MODERN TECHNOLOGIES APPLICATION AND STUDENTS' ACADEMIC PERFORMANCE IN TOURISM STUDIES IN TERTIARY INSTITUTIONS IN CROSS RIVER STATE, NIGERIA

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ABSTRACT

The study examined modern technologies application and student's academic performance in tourism studies in tertiary institutions in Cross River State, Nigeria. The independent variables (Modern technology applications) examined were cloud and edge computing and artificial intelligence while the dependent variable was students' academic performance. To achieve the purpose of the study, two hypotheses were formulated respectively to guide the study. Review related literature was based on the sub-variables of the study. The research design adopted for this study was correlational research design. Three hundred and eighty-one tourism studies students from three universities were selected using the purposive sampling technique. Two instruments the questionnaire and Students' Academic Performance Test in Tourism Studies were used for data collection. The face validity was established by using one expert in Environmental Education and two expert in measurement and evaluation in the Faculty of Educational Foundations Studies, University of Calabar. The reliability of the instruments were done using Cronbach Alpha reliability and Kuder-Richardson 21 and the instruments yield a reliable co-efficient estimate ranging from .72 to .91. Simple linear regression was used as statistical tool for data analysis. Each of the hypothesis was tested at .05 level of significance. The findings revealed that cloud and edge computing and artificial intelligence (AI) have relationship with academic performance of tourism students in the universities. Based on the findings of the study, it was recommended amongst others that educational institutions should prioritize the development of ICT infrastructure and resources to support the adoption and implementation of technology applications in tourism studies.

Key words: Modern technologies application, cloud and edge computing, artificial intelligence and students' academic performance

INTRODUCTION

The rapid advancement of modern technologies is transforming sectors and education is no exception. It is recognized that conventional learning resources can no longer meet the needs of our teaching and learning process. As a result, they are replaced by instructional technology. These technologies provide a learning environment that is self-paced, learner controlled, individualized, provides real world experiences, and equip students and teachers with the digital literacy skills needed for the 21st century. Universities across the globe are investing huge resources in technologies with research findings showing that academic performance of students are not only

tied to intellectual ability but other influencing factors such as learning resources. This shows that there is a direct relationship between the application of information and communication technology and student's academic performance of the undergraduates.

Technology has revolutionized educational methodologies, providing various tools and online platforms that enhance student's teaching and learning experiences, it allows for a more interactive and engaging learning environment when information is transmitted and actively constructed by the students (Thaktor, 2020). According to Surmelioglu and Seferoglu (2019), information communication technology has the ability to expand access to education while also increasing its relevance and quality. Wakil, (2019) argued that information communication technology has a profound effect on education in terms of knowledge acquisition and absorption for both instructors and students by promoting active learning, collaborative learning which promotes contact and collaboration between students and their teachers regardless of their geographical location. Additionally, it allows students to interact with individuals from many cultures and work in groups; which helps develop their conversational skills and global awareness and creative learning which supports the alteration of pre-existing data and the creation of one's own knowledge in order to generate a concrete product or to accomplish a specific educational goal. The first is connectivity capabilities, where digital-based technology make it easier for learners to get information or study materials. The second area, learning, involves interactions, which offer a variety of teaching methods that use media to improve the quality of learning. The third area, learning, is adapted to the needs of the individual, which allows the learning stage to adjust according to the student's situation, needs, and environments.

Technological advances in the view of Obarisiagbon (2018) assert that in the 21st century, technologies play a great role in the actualization of most activities like learning. Learning in the educational sector, requires a critical thinking/assimilation process with the availability of the required tools for learning as students now prefer the use of modern technologies in getting positive impact on learning. It was also revealed that information and communication technologies (ICT) have revolutionized how materials are presented to students presenting a more innovative approach (Riedmann, 2024). Modern technological applications use hardware such as personal computers, laptops, the internet and devices as a learning medium which have enhance academic performance.

