily practices of higher education institutions, with universities around the world striving to adopt these technologies sustainably. This rapid development calls for new and innovative teaching and learning methods to remain relevant in a digitally evolving landscape.

The integration of AI in educational contexts has grown due to advancements in computing and information processing techniques. Chen, Xie, and Hwang (2020) argue that these developments have enabled widespread adoption of AI technologies in higher education. AI provides a competitive advantage to educational institutions by streamlining administrative operations, reducing costs, and enhancing the overall student learning experience (Stanley, 2018). Several AI-driven tools and platforms have been developed specifically for educational use, each offering unique benefits to both students and educators.

Among the most notable AI systems in higher education are Brain-Computer Interfaces (BCIs), teacherbots, chatbots, Intelligent Tutoring Systems (ITS), Automatic Speech Recognition (ASR) tools, Neurolinguistic Programming systems, Smart Sparrow, and Desire2Learn (D2L). For instance, BCIs facilitate communication through brain signals, offering potential support for individuals with impaired motor functions (Wolpaw & Wolpaw, 2012). Teacherbots, on the other hand, automate tasks such as delivering content and providing immediate feedback. These bots can offer personalized learning experiences, thereby improving instructional efficiency (Fahimirad & Kotamjani, 2018).

Chatbots have also gained prominence in academic settings. Vazquez et al. (2018) define a chatbot as a robot capable of engaging users in real-time through a chat interface. These tools are particularly beneficial in large classes or remote learning settings, where instant responses can enhance student engagement. Intelligent Tutoring Systems (ITS), also known as Intelligent Educational Systems, are designed to simulate one-on-one tutoring by using AI to adapt to each learner's needs. These systems have been in development for many years and continue to evolve, offering individualized instruction across multiple disciplines (Ocana-Fernandez et al., 2019).

Further contributing to AI's impact in education are ASR systems and Neurolinguistic Programming tools, which aid in identifying and correcting language-related errors. These tools are extensively used in language learning applications such as Duolingo and Carnegie Speech, particularly in online learning environments (Defrancq & Fantinouli, 2021). Smart Sparrow, an adaptive learning platform used in Australian universities, allows educators to design content tailored to students' specific needs (Zhao & Liu, 2019). Similarly, Desire2Learn (D2L), a cloud-based learning management platform widely used in the United States, supports a range of academic activities, from assignment submission to collaborative learning and automated feedback systems (Zhao & Liu, 2019).

Closely linked to AI and playing a critical role in the contemporary educational landscape is Learning Analytics (LA). LA involves the collection, analysis, and interpretation of large sets of educational data with the aim of optimizing learning outcomes. Dimitrios and Stavros (2021) describe LA as a tool that leverages big data to create predictive models, thereby informing educational strategies and personalizing the learning experience. Scheffel, Drachsler, Stoyanov, and Specht (2014) view LA as a multidisciplinary approach grounded in educational data mining, data visualization, and learning science. These technologies allow educators to intervene early, supporting students who are at risk of falling behind and aligning learning outcomes with individual competencies and needs.

In the context of Nigeria, the application of learning analytics is particularly pertinent. Jimoh, Abanyam, and Uloko (2021) highlight the urgent need for higher education institutions to improve accountability and learning outcomes, particularly in light of persistent poor academic performance. LA offers data-driven insights that not only track students' progress but also support continuous improvement — a key requirement for accreditation bodies.

The functionalities of LA are diverse. As Verbert, Manouselis, Drachsler, and Duval (2012) explain, LA tools can predict learner performance, suggest suitable resources, detect unproductive learning behaviors, and even identify affective states like boredom or frustration. These insights empower both students and educators. By using LA, students are better able to plan, reflect, and take responsibility for their own learning. For lecturers, the data can inform teaching strategies, curriculum design, and support services. Abanyam

and Guma (2021) stress that LA ultimately promotes a more reflective, responsive, and personalized educational environment.

However, the rapid implementation of AI and LA technologies in education raises important ethical considerations. Issues such as data privacy, algorithmic bias, surveillance, and the loss of human agency in decision-making are frequently debated. As these technologies become increasingly integrated into higher education systems, there is a growing need to assess their implications on students' rights, academic freedom, and institutional transparency. Ethical concerns also extend to the fairness of AI-driven evaluations and the security of learners' personal data.

