

PRINCIPALS' EFFICIENCY TOWARDS UTILIZATION OF AI-DRIVEN APPLICATIONS FOR SUSTAINABLE SCHOOL MANAGEMENT IN THE DIGITAL AGE IN DELTA STATE

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Abstract

This study examined principals' efficiency towards utilization of AI-driven applications for sustainable school management in the Digital Age in Delta State. Four research questions guided the study. The study adopted a descriptive survey research design. The population of this study comprised all 474 principals of public secondary schools in Delta State. A total of 237 principals from 237 public secondary schools was used as the sample size, selected at 50% using a proportionate stratified random sampling technique. A 20-item self-structured questionnaire designed by the researcher and titled "Principals' Efficiency in Utilization of AI-Driven Applications for Sustainable School Management Questionnaire (PEAIASSMQ)" was used for data collection. Both validity and reliability of the questionnaire was established. Data collected and collated were analyzed using mean statistics rated at 2.50 and standard deviation statistics. Findings of this study generally revealed, among others, that principals were inefficient in utilizing AI-driven applications for sustainable curriculum and instructional management, personnel management, decision-making management and teaching-learning resource management in the digital age in secondary schools. Among the recommendations proffered from the findings included that the Delta State Government in conjunction with the Post Primary Education Board (PPEB) and other educational authorities should organize consistent compulsory capacity-building programmes and continuous professional development (CPD) training for principals on AI-driven applications and digital leadership in the areas of curriculum and instructional management in order principals' efficiency in using AI tools for sustainability of instructional, administrative and decision-making processes in public secondary schools in the digital age.

Keywords: Principals, Efficiency, AI, Applications, Management

Introduction

Education globally is undergoing rapid transformation driven by advancements in digital technologies and artificial intelligence (AI). These innovations and changes, which positively affect the education system, are reshaping how educational institutions are managed, how teaching and learning are delivered, and how decisions are made within institutions for sustainable school management. In contemporary educational discourse, the concept of sustainable school management has become increasingly important as schools are expected not only to achieve academic excellence but also to ensure efficient use of resources, long-term institutional stability and adaptability to technological change. In this context, principals' efficiency in using AI-driven applications has emerged as a critical factor in enhancing sustainable school management and effectiveness in the digital age. Management in this study implies the coordination and utilization of human and material resources of educational institutions, which is channeled towards the achievement of educational goals and objectives. According to Ezugoh et al. (2024), management entails a process involving organizing, planning, leading, measuring and controlling as well as undertaking of risk and handling of uncertainty, planning and innovation, coordination and routine supervision. It is a process designed

to ensure cooperation, participation, intervention of personnel in the effective achievement of a given objective. It is leadership which is aimed at influencing group activity towards goal achievement. Management of educational institutions rests mostly upon the leadership who can be termed as principals as found in secondary schools. Hence, for sustainable school management, it is very crucial that principals efficiently incorporate and utilize the Artificial Intelligence (AI) into the schools' daily operations and activities.

The Artificial Intelligence (AI) refers to computer-based systems capable of performing tasks that typically require human intelligence, such as decision-making, problem-solving, prediction and pattern recognition. According to the Organization for Economic Co-operation and Development (OECD) (2023), AI encompasses systems that are designed to operate with varying levels of autonomy and can influence decision-making processes through data-driven analysis and predictive modelling. Similarly, the United Nations Educational, Scientific and Cultural Organization (UNESCO) (2024a) conceptualized AI in education as intelligent systems that support teaching-learning activities, school administration and policy implementation through automation, analytics and adaptive learning technologies. In the context of school management, AI therefore refers to intelligent systems that support principals and school administrators in planning, organizing, monitoring and evaluating educational activities using applications including data-driven and automated processes. The AI has several applications which can aid effective school management especially in this digital age.