The cloud and edge computing technology involves accessing computing services over the internet from vast, centralized data centers owned by the third-party provider. This technology connects objects generate data that is transferred to the cloud and subsequently stored. This data is used to develop insights and logic, which is then fed back to the objects as required. While edge computing means pushing computing away from a centralized point, closer to the device, the 'edge' or periphery of a network. As such, rather than sending raw data back to a cloud or data center, the device generates action independently or sends already refined data to the network (Gartner 2020), cloud and edge computing provide enhanced real-time collaboration and immersive learning

experiences, improve accessibility, cost savings, scalability and efficiency for institutions and students.

Artificial intelligence (AI) is revolutionizing modern education. It is the capability of a machine to perform tasks that typically requires human intelligence, such as learning, reasoning, problem-solving and decision-making. Artificial intelligence uses various technologies, including machine learning and natural language processing, to all computers and machines to stimulate human-like comprehension, perception, and autonomy. Artificial algorithms and educational robots are now integral to learning management and training systems providing supports for a wide array of teaching and learning. With this technology, teachers can develop their subject content logical and deliver their lesson effectively while students can make quick references and remain focus in the lesson.

However, despite the gradual increase in the application of modern technologies in higher educations, there are still many challenges facing its application. This study is interested in investigating the relationship between modern technologies and academic performance of under-graduate and post-graduate students of tertiary institutions in Cross River State offering tourism as a course.

LITERATURE REVIEW

Cloud and Edge Computing Application and Academic Performance.

Alfailakawi, (2021) studied the reality of the use of cloud computing in university education from the point of view of faculty members in Kuwait. Using the survey descriptive method and preparing the study tool of questionnaire to measure the reality of the use of cloud computing in university education, the researcher divided the tool into four areas: information management, second: digital cloud libraries, third: electronic archiving, fourth, digital repositories and scientific research. The tool was applied to the study sample of 258 members and faculty members of the College of Basic Education. The results showed that the computational averages ranged between(2.51-2.96),where digital cloud libraries came in first place with the highest computational average of (2.96),electronic archiving came in second with a mathematical average of (2.30), digital repositories and scientific research came in third place with a mathematical average of(2.28) ,while information management came in last place with a mathematical average of 2.21.The result shows that cloud computing promote teaching and learning process.

Achar, (2021) determined how students' use of cloud storage and collaboration, the number of hours spent studying, and academic success are related. K-means clustering was used to evaluate a sample of 408 students, and the results showed that there were three groups of students: those who performed well, those who performed averagely, and those who performed poorly. Higher cloud storage and collaboration use were shown to be positively related to improved academic achievement. Additionally, improved academic achievement was associated with longer study periods.

This implies that extending study time and employing cloud technologies will help pupils do better academically. It is advised that students utilize cloud storage and collaboration technologies to enhance their academic performance. They may also collaborate with peers using cloud-based technologies while working on group work. The promotion of cloud storage and cooperation in the classroom may also be greatly aided by teachers. Teachers may help students do better in classrooms by providing them with the information and skills they need to utilize cloud computing tools efficiently. It might be helpful for students to develop their cooperation and collaboration abilities to encourage them to work on group projects or assignments utilizing cloud computing collaboration technologies.