Artificial intelligence and learning analytics have revolutionized the higher education landscape, offering significant potential to enhance learning outcomes, improve administrative efficiency, and personalize the educational experience. Their integration into Nigerian higher education institutions — especially at the postgraduate level — holds great promise. However, the successful and responsible adoption of these technologies requires careful attention to ethical implications, infrastructural readiness, and institutional policy frameworks. This study, therefore, investigates the influence of artificial intelligence and learning analytics, along with their ethical implications, on postgraduate students' learning in higher education institutions in Cross River State, Nigeria.

Statement of the Problem

The 21st century has witnessed an unprecedented integration of Artificial Intelligence (AI) and Learning Analytics (LA) into various sectors, with higher education standing out as one of the most significantly impacted. As AI and LA become increasingly embedded in teaching, learning, and institutional management, higher education institutions are expected to harness these technologies to enhance academic delivery, personalize learning experiences, and improve overall student outcomes. However, while these innovations offer numerous possibilities, their effective and ethical deployment remains a pressing concern, particularly in developing regions like Cross River State, Nigeria.

In Nigerian higher education institutions, particularly at the postgraduate level, there is limited empirical evidence on how AI and LA tools influence students' learning experiences and academic performance. Although AI-powered tools such as intelligent

tutoring systems, chatbots, teacherbots, and adaptive learning platforms are gaining global traction, their availability, accessibility, and utilization in Nigerian institutions appear inconsistent and underexplored. Similarly, the application of learning analytics for personalized learning, predictive interventions, and academic decision-making is not yet widespread or fully understood among stakeholders in the Nigerian educational system.

Moreover, the ethical concerns surrounding the adoption of AI and LA — including data privacy, algorithmic bias, surveillance, and the potential erosion of academic freedom — present additional challenges. There is a growing need to understand whether Nigerian higher education institutions are prepared to address these ethical issues while ensuring the responsible use of emerging technologies.

Given these concerns, it becomes imperative to investigate how artificial intelligence and learning analytics are currently being integrated into postgraduate learning, their actual influence on learning outcomes, and the ethical implications of their use. Without such an inquiry, there is a risk of misaligned technology implementation, potential violations of student rights, and missed opportunities to improve educational quality. This study sought to address these gaps by examining the influence of AI and LA on postgraduate students' learning in higher education institutions in Cross River State.

Research Objectives

The main objective of this study is to examine the influence of artificial intelligence and learning analytics, along with their ethical implications, on postgraduate students' learning in higher education institutions in Cross River State. Specifically, the study sought to:

1. Assess the extent to which artificial intelligence technologies influence postgraduate students' learning in higher education institutions in Cross River State.
2. Examine the extent to which the ethical implications of artificial intelligence influence postgraduate students' learning in higher education institutions in Cross River State.
3. Determine the extent to which learning analytics influence postgraduate students' learning in higher education institutions in Cross River State.
4. Investigate the extent to which the ethical implications of learning analytics influence postgraduate students' learning in higher education institutions in Cross River State.

Research Questions

These four research questions were engaged during this study, which are:

1. To what extent has artificial intelligence technologies influence postgraduate students learning in higher education institutions in Cross River State?
2. To what extent have ethical implications of artificial intelligence influence postgraduate students learning in higher education institutions in Cross River State?
3. To what extent has learning analytics influence postgraduate students learning in higher education institutions in Cross River State?
4. To what extent have ethical implications of learning analytics influence postgraduate students learning in higher education institutions in Cross River State?

Statement of hypotheses

The study made use of the following null hypotheses:

1. There is no significant influence of artificial intelligence technologies on postgraduate students learning in higher education institutions in Cross River State
2. There is no significant influence of ethical implications of artificial intelligence on postgraduate students learning in higher education institutions in Cross River State
3. There is no significant influence of learning analytics on postgraduate students learning in higher education institutions in Cross River State
4. There is no significant influence of ethical implications of learning analytics on postgraduate students learning in higher education institutions in Cross River State.