AI-driven applications in education therefore include intelligent tutoring systems, Learning Management Systems (LMS) with AI features, learning analytics platforms, automated grading systems, AI-based timetabling and scheduling systems, chatbot-based communication tools and virtual assistants, intelligent student information systems, automated grading and assessment tools, predictive student performance systems, and school management information systems powered by machine learning (Zawacki-Richter et al., 2019). These applications are increasingly being integrated into school administration or management to enhance efficiency, reduce administrative workload, improve data-driven decision-making and support personalized learning experiences. In secondary school management, principals occupy a central leadership position responsible for planning, organizing, directing and evaluating educational processes. Their efficiency in utilizing AI-driven applications determines how effectively they can successfully manage curriculum implementation, personnel administration, decision-making processes, school-community relations and instructional resources which are all aimed at sustainable school management in the digital age. Efficiency within the context of this study refers to the ability of principals to achieve optimal outcomes using minimal time, effort and resources while maximizing institutional productivity.

According to Robbins and Coulter (2021), efficiency is the relationship between inputs and outputs, where managers are considered efficient when they minimize resource wastage while achieving organizational goals effectively. This definition highlights optimal resource utilization. Similarly, Drucker (2020) conceptualized efficiency as doing things right by ensuring that organizational resources are used in the most productive and cost-effective manner to achieve desired outcomes. Principals' efficiency in essence, refers to the ability of school administrators to effectively utilize available human, financial and technological resources to achieve educational goals with minimal waste. In the view of Hallinger (2022), principals' efficiency involves the capacity of school leaders to manage instructional processes, personnel and resources in a way that maximizes school performance and student outcomes while minimizing inefficiencies in school administration. Sustainable school management, on the other hand, refers to the ability of educational leaders to ensure long-term institutional effectiveness through responsible resource utilization, continuous improvement, technological integration and adaptive leadership practices.

According to UNESCO (2024a), sustainable educational management involves ensuring equity, efficiency, accountability and resilience in school systems while responding to the demands of a rapidly changing digital environment. The OECD (2023) described sustainable school management as the strategic administration of educational institutions in a manner that ensures long-term performance, adaptability, resilience and optimal use of technological and human resources.

Sustainability is defined as development that meets present needs without compromising the ability of future generations to meet their own needs, particularly in resource utilization and institutional development (United Nations, 2023).

From all the foregoing discussions, efficient utilization of AI-driven applications in education would definitely lead to sustainability in the management of educational institutions/schools especially in the digital age. The concept of a digital age further emphasizes the increasing reliance on digital technologies, automation, artificial intelligence and data-driven systems in educational administration and management. According to Castells (2021), the digital age is a socio-technological era defined by the dominance of information networks, digital communication systems and knowledge-based economies that reshape how organizations operate and interact. Similarly, the OECD (2023) described the digital age as a period of rapid technological transformation driven by digital connectivity, automation, artificial intelligence and data analytics that influence education, governance, and economic systems. The digital age is thus characterized by rapid technological innovation and advancement in ICT and AI tools, widespread internet connectivity involving instant communication across geographical boundaries, big data utilization, information abundance by granting easy access to large volumes of digital information, use of analytics for planning and evaluation or data-driven decision-making, automation of processes using intelligent systems in administration and the integration of intelligent systems into organizational processes for prediction and optimization.

Within the school environment, principals are expected to adopt AI-driven applications not only as supportive tools but as strategic instruments for improving school effectiveness. AI-driven applications hence can be efficiently utilized in various aspects of school management by principals for curriculum and instructional management, personnel management, decision-making likewise teaching-learning resource management. Previous empirical studies have shown that AI-driven applications significantly enhance curriculum delivery and instructional management when effectively utilized by school leaders. Intelligent tutoring systems, adaptive learning platforms and AI-based learning analytics have been reported to improve instructional planning, personalization of learning, and monitoring of student progress. Citing instances, an empirical study conducted by Holmes et al., (2019) which investigated the role of Artificial Intelligence in education indicated that AI-supported instructional systems improve curriculum delivery by enabling adaptive learning pathways tailored to students' needs. The study emphasized that school leaders who efficiently integrate AI tools into instructional processes achieved improved teaching effectiveness and learner engagement. Similarly, Luckin et al. (2016) study indicated that AI applications such as intelligent feedback systems and learning analytics dashboards enhance teachers' instructional decision-making and curriculum alignment. The study concluded that principals' efficiency in adopting such tools determined the extent of instructional improvement in schools. Zawacki-Richter et al. (2019) also observed that AI in educational settings supports curriculum design through automated assessment and personalized learning systems, but its effectiveness depends on leadership capacity and institutional readiness. Again, a few research has shown that AI-driven systems are increasingly used in human resource and personnel management in educational institutions. These systems assist in teacher recruitment, performance evaluation, attendance monitoring and professional development planning. According to Selwyn (2022), AI-based human resource systems improve efficiency in personnel management by automating administrative tasks and providing data-driven insights into staff performance. However, the study noted that principals' digital competence determined how effectively these systems are utilized.