Muzaffar, Hussain, Ali, Ibrahim & Daniya, (2020) investigated the impact of cloud computing adaptation on academic performance and how cloud computing technology directly and indirectly impacting or facilitating the learning environment for students. The research supports the TAM (Technology Acceptance Model) Theory. Data was collected by using an electronic web-based questionnaire completed by 500 online respondents. For data collection, we have to use Partia1 Least Square (PLS), and Statistical Package examined data for Social Science (SPSS). In which three tests that are Reliability Test, Factor Analysis, and Regression Analyses method were used to analyze the priorities of explanation. A quantitative approach questionnaire has been used to collect the data from online respondents of Karachi. The research shows that cloud computing technology plays a crucial role in the e-learning field. Not only it increases efficiency in academic activities, but it also helps to work effectively. Within no time, students can share, store, and transfer their data information through various electronic devices. This study is initiated to investigate the cloud computing effects on academic activities or e-learning environment. The limitations of this research are sample size, which we have received is 500, which is limited for our study. In the present study, it was unable to approach to all the students of the university as the recent research is conducted only in Karachi city. The survey was undertaken solely by concentrating on how cloud computing affects academic performance. Still, the analysis can also be performed on how cloud computing technology can change the business sector or the corporate sector. We can focus on other variables as well in future researches. Amah, (2020) investigated the prospects of cloud technology and student's academic achievement in colleges of education in Imo State. Correlational survey design was adopted for the study in Imo State. The population of the study comprised of all Management staff. Lecturer and Student in Imo State. Non proportionate stratified sampling technique was used to select 10 Management,60 Lecturer,200Student from the study area and these gave the sample size of 270 respondents. The Main Instrument used in this study was a questionnaire titled "Prospects of Cloud Technology and Students' Academic Achievement in Colleges of Education Questionnaire" (PCTSAACEQ)". Face and content validation of the instrument was carried out by expert in test, measurement and evaluation from Imo State University to ensure that the instrument has the accuracy of study under consideration. Cronbach Alpha technique was used to determine the reliability of the instrument. The reliability coefficient obtained was 0.86 and this was high enough to justify the use of the instrument. The researcher subjected the data generated for this study to appropriate statistical techniques such as percentage analysis and simple regression. The

test for significance was done at 0.05alpha levels. The study concluded that the cloud technology is a set of active network services, providing scalability, quality of service, an inexpensive computing infrastructure which can be accessed in a simple and pervasive way. One of the recommendations made was that colleges should incorporate cloud computing technology in their everyday activity most especially the laboratory activities in order to help foster effective and comprehensive performance.

Artificial Intelligence Application and Academic Performance.

Aniella and Gabriel (2025) examine artificial intelligence (AI) on students' academic development in the National University of Science and Technology POLITEHNICA Buchavest. The sample consisted of l85 second-year students. A purposive, non-probabilistic sampling method was employed to ensure the selection of participants with direct experience in AI – integrated learning environments. This, enhancing the relevance of the findings. Data were collected using a self-administered questionnaire distributed via Google forms. This platform was chosen for its user-friendly interface and integrated analytical tools, which facilitate efficient data management and interpretation. The study utilized a mixed-methods design, incorporating both quantitative and qualitative data collection techniques. The questionnaire consisted of 11 items, categorized into two types of questions as follows; 7 closed-ended questions designed to quantify students' responses and identify patterns, and 4 open-ended questions aimed at capturing detailed quantitative insights into participants' experience, perceptions, and expectations regarding the impact of AI on their learning. The closed-ended questions were further divided as follows: yes/no questions (Item 1, 4, and 6), multiple-choice questions (items 2 and 7), and Likert scale questions (Items 3 and 5), enabling both categorical and ordinal data analysis. Quantitative data were analyzed using descriptive statistical methods, including frequency and percentage calculations, to provide a clear overview of students' perceptions, usage patterns, and the perceived effectiveness of AI tools. For the qualitative data, responses to the open-ended questions were analyzed using thematic analysis, a well-established and vigorous method for interpreting qualitative data. The thematic analysis followed the framework proposed by Braun and Clarke (2016), ensuring a systematic and transparent approach to identifying, analyzing and reporting patterns within the data. The analysis was conducted at two levels as follows: vertical analysis, which focused on individual responses to identify unique insights, and horizontal analysis which examined patterns across the entire data set to ensure a comprehensive understanding of emerging themes. The result shows that 95.6% of respondents were us artificial intelligence technologies in academic activities. This high percentage suggests the widespread adoption of AI tools among students, reflecting the increasing integration of advanced technologies into the educational landscape.