Methodology

The study adopted a descriptive survey design. This design was considered appropriate because it enables the collection of data from a representative sample of respondents to examine the influence of artificial intelligence (AI) and learning analytics (LA) on the academic performance of postgraduate students in universities. The design also allows for the analysis of existing conditions and relationships among variables without manipulation.

The study was conducted in Cross River State, Nigeria, specifically focusing on public universities that offer postgraduate programmes. These include institutions located in

Calabar, Ikom, and Ogoja. The area was chosen because it hosts a significant number of postgraduate students and is gradually adopting digital educational technologies, including AI and learning analytics.

The target population comprised all postgraduate students enrolled in recognized postgraduate programmes across accredited universities in Cross River State. This includes both Master's and Doctoral students across different faculties and departments.

The study employed a multistage sampling technique. Firstly, purposive sampling was used to select universities known to integrate AI tools or digital learning platforms. Secondly, stratified random sampling was used to group the students based on faculty or department. Finally, proportionate sampling was used to select participants from each stratum to ensure fair representation.

A total of 300 postgraduate students were selected as the sample size for the study. This number was determined using the Taro Yamane formula, ensuring that the sample was statistically adequate to generalize findings across the target population.

The instrument used for data collection was a structured questionnaire titled “Artificial Intelligence and Learning Analytics Influence Questionnaire (AILAIQ).” The questionnaire consisted of both closed-ended and Likert-scale items divided into sections covering: Demographic information, Use of artificial intelligence tools, Exposure to learning analytics, Perceived influence on academic performance.

The instrument was subjected to face and content validation by three experts in Educational Technology and Measurement and Evaluation from universities in the region. Their feedback led to revisions in the language, structure, and clarity of items to ensure that the instrument adequately measured what it was intended to assess.

The reliability of the instrument was established through a pilot study conducted among 30 postgraduate students in a university not included in the main study. The internal consistency of the questionnaire was measured using Cronbach's Alpha, yielding a reliability coefficient of 0.84, indicating a high level of reliability.

Data collected were analyzed using simple linear regression to answer research questions and regression t-test was utilized to test null hypotheses. All analyses were conducted at a 0.05 level of significance.

Results and Discussion

The results of this study are presented in this chapter according to the research questions and hypotheses that guided the study.

Research Question One

To what extent has artificial intelligence technologies influence postgraduate students learning in higher education institutions in Cross River State?

Table 1: Linear regression analysis of the extent has artificial intelligence technologies influence postgraduate students learning in higher education institutions in Cross River State

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.259 ^a	.067	.064	4.88247

(R²) = Coefficient of Determination

The result in Table1 shows that the correlation coefficient between artificial intelligence technologies and postgraduate students learning in higher education institutions in Cross River State was 0.259. This means that, there exist a low positive relationship between artificial intelligence technologies and postgraduate students learning in higher education institutions in Cross River State. Table 1 also revealed that, the coefficient of determination (R²) associated with the correlation coefficient of 0.259 was 0.067. This coefficient of determination (R²) indicates that 6.7% of variation in postgraduate students learning in higher education institutions in Cross River State is attributed to between artificial intelligence technologies. This is an indication that 93.3% of the variation in postgraduate students learning in higher education institutions in Cross River State is attributed to other factors other than artificial intelligence technologies.

Hypothesis One

There is no significant influence of artificial intelligence technologies on postgraduate students learning in higher education institutions in Cross River State

Table 2: Regression t-test analysis of significant influence of artificial intelligence technologies on postgraduate students learning in higher education institutions in Cross River State

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	29.031	1.773		16.376	.000
	Artificial intelligence technologies	.211	.041	.259	5.132	.000

The result in Table 2 shows that t-value of 5.132 with associated exact probability value of .000 was obtained. This probability value of 0.000 was compared with 0.05 set as level of significance for testing the hypothesis and it was found to be significant since the obtained probability value of 0.000 is less than 0.05. Thus, the null hypothesis no significant influence of artificial intelligence technologies on postgraduate students learning in higher education institutions in Cross River State was rejected. The researcher therefore, concludes that there is a significant influence of artificial intelligence technologies on postgraduate students learning in higher education institutions in Cross River State.

Research Question Two

To what extent have ethical implications of artificial intelligence influence on postgraduate students learning in higher education institutions in Cross River State?