The OECD (2023) reported that AI-enabled administrative systems in schools contributed to improved workforce management by reducing workload, enhancing staff allocation, and supporting performance tracking. The study emphasized that school leaders who efficiently use AI tools experience better organizational productivity. UNESCO (2024b) further highlighted that AI applications can support teacher development by identifying training needs through predictive analytics. However, inefficient utilization of these tools limits their impact on personnel management in many developing education systems. Furthermore, empirical evidence has indicated that AI

significantly enhances data-driven decision-making in school leadership when properly utilized. Predictive analytics, dashboard reporting systems and School Management Information Systems (SMIS) support evidence-based planning and policy implementation.

According to Holmes et al. (2019), AI systems enable school leaders to make informed decisions by analyzing large datasets on student performance, attendance, and resource allocation. The study emphasized that principals' efficiency in interpreting AI-generated data determines the quality of school decisions. Zawacki-Richter et al. (2019) study indicated that AI-supported decision-making tools improved institutional planning by providing real-time insights into academic and administrative performance. However, the study noted that lack of digital literacy among school leaders limited effective utilization. The OECD (2023) reported that AI-based decision-support systems improve governance in schools by enabling predictive planning, risk identification, and resource optimization. Additionally, studies have indicated that AI-driven applications play a crucial role in managing teaching and learning resources such as digital content, instructional materials and educational infrastructure.

In a study, Luckin et al. (2016) indicated that AI systems enhance resource management by recommending appropriate learning materials based on student performance data. The study concluded that efficient leadership improves resource allocation and utilization. UNESCO (2024b) reported that AI-based platforms support equitable distribution of educational resources, particularly in resource-constrained environments. However, inefficiency in leadership reduced the effectiveness of such systems. Selwyn (2022) emphasized that digital resource management in schools is increasingly dependent on AI-powered systems, but successful implementation requires strong administrative efficiency and ICT competence among principals.

Holmes et al. (2019) also noted that AI systems improve resource optimization by tracking usage patterns and predicting resource needs, thereby, supporting sustainable school management. Despite the potential benefits of AI in education, many school systems, particularly in developing regions such as Nigeria and Delta State inclusive, continue to experience challenges in adopting and efficiently utilizing these technologies. Issues such as inadequate ICT infrastructure, limited digital literacy among school administrators, insufficient training, poor funding and resistance to technological change, among other factors often hinder effective implementation and utilization of AI applications. As a result, the potential of AI-driven applications to facilitate and enhance curriculum delivery, personnel management, decision-making, school-community relationships and instructional resource management remains underutilized in many secondary schools.

This present study is therefore grounded on the need to examine principals' efficiency in utilizing AI-driven applications for sustainable school management in secondary schools in Delta State. The study investigated the extent to which principals apply AI tools in curriculum and instructional management, personnel management, decision-making processes and teaching-learning resource management. These areas are critical because they directly influence school effectiveness, academic performance and institutional sustainability. The study is guided by the understanding that effective utilization of AI-driven applications can significantly improve curriculum delivery by enabling personalized learning and adaptive instruction. In personnel management, AI systems can support staff recruitment, performance monitoring and professional development planning. In decision-making, AI enhances evidence-based planning through predictive analytics and data interpretation. In teaching-learning resource management, AI facilitates efficient allocation, monitoring and utilization of instructional materials and digital resources. Given the increasing importance of artificial intelligence in education, it becomes imperative to assess how efficiently school principals are utilizing these technologies for sustainable school management in the digital age, especially in secondary schools. Although, many empirical studies have been conducted in the area of ICT, but a few of these studies are found within the context of AI utilization for sustainable school management.