Regarding the main types of AI used in academic activities, 88.2% of respondents use virtual assistants (e.g. ChatGPT, Siri, Google Assistant, etc), 42,.4% of respondents used AI-based educational platforms (e.g. Coursera, Duolingo, etc.), 17.6% of respondents use automatic content generation tools, 8.2% of respondent use data processing tools (e.g. predictive analysis), while 3.5% of respondents use other types of AI. For the data analysis, frequency analysis and percentage calculations were applied.

The study also investigated the frequency of artificial intelligence tool usage in academic activities. The results show significant variation among students with data indicating the widespread adoption of these technologies. Most students (57.6%) use them weekly, suggesting that these tools have become an integral part of the educational process, assisting with homework, projects and knowledge enhancement. A considerable percentage, 18.8% use AI daily, indicating a higher reliance on these technologies, possibly because they consider them essential for learning-whether through virtual assistants, educational platforms, or other AI-based tools. On the other hand, 11.8% of students use AI monthly, which may suggest occasional used depending on academic needs, while a similar percentage (11.8%) uses them rarely, indicating limited adoption on a preference for traditional learning methods. Only 1.2% of students stated that they do not use AI tools at all, confirming that AI has become a almost indispensable resource in education.

Regarding the impact of AI usage on academic performance in Exams, projects, and grades, many students believe that AI plays a positive role in improving their results. Specifically, 82.4% of students think that using AI contributes to enhancing their academic performance. (Holmes et al, 2019). However, some (15.3%) believe that implementing AI does not bring significant changes in this regard, and 3.5% feel that is only limits knowledge acquisition. Additionally, only 2.4% of students think that using AI could lead to a decline in academic performance, suggesting that these are also critical voices regarding the long-term effects of this technology on the educational process. Based on the study, it was concluded that AI offers significant benefits, such as personalized learning, improved educational outcomes, and increased students' engagement.

Hairunnisa,Nur'ain,Nor,Nabila and Najwa (2024) investigated the effect of artificial intelligence on students' learning in Puncak Alan campus, Malaysia. The population of the study consists of students from Bachelor of Business Administration (Hons) Human Resource Management. A total of 110 questionnaires were distributed to respondents, 96.4% of the return rate was achieved and a total of 106 questionnaires were analyzed using SPSS version 29. Using regression analysis with a value of B=.605 with $P<0.05$ indicate that artificial intelligence influences students' academic performance in the Bachelor of Business Administration in Puncak Alan Campus, Malaysia.

Dheeba, Veysel, Aishath, and Aishath (2024) study investigates the influence of AI on students' perception of academic performance within the Maldives higher education context. A closed-ended adapted online survey questionnaire was utilized for data collection among students studying at six private higher education institutions and two private universities in the Maldives. The total population is 21,964 (Maldives Bureau of Statistics, 2022). Based on Krejcie and Morgan's (1970), the sample size is 377 for this population. However, 260 responses were received which is 69% response rate. The confidence level was 95% with an error of 5%.

Artificial intelligence use and AI perception of students' academic performance were subjected to Explanatory Factor Analysis. In their study, students think that artificial intelligence increases their motivation, improves their problem-solving skills and helps them understand subjects better. The average of this factor is 3.44. This dimension focuses on the effects of artificial intelligence on learning and academic performance. 73% of students think that artificial intelligence tools make

their learning process more effective and efficient. The rate of those who said "Artificial Intelligence improves my problem-solving skills" which is 50%. This shows that students are partially skeptical about the contribution to Artificial Intelligence to problem-solving skills.

Another dimension of the study shows the practical use of Artificial Intelligence in academic tasks. Data shows that at least some of the students utilize AI in areas such as research projects, assignments, and preparing for exams. The mean for this dimension is 3.08. Sixty percent of the students stated that they use artificial intelligence for language support, 59% for personal development, 47% for preparing assignments and 48% for research projects. The lowest rate of usage was 41% for those who said that they used it to prepare for examinations. The study recommended educational institutions can empower students to maximize the advantages of technology in their learning experiences. To achieve this, institutions should implement comprehensive artificial intelligence programs that includes hands-on workshops and emphasize ethical artificial intelligence usage.