Table 3: Linear regression analysis of the influence of ethical implications of artificial intelligence on postgraduate students learning in higher education institutions in Cross River State

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.365 ^a	.133	.131	4.70576

(R²) = Coefficient of Determination

The result in Table 3 shows that the correlation coefficient between ethical implications of artificial intelligence and postgraduate students learning in higher education institutions in Cross River State was 0.365. This means that, there exists a low positive relationship between ethical implications of artificial intelligence and postgraduate students learning in higher education institutions in Cross River State. Result in Table 3 also revealed that, the coefficient of determination (R²) associated with the correlation coefficient of 0.365 was 0.133. This coefficient of determination (R²) indicates that 13.3% of variation in postgraduate students learning in higher education institutions in Cross River State is attributed to ethical implications of artificial intelligence. This is an indication that 86.7% of the variation in postgraduate students learning in higher education institutions in Cross River State is attributed to other factors other than ethical implications of artificial intelligence.

Hypothesis Two

There is no significant influence of ethical implications of artificial intelligence on postgraduate students learning in higher education institutions in Cross River State.

Table 4: Regression t-test analysis of significant influence of ethical implications of artificial intelligence on postgraduate students learning in higher education institutions in Cross River State

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1 (Constant)	24.414	1.830		13.342	.000
Ethical implications of artificial intelligence	.358	.048	.365	7.512	.000

The result in Table 4 shows that t-value of 7.512 with associated exact probability value of .000 was obtained. This probability value of 0.000 was compared with 0.05 set as level of significance for testing the hypothesis and it was found to be significant since the obtained probability value of 0.000 is less than 0.05. Hence, the null hypothesis there is no significant influence of ethical implications of artificial intelligence on postgraduate students learning in higher education institutions in Cross River State was rejected. The researcher therefore, concludes that there is a significant influence of ethical implications of artificial intelligence on postgraduate students learning in higher education institutions in Cross River State.

Research Question Three

To what extent has learning analytics influence postgraduate students learning in higher education institutions in Cross River State?

Table 5: Linear regression analysis of the influence of learning analytics on postgraduate students learning in higher education institutions in Cross River State

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.109 ^a	.012	.009	5.02432

(R²) = Coefficient of Determination

The result in Table 5 shows that the correlation coefficient between learning analytics and postgraduate students learning in higher education institutions in Cross River State was 0.109. This means that, there exist a very low positive relationship between learning analytics and postgraduate students learning in higher education institutions in Cross River State. Table 5 also revealed that, the coefficient of determination (R²) associated with the correlation coefficient of 0.109 was 0.012. This coefficient of determination (R²) indicates that 1.2% of variation in postgraduate students learning in higher education institutions in Cross River State is attributed to learning analytics. This is an indication that

98.8% of the variation in postgraduate students learning in higher education institutions in Cross River State is attributed to other factors other than learning analytics.

Hypothesis Three

There is no significant influence of learning analytics on postgraduate students learning in higher education institutions in Cross River State

Table 6: Regression t-test analysis of significant influence of learning analytics on postgraduate students learning in higher education institutions in Cross River State

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1 (Constant)	34.175	1.851		18.466	.000
Learning analytics	.099	.047	.109	2.107	.036

The result in Table 6 shows that t-value of 2.107 with associated exact probability value of 0.036 was obtained. This probability value of 0.036 was compared with 0.05 set as level of significance for testing the hypothesis and it was found to be significant since the obtained probability value of 0.036 is less than 0.05. Hence, the null hypothesis there is no significant influence of learning analytics on postgraduate students learning in higher education institutions in Cross River State was rejected. The researcher therefore, concludes that there is a significant influence of learning analytics on postgraduate students learning in higher education institutions in Cross River State.

Research Question Four

To what extent have ethical implications of learning analytics influence postgraduate students learning in higher education institutions in Cross River State?