A review of existing literature reveals that while several studies (Luckin et al., 2016; Holmes et al., 2019; Zawacki-Richter et al., 2019; UNESCO, 2024) have extensively examined the general applications of Artificial Intelligence in education, much of the focus has been on higher education contexts, instructional innovation and theoretical discussions of AI potential. Similarly, studies

conducted by the Selwyn (2022) and OECD (2023) have highlighted the global relevance of AI in education management, but with limited empirical attention to school-level administrative efficiency, particularly in secondary schools within developing economies. Furthermore, available studies tend to emphasize AI adoption and availability rather than the efficiency of school principals in utilizing AI-driven applications for specific administrative domains such as curriculum management, personnel administration, decision-making and resource management. There is also a noticeable gap in empirical studies that integrate these multiple dimensions of school management under a single framework to assess principals' efficiency in a comprehensive manner. It is therefore against this background that the researcher was motivated to conduct a field investigation in order to examine principals' efficiency towards the utilization of AI-driven applications for sustainable school management in secondary schools in Delta State, with particular focus on curriculum and instructional management, personnel management, decision-making and teaching-learning resource management. The study sought to provide empirical evidence on principals' efficiency towards utilization of AI-driven applications in school management practices in Delta State, thereby contributing to policy formulation, leadership development and educational innovation in the digital era.

Statement of the Problem

The rapid advancement of Artificial Intelligence (AI) and other digital technologies has transformed educational administration globally, making school management more data-driven, efficient and responsive to contemporary educational demands. In the digital age, secondary school principals are increasingly expected to integrate AI-driven applications such as intelligent school management platforms, predictive decision-support tools and automated administrative systems to enhance curriculum delivery, personnel management, decision-making processes and teaching-learning resource management. In developed educational systems, AI-driven technologies have been successfully deployed to improve instructional supervision, streamline administrative processes, support evidence-based decision-making, and optimize resource allocation. However, in many developing contexts such as Nigeria, particularly in Delta State, the level of integration and efficient utilization of these technologies in secondary school administration remains questionable. Despite government and stakeholder efforts toward digital transformation in education, many public secondary schools still rely heavily on traditional, conventional methods, manual and less efficient administrative systems.

Observations and emerging literature indicate that many principals seem to lack adequate efficiency in utilizing AI-driven applications for effective school management. This inefficiency which may be attributed to some factors have negative consequences on the potential of AI to enhance curriculum and instructional management, improve personnel administration, support evidence-based decision-making and optimize teaching-learning resources in this digital age, and which equally remains largely underutilized. Consequently, the secondary schools may continue to experience challenges such as ineffective instructional supervision, delayed decision-making processes, inefficient resource management and suboptimal staff performance evaluation. These challenges undermine the goal of sustainable school management and limit the capacity of schools to respond effectively to the demands of a rapidly evolving digital society. In the Nigerian context, and particularly in Delta State, empirical evidence on how secondary principals efficiently utilize AI-driven applications for sustainable school management remains scarce. Most existing studies focus broadly on ICT usage in education without isolating AI-specific tools or examining efficiency across key administrative functions. This leaves a critical gap in understanding not only whether AI tools are available, but how efficiently and effectively they are being utilized by principals to improve school management sustainability. Therefore, the present study sought to address this problem and fill all the necessary practical, theoretical, knowledge and contextual gaps by providing empirical evidence on principals' efficiency in utilizing AI-driven applications for sustainable school management in Delta State across four critical areas of: curriculum and instructional management, personnel management, decision-making and teaching-learning resource management.

Purpose of the Study

The purpose of this study was to examine principals' efficiency towards utilization of AI-driven applications for sustainable school management in the Digital Age in Delta State. Specifically, the study sought to:

1. Determine principals' efficiency towards utilization of AI-driven applications for sustainable curriculum and instructional management in the digital age in secondary schools in Delta State.
2. Examine principals' efficiency towards utilization of AI-driven applications for sustainable personnel management in the digital age in secondary schools in Delta State.
3. Ascertain principals' efficiency towards utilization of AI-driven applications for sustainable decision-making in the digital age in secondary schools in Delta State.
4. Find out principals' efficiency towards utilization of AI-driven applications for sustainable teaching-learning resource management in the digital age in secondary schools in Delta State.