Haliru and Abdullahi (2025) assess the impact of artificial intelligence driven personalized learning platforms on Chemistry students' academic performance in Federal University of Education, Zaria, Nigeria. The study employed a qualitative survey research design. The target population comprised of NCE Chemistry students in Kaduna State during the 2023/2024 academic session, using Krejcie & Morgan's (1970) sample size determination table, for a population of 1500, the sample was 306 students from both degree and NCE were selected through simple random sampling to ensure representatives across schools. Data were collected using a structured questionnaire. Responses were measured on a 5-point Likert scale ranging from strongly Agree (5) to Strongly Disagree (1). Data were analyzed using the statistical package for the Social Science (SPSS, version 25) while inferential statistics (independent-samples t-test) were applied to test the hypothesis at the 0.05 level of significance. The study revealed that there is statistically significant difference in academic performance between chemistry students who used artificial intelligence as-driven personalized learning platforms and those who do not at the p-value (0.000) is less than the alpha level of 34.9 at 0.05df. The study recommended that policy makers should prioritize infrastructural investments to enable reliable artificial intelligence adoption.

RESEARCH METHODOLOGY

The correlational research design was adopted for this study. The study was carried out in Cross River State, Nigeria. Cross River lies between latitude $5^{0}32^{1}$ and $4^{0}27^{1}$N of the equator and longitude $7^{0}50^{1}$ and $9^{0}28^{1}$ east of the Greenwich Meridian. The population of the study comprises of year two to final year undergraduate students who would have felt the influence of technologies in their academic performance in the University of Calabar, University of Cross River State (UNICROSS), Ogoja and Arthur Jarvis University, Akpabuyo. The population size was 761 which is the total number of undergraduate students in year 2, 3 and 4 of 2023/2024 academic session from the tertiary institutions offering tourism. The study adopted purposive sampling technique. The sample of the study was made up of three hundred and eighty-one (381). This study involved the use of two instruments. Questionnaire on Modern Technologies Variables and Students'

Academic Performance Test in Tourism Studies. The questionnaire consisted of statements to which respondents were meant to indicate their level of agreement or disagreement based on the 4 points Likert type scale. Two kinds of validity were established for the instrument of this study. These are the face and content validity. Face validity refers to the way the questionnaire items appear to take care of relevant content in the subject area of interest, while the extent to which the instrument represents the content of interest, or how well the items on the instrument represent or sample the content to be measured is the content validity. The face validity was established by using one expert in Environmental Education and two experts in measurement and evaluation in the Faculty of Educational Foundations Studies, University of Calabar. The content validity for the students' academic performance in tourism studies was established through the development of a Table of Specification. Cronbach Alpha reliability method was used in addition to Kuder-Richardson 20 to test the reliability for the students' academic performance. The instruments yielded a reliable co-efficient estimate ranging from .72 to .91 which showed that the instrument was reliable for the study. The instrument used for data collection was the questionnaire. The respondents were informed of the exercise and the need to be honest in terms of giving objective responses. The researcher administered the instrument in the examination hall during lecture free hours from 12noon to 2pm for two weeks depending on accessibility of respondents. The researcher ensures anonymity and confidentiality.

Presentation of result

In this section each research question and hypothesis were re-stated, and the result of data analysis carried out to test it is presented. Each hypothesis of the study was tested at .05 level of significance.

Hypothesis 1: There is no significant influence of Cloud and edge computing application on students' academic performance in tourism studies. The independent variable in this hypothesis is Cloud and edge computing application; while the dependent variable is students' academic performance in tourism studies. Simple linear regression analysis was the employed to test this hypothesis. The result of the analysis is presented in Table 1.