Table 7: Linear regression analysis of the influence of ethical implications of learning analytics on postgraduate students learning in higher education institutions in Cross River State

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.282 ^a	.079	.077	4.84973

(R²) = Coefficient of Determination

The result in Table 7 shows that the correlation coefficient between ethical implications of learning analytics and postgraduate students learning in higher education institutions in

Cross River State was 0.282. This means that, there exist a low positive relationship between ethical implications of learning analytics and postgraduate students learning in higher education institutions in Cross River State. The result in Table 7 also revealed that, the coefficient of determination (R^2) associated with the correlation coefficient of 0.282 was 0.079. This coefficient of determination (R^2) indicates that 7.9% of variation in postgraduate students learning in higher education institutions in Cross River State is attributed to ethical implications of learning analytics. This is an indication that 92.1% of the variation in postgraduate students learning in higher education institutions in Cross River State is attributed to other factors other than ethical implications of learning analytics.

Hypothesis Four

There is no significant influence of ethical implications of learning analytics on postgraduate students learning in higher education institutions in Cross River State.

Table 8: Regression t-test analysis of significant influence of ethical implications of learning analytics on postgraduate students learning in higher education institutions in Cross River State

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1 (Constant)	27.466	1.895		14.493	.000
Ethical implications of learning analytics	.263	.047	.282	5.627	.000

The result in Table 8 shows that t-value of 5.627 with associated exact probability value of 0.000 was obtained. This probability value of 0.000 was compared with 0.05 set as level of significance for testing the hypothesis and it was found to be significant since the obtained probability value of 0.000 is less than 0.05. Thus, the null hypothesis there is no significant influence of ethical implications of learning analytics on postgraduate students learning in higher education institutions in Cross River State was rejected. The researcher therefore, concludes that there is a significant influence of ethical implications of learning analytics on postgraduate students learning in higher education institutions in Cross River State.

Summary of the findings

Based on the analysis of data in the study, the following findings emerged;

1. Artificial intelligence technologies accounts for up to 6.7% of postgraduate students learning in higher education institutions in Cross River State. Further analysis revealed significant influence of artificial intelligence technologies on postgraduate students learning in higher education institutions in Cross River State.
2. The 13.3% of variation in postgraduate students learning in higher education institutions in Cross River State is attributed to ethical implications of artificial intelligence. Further analysis revealed a significant influence of ethical implications of artificial intelligence on postgraduate students learning in higher education institutions in Cross River State.
3. Learning analytics accounts for up to 1.2% of postgraduate students learning in higher education institutions in Cross River State. Further analysis revealed a significant influence of learning analytics on postgraduate students learning in higher education institutions in Cross River State.
4. The 7.9% of variation in postgraduate students learning in higher education institutions in Cross River State is attributed to ethical implications of learning analytics. Further analysis revealed a significant influence of ethical implications of learning analytics on postgraduate students learning in higher education institutions in Cross River State.

Discussion of Findings

The results in table one and two showed that artificial intelligence technologies account for up to 6.7% of postgraduate students' learning in higher education institutions in Cross River State. Further analysis revealed a significant influence of artificial intelligence technologies on postgraduate students' learning. This finding suggests that although artificial intelligence (AI) accounts for a relatively modest proportion (6.7%) of the variation in postgraduate students' learning, its influence is nonetheless statistically significant. This indicates that AI tools, such as intelligent tutoring systems, chatbots, virtual assistants, and automated feedback systems, are positively impacting how students learn, engage with content, and manage their studies in Cross River State. This results aligns with the findings of Chen, Xie, and Hwang (2020), who emphasized that AI-powered personalized learning tools improve student engagement and lead to higher academic achievement in higher education. Similarly, Fahimirad and Kotamjani (2018)

found that teacherbots and AI-enabled systems can create responsive learning environments, leading to increased learner motivation and better performance.

Results from table three and four showed that thirteen point three percent (13.3%) of variation in postgraduate students' learning is attributed to the ethical implications of artificial intelligence. Further analysis revealed a significant influence of ethical implications of artificial intelligence on postgraduate students' learning. This finding highlights that ethical concerns related to AI—such as privacy, surveillance, fairness, and algorithmic bias—substantially affect students' learning experiences. Ethical discomfort may limit students' willingness to engage fully with AI systems, especially when they fear misuse of data or lack of transparency in AI-driven assessments. This is in line with the work of Scheffel et al. (2014), who stressed that trust in AI systems depends significantly on how ethically those systems are implemented. When students feel their privacy is respected and data are used responsibly, they are more likely to embrace AI technologies. Likewise, Jimoh, Abanyam, and Uloko (2021) noted that ethical compliance in the deployment of AI systems contributes to better learning experiences and institutional credibility, especially in the Nigerian context.