Research Questions

The following three research questions guided the study:

1. How efficient are principals in utilizing AI-driven applications for sustainable curriculum and instructional management in the digital age in secondary schools in Delta State?
2. How efficient are principals in utilizing AI-driven applications for sustainable personnel management in the digital age in secondary schools in Delta State?
3. How efficient are principals in utilizing AI-driven applications for sustainable decision-making in the digital age in secondary schools in Delta State?
4. How efficient are principals in utilizing AI-driven applications for sustainable teaching-learning resource management in the digital age resource management in secondary schools in Delta State?

Methods

This study adopted a descriptive survey research design. The design was considered appropriate because it enabled the researcher to obtain data from respondents (principals) on existing conditions without manipulating variables. In this study, it was used to investigate principals' efficiency towards the utilization of AI-driven applications for sustainable school management in secondary schools in Delta State. The study was conducted in Delta State, Nigeria, a South-South geopolitical state with a growing number of public secondary schools increasingly exposed to digital and technological reforms in education. The State comprises three Senatorial districts, namely: Delta North, Delta Central and Delta South, each with varying levels of ICT infrastructure development and educational resource distribution.

The population of the study comprised all 474 principals of public secondary schools in Delta State. According to the Delta State Post Primary Education Board (2025), there are approximately 474 public secondary schools, each headed by a principal. Principals were selected as the respondents because they are the chief administrators of public secondary schools and are directly responsible for the implementation and utilization of AI-driven applications for curriculum management, personnel administration, decision-making and resource management. A total of 237 principals from 237 public secondary schools was used as the sample size, selected at 50% from the total population, using a proportionate stratified random sampling technique. These principals were selected because they had acquired some digital literacy skills which enabled them to utilize AI technology. This sampling technique was considered appropriate because it enabled the researcher to proportionately and randomly draw the sample at 50% according to strata, that is, the three Senatorial districts in the State and which also allowed for comprehensive coverage of all principals, thereby eliminating sampling error and enhancing the reliability of the findings.

The instrument for data collection was a 20-item self-structured questionnaire designed by the researcher and titled “Principals’ Efficiency in Utilization of AI-Driven Applications for Sustainable School Management Questionnaire (PEAIASSMQ)”. The questionnaire was designed based on the objectives of the study and relevant literature reviewed. Items in the questionnaire were measured using a 4-point rating scale as follows: Very Efficient (VE) – 4 points, Efficient (E) – 3, Less Efficient (LE) - 2 points and Inefficient (IE) - 1 point. The instrument was subjected to face and content validation by three experts; and two of these experts were from Educational Management unit and one from Measurement and Evaluation unit, Faculty of Education, Delta State University, Abraka. The experts examined the instrument for clarity, relevance, adequacy and alignment with the research objectives and questions. Their suggestions and corrections were incorporated to improve the final version of the questionnaire. The reliability of the instrument was determined through a pilot test conducted on a single administration of the questionnaire sampling 25 principals in Edo State, which was outside the study area but shared similar educational characteristics with Delta State.

Data obtained were analyzed using Cronbach’s Alpha statistics, whose result yielded reliability coefficient values of .81, .85, .83 and .87 for the four clusters respectively, with an overall internal consistency reliability coefficient of .84. This indicated that the instrument with its high level of consistency was reliable to collect data for the study. Data collection was carried out by the researcher with the help of three research assistants who met with the principals of the various public secondary schools sampled in order to administer the questionnaire to the respondents (principals). Permission was obtained from the school principals before administering the questionnaire. All ethical considerations were strictly observed.

Here, participation was voluntary and respondents were assured that the data collected would be used strictly for academic purposes. The purpose of the study was clearly explained to respondents and confidentiality and anonymity were assured to encourage honest responses. Distribution of all the questionnaire was done within an interval of two weeks, in order to get all the 237 valid copies of the questionnaire which was retrieved, giving a response rate of 100%. Data collected and collated were analyzed using mean statistics and standard deviation statistics to answer the research questions. The decision rule was based on a criterion mean of 2.50. Any item with a mean score of 2.50 and above was regarded as efficient, while a mean score below 2.50 was regarded as inefficient. The analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 26.

Results

Research Question 1: How efficient are principals in utilizing AI-driven applications for sustainable curriculum and instructional management in the digital age in secondary schools in Delta State?