TABLE 1

Simple linear regression result of the influence of Cloud and edge computing application on students' academic performance in tourism studies

Model	R	R. square	Adjusted R. square	Std error of the estimate		
1	.820(a)	.673	.672	1.83767		
Linear regression	2633.046	1	2633.046	779.696	.000(a)	
Residual	1279.889	379	3.377			
Total	3912.934	380				
Variables	Unstandardized linear regression weight B		Standardized linear regression weight	Beta weight	t	p-value
(Constant)		11.243	1.034		10.877	.000
Cloud and edge computing application		1.627	.058	.820	27.923	.000

* Significant at .05 level.

The simple linear regression analysis of the influence of Cloud and edge computing application on the students' academic performance in tourism studies yielded a coefficient of multiple linear regression (R) of .820 and a multiple linear regression R-square (R^2) of .673 and an adjusted R^2 of .672. The adjusted R^2 of .672 indicated that the Cloud and edge computing application account for 67.2 percentage of the variance in students' academic performance in tourism studies in the study area. This finding is a critical indication that Cloud and edge computing application highly influence students' academic performance in tourism studies in the area of the study. The F-value of the Analysis of Variance (ANOVA) obtained from the linear regression table was F = 779.696 and the sig. value of .000 (or $p<.05$) at the degree of freedom (df) 1 and 379. The implication of this result is that Cloud and edge computing application is a significant relate to students' academic performance in tourism studies. The identified equation to understand this influence was that students' academic performance in tourism studies = 11.243 + 1.627 (Cloud and edge computing application).

Hypothesis 2: Artificial Intelligence (AI) does not significantly influence students' academic performance in tourism studies. The independent variable in this hypothesis is Artificial

Intelligence (AI); while the dependent variable is students' academic performance in tourism studies. Simple linear regression analysis was employed to test this hypothesis. The result of the analysis is presented in Table 2.

TABLE 2

Simple linear regression results on the influence of Artificial Intelligence (AI) on students' academic performance in tourism studies

Model	R	R. square	Adjusted R. Square	Std error of the estimate	
1	.797(a)	.635	.634	1.94110	
Model	Sum of square	df	Mean square	F	p-value
Linear regression	2484.906	1	2484.906	659.496	.000(a)
Residual	1428.028	379	3.768		
Total	3912.934	380			
Variables	Unstandardized linear regression weight B		Standardized linear regression weight	Beta weight	t	p-value
(Constant)	12.294		1.083		11.352	.000
Artificial Intelligence (AI)	1.564		.061	.797	25.681	.000

* Significant at .05 level.

The simple linear regression analysis on the influence of Artificial Intelligence (AI) on the students' academic performance in tourism studies yielded a coefficient of multiple linear regression (R) of .797 and a multiple linear regression R-square (R^2) of .635 and an adjusted R^2 of .634. The adjusted R^2 of .634 indicated that Artificial Intelligence (AI) accounted for 63.4 percentage of the variance in students' academic performance in tourism studies in the study area. This finding is a critical indication that Artificial Intelligence (AI) is highly influence decision-making in the area of the study.The F-value of the Analysis of Variance (ANOVA) obtained from the linear regression. Table was F = 659.496 and the sig. value of .000 (or $p<.05$) at the degree of freedom (df) 1 and 379. The implication of this result is that Artificial Intelligence (AI) has significant influence on students' academic performance in tourism studies. The identified equation to understand this influence was that students' academic performance in tourism studies = 12.294 + 1.564 (Artificial Intelligence (AI)).

Discussion of findings

The result of the first hypothesis revealed that there is a significant relationship between Cloud and edge computing application and students' academic performance in tourism studies. The finding of this hypothesis is in line with the view of Alfailakawi, (2021) who showed that the computational averages ranged between(2.51-2.96),where digital cloud libraries came in first place with the highest computational average of (2.96),and by importance 49%,electronic archiving came in second with a mathematical average of (2.30), and by importance 46%,digital repositories and scientific research came in third place with a mathematical average of(2.28) By importance,45.6%,while information management came in last place with a mathematical average of 2.21, and by importance 44.2%.and the average arithmetic of the instrument as a whole (2.31%)and the ratio (46.2%), the result was low. The results showed no statistically significant differences due to the effect of Gender and scientific rank, while statistically significant differences between less than five years and5-10 years were in favor of 5-10 years.