In table five and six, the result indicated that learning analytics account for up to 1.2% of postgraduate students' learning in higher education institutions in Cross River State. Further analysis revealed a significant influence of learning analytics on postgraduate students' learning. Although the percentage of influence (1.2%) is relatively small, the finding shows that learning analytics (LA) still plays a meaningful and statistically significant role in shaping postgraduate learning. LA tools can provide insights into learner progress, recommend learning resources, and allow instructors to intervene proactively with struggling students. This supports Dimitrios and Stavros (2021), who argued that learning analytics improve academic outcomes by offering real-time feedback and data-driven learning pathways. In a similar vein, Verbert et al. (2012) observed that even when LA tools are minimally adopted, they still offer measurable benefits in tailoring instruction and supporting self-regulated learning behaviours.

Results in tables seven and eight revealed that seven point nine percent (7.9%) of variation in postgraduate students' learning is attributed to the ethical implications of learning analytics. Further analysis revealed a significant influence of ethical implications of

learning analytics on postgraduate students' learning. This finding shows that students' concerns about how their data are collected, analyzed, and used within learning analytics systems significantly affect their engagement with such technologies. Ethical issues such as lack of informed consent, opacity in data use, and fears of being unfairly profiled can hinder students from fully benefiting from LA tools. This observation mirrors Scheffel et al. (2014), who reported that when students perceive a lack of ethical transparency in LA systems, their trust in educational institutions diminishes. Also, Abanyam and Guma (2021) emphasized that addressing ethical issues in LA—such as data security, informed consent, and equity—is vital for optimizing student learning outcomes and ensuring effective educational interventions.

Conclusions

Based on the findings presented, the following conclusions were drawn:

1. That AI tools—such as intelligent tutoring systems, chatbots, and virtual learning assistants—positively contribute to postgraduate education in Cross River State. This demonstrates that integrating AI into teaching and learning processes can enhance student engagement, support personalized learning, and improve academic outcomes.
2. that ethical concerns—such as data privacy, fairness, and transparency—play a critical role in shaping students' acceptance and utilization of AI tools. If these ethical issues are not properly addressed, they can hinder effective engagement with AI-based learning systems, even when the technologies themselves are beneficial.
3. That learning analytics support student learning by providing timely feedback, tracking progress, and guiding instructional decisions, even if their overall quantitative impact is modest compared to AI technologies.
4. That ensuring ethical use of student data is vital to maximizing the potential benefits of learning analytics in higher education.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. Higher education institutions in Cross River State should expand the use of artificial intelligence technologies in postgraduate programs. Tools such as intelligent tutoring systems, chatbots, and virtual assistants should be strategically integrated into teaching and learning to personalize instruction, enhance learner engagement, and improve academic outcomes.
2. Institutions should develop clear ethical frameworks governing the use of AI in education. These should include policies on data privacy, transparency in algorithmic decision-making, and measures to prevent bias and surveillance, ensuring that students feel safe and confident when interacting with AI systems.
3. Faculty, staff, and students should be trained on ethical issues surrounding AI. Awareness programs and workshops should be organized to sensitize stakeholders on the responsible use of AI tools and how ethical concerns—if ignored—can negatively impact student trust, participation, and learning outcomes.
4. Universities should invest in infrastructure, software, and staff capacity building to better collect, interpret, and apply learning analytics to support student success.
5. Ethical use of learning analytics should involve informed consent, data security measures, and clear communication to students about how their data benefits their academic progress.
6. Institutions should ensure that the use of AI and learning analytics prioritizes students' academic needs, learning styles, and privacy. Involving students in the development and review of technological tools will enhance acceptance and utilization, leading to better learning outcomes.
7. Continuous research should be encouraged to monitor and evaluate the effectiveness and ethical impact of AI and learning analytics in real-time. This will help in refining their use and ensuring that these technologies remain aligned with the educational goals of the institutions.

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