Table 1

Mean Score Rating and SD of Principals concerning their Utilization of AI-Driven Applications for Sustainable Curriculum and Instructional Management in the Digital Age in Secondary Schools in Delta State (N = 237 Principals)

S/N	Efficiency in:	VE	E	LE	IE	X	SD	Decision
1.	utilizing AI-based learning analytics such as Google classroom with tracking features and Moodle LMS to monitor students’ academic performance in the digital age	11	21	94	111	1.71	.81	Inefficient
2.	using AI-driven platforms such as Magic School AI and Microsoft Copilot for education to support curriculum planning and instructional delivery in the digital age	19	27	89	102	1.84	.92	Inefficient

3.	applying AI tools such as Khan Academy (Khanmigo) and Century Tech for personalized learning and student-centred instruction in the digital age	14	20	103	100	1.78	.83	Inefficient
4.	using AI systems such as Dream Box Learning and ALEKS (Assessment and Learning in Knowledge Spaces) to identify students' learning difficulties and instructional needs in the digital age	8	12	122	95	1.72	.71	Inefficient
5.	integrating AI applications such as TeachFX and GoReact in supervising classroom instruction in the digital age	10	22	115	90	1.80	.77	Inefficient
Overall Mean Score & SD =						1.77	.81	Inefficient

Analysis of data in Table 1 revealed that none of the items from 1 to 5 were rated “efficient” above the acceptable mean score of 2.50 by the respondents (principals) to show their agreement with these statements. All the items were rated “inefficient” below the acceptable mean score of 2.50 by the principals to show their disagreement with these statements. The grand mean of 1.77 and standard deviation (SD) of .81 showcased closeness in the responses of the principals, therefore indicating their inefficiency in utilizing AI-driven applications for sustainable curriculum and instructional management in the digital age in secondary schools in Delta State. They were inefficient in all the aspects relating to utilizing AI-driven applications to sustain the curriculum and instructional management practices in schools.

Research Question 2: How efficient are principals in utilizing AI-driven applications for sustainable personnel management in the digital age in secondary schools in Delta State?

Table 2
Mean Score Rating and SD of Principals concerning their Utilization of AI-Driven Applications for Sustainable Personnel Management in the Digital Age in Secondary Schools in Delta State (N = 237 Principals)

S/N	Efficiency in:	VE	E	LE	IE	X	SD	Decision
6.	using AI systems such as Microsoft Viva Insights and Workday HCM (AI-powered Performance Management) for staff performance monitoring and data-driven evaluation in the digital age	9	24	106	98	1.76	.78	Inefficient
7.	utilizing AI applications such as LinkedIn Talent Solutions (AI Matching) and Oracle Fusion Cloud HCM (AI Recruiting) for teacher recruitment and deployment decisions in the digital age	6	17	133	81	1.78	.68	Inefficient
8.	using AI-driven tools such as Kronos Workforce Ready (UKG Ready) and Workeasy AI Time and Attendance for staff attendance and punctuality tracking in the digital age	12	27	101	97	1.81	.83	Inefficient
9.	relying on AI-based systems such as Cornerstone Learning Experience Platform (LXP) and Docebo Learning platform for identifying teachers' training needs in the digital age	18	20	96	103	1.80	.89	Inefficient
10.	using AI applications such as Microsoft Viva Learning and SAP SuccessFactors Learning to support staff development planning and supervision in the digital age	14	25	113	85	1.86	.83	Inefficient
Overall Mean Score & SD =						1.80	.80	Inefficient

Analysis of data in Table 2 revealed that none of the items from 6 to 10 were rated “efficient” above the acceptable mean score of 2.50 by the respondents (principals) to show their agreement with these statements. All the items were rated “inefficient” below the acceptable mean score of 2.50 by the principals to show their disagreement with these statements. The grand mean of 1.80 and standard deviation (SD) of .80 showcased closeness in the responses of the principals, indicating their inefficiency in utilizing AI-driven applications for sustainable personnel management in the digital age in secondary schools in Delta State. They were inefficient in all the aspects relating to utilizing AI-driven applications to sustain the personnel management practices in schools.

Research Question 3: How efficient are principals in utilizing AI-driven applications for sustainable decision-making in the digital age in secondary schools in Delta State?

Table 3

Mean Score Rating and SD of Principals concerning their Utilization of AI-Driven Applications for Sustainable Decision-Making Management in the Digital Age in Secondary Schools in Delta State (N = 237 Principals)

S/N	Efficiency in:	VE	E	LE	IE	X	SD	Decision
11.	using AI-generated data from Microsoft Power BI with Copilot and Tableau Pulse (Salesforce AI) for making administrative decisions in the digital age in school	8	10	114	105	1.67	.71	Inefficient
12.	relying on AI predictive tools such as IBM watsonx and Microsoft Azure Machine Learning for planning school activities and policies in the digital age	17	24	107	89	1.87	.86	Inefficient
13.	using AI dashboards such as Microsoft Power BI with Copilot and Oracle analytics cloud to guide resource allocation decisions in the digital age	9	13	112	103	1.70	.74	Inefficient
14.	utilizing AI systems such as civitas learning and D2L Brightspace insights to analyze student performance for decision-making in the digital age	7	11	108	111	1.64	.71	Inefficient
15.	using AI tools such as Microsoft Copilot and Google Gemini for workspace to improve efficiency in school problem-solving processes in the digital age	18	25	101	93	1.86	.89	Inefficient
Overall Mean Score & SD =						1.75	.79	Inefficient

Analysis of data in Table 3 revealed that none of the items from 11 to 15 were rated “efficient” above the acceptable mean score of 2.50 by the respondents (principals) to show their agreement with these statements. All the items were rated “inefficient” below the acceptable mean score of 2.50 by the principals to show their disagreement with these statements. The grand mean of 1.75 and standard deviation (SD) of .79 showcased closeness in the responses of the principals, indicating their inefficiency in utilizing AI-driven applications for sustainable decision-making management in the digital age in secondary schools in Delta State. They were inefficient in all the aspects relating to utilizing AI-driven applications to sustain decision-making management practices in schools.

Research Question 4: How efficient are principals in utilizing AI-driven applications for sustainable teaching-learning resource management in the digital age resource management in secondary schools in Delta State?

Table 4

Mean Score Rating and SD of Principals concerning their Utilization of AI-Driven Applications for Sustainable Teaching-Learning Resource Management in the Digital Age in Secondary Schools in Delta State (N = 237 Principals)

S/N	Efficiency in:	VE	E	LE	IE	X	SD	Decision
16.	using AI systems such as Microsoft Copilot for education and Oracle Fusion Cloud ERP (AI-powered resource management) to manage and allocate teaching-learning resources effectively in the digital age	11	23	104	99	1.77	.81	Inefficient
17.	utilizing AI platforms such as Follett Destiny Resource Manager and Manage Bac analytics to monitor availability and usage of instructional materials in the digital age	9	21	81	126	1.63	.80	Inefficient
18.	using AI applications such as Magic School AI and Khanmigo (Khan Academy) to recommend relevant digital learning resources for teachers in the digital age	15	19	114	89	1.83	.82	Inefficient
19.	applying AI tools such as Microsoft Intune and Cisco Meraki Dashboard to track utilization of ICT facilities in the digital age in school	12	27	100	98	1.80	.83	Inefficient
20.	using AI systems such as Microsoft Power BI with Copilot and IBM watsonx to improve resource planning and sustainability in the digital age in school	17	13	85	122	1.68	.87	Inefficient

Overall Mean Score & SD =	1.74	.83	Inefficient
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Analysis of data in Table 4 revealed that none of the items from 15 to 20 were rated “efficient” above the acceptable mean score of 2.50 by the respondents (principals) to show their agreement with these statements. All the items were rated “inefficient” below the acceptable mean score of 2.50 by the principals to show their disagreement with these statements. The grand mean of 1.74 and standard deviation (SD) of .83 showcased closeness in the responses of the principals, indicating their inefficiency in utilizing AI-driven applications for sustainable teaching-learning resource management in the digital age in secondary schools in Delta State. They were inefficient in all the aspects relating to utilizing AI-driven applications to sustain teaching-learning resource management practices in schools.

Discussion of Findings

Findings of this study generally revealed principals’ inefficiency in the utilization of AI-driven applications for sustainable management in the digital age in secondary schools in Delta State. They were inefficient in utilizing AI-driven applications for sustainable curriculum and instructional management, personnel management, decision-making management and teaching-learning resource management in the digital age in secondary schools. One of the findings revealed that the public secondary school principals were inefficient