Achar, (2021) also showed that there were three groups of students: those who performed well, those who performed averagely, and those who performed poorly. Higher cloud storage and collaboration use were shown to be positively related to improved academic achievement. Additionally, improved academic achievement was associated with longer study periods. This implies that extending study time and employing cloud technologies will help pupils do better academically. It is advised that students utilize cloud storage and collaboration technologies to enhance their academic performance. They may also collaborate with peers using cloud-based technologies while working on group work. The promotion of cloud storage and cooperation in the classroom may also be greatly aided by teachers. Teachers may help students do better in classrooms by providing them with the information and skills they need to utilize cloud computing tools efficiently. It might be helpful for students to develop their cooperation and collaboration abilities to encourage them to work on group projects or assignments utilizing cloud computing collaboration technologies.

The result of the second hypothesis revealed that there is a significant relationship between Artificial Intelligence application (AI) and students' academic performance in tourism studies. The finding of this hypothesis is in line with view of Aniella and Gabriel (2025) who examine artificial intelligence (AI) on students' academic development in the National University of Science and Technology POLITEHNICA Bucha vest. The sample consisted of l85 second-year students. A purposive, non-probabilistic sampling method was employed to ensure the selection of participants with direct experience in AI – integrated learning environments. This, enhancing the relevance of the findings. Data were collected using a self-administered questionnaire distributed via Google forms. This platform was chosen for its user-friendly interface and integrated analytical tools, which facilitate efficient data management and interpretation. The study utilized a mixed-methods design, incorporating both quantitative and qualitative data collection techniques. The questionnaire consisted of 11 items, categorized into two types of questions as follows; 7 closed-ended questions designed to quantify students' responses and identify patterns, and 4 open-ended questions aimed at capturing detailed quantitative insights into participants' experience, perceptions, and expectations regarding the impact of AI on their learning. The closed-ended questions were further divided as

follows: yes/no questions (Item 1, 4, and 6), multiple-choice questions (items 2 and 7), and Likert scale questions (Items 3 and 5), enabling both categorical and ordinal data analysis. Quantitative data were analyzed using descriptive statistical methods, including frequency and percentage calculations, to provide a clear overview of students' perceptions, usage patterns, and the perceived effectiveness of AI tools. For the qualitative data, responses to the open-ended questions were analyzed using thematic analysis, a well-established and vigorous method for interpreting qualitative data.

Conclusion

The study's findings demonstrate that the application of various technologies significantly relates to students' academic performance in tourism studies in Cross River State Tertiary Institutions, Nigeria. Specifically, the study concludes that cloud and edge computing, and Artificial Intelligence (AI) all have a significant impact on students' academic performance.

The study reveals that the effective integration of these technologies can enhance students' learning experiences, improve their engagement, and increase their academic achievement in tourism studies. The findings suggest that cloud and edge computing can provide students with access to vast resources and facilitate collaboration, while AI can help personalize learning and improve student outcomes.

Recommendations

The study's findings highlight the significant relationship between various technology applications and students' academic performance in tourism studies in Cross River State Tertiary Institutions, Nigeria. Based on the variables examined, the following recommendations are made:

1. Tertiary institutions in Cross River State should prioritize the adoption and implementation of cloud and edge computing technologies to support teaching and learning in tourism studies. Lecturers should be trained on how to effectively integrate cloud and edge computing applications into their teaching methods to enhance student engagement and learning outcomes. Students should be provided with access to cloud and edge computing resources to facilitate their learning and research activities.

2. Tertiary institutions in Cross River State should invest in AI technologies that can support teaching and learning in tourism studies, such as AI-powered adaptive learning systems and virtual teaching assistants. Lecturers should be trained on how to effectively integrate AI applications into their teaching methods to personalize learning and improve student outcomes. Students should be educated on the benefits and limitations of AI applications in tourism studies to prepare them for the changing landscape of the industry.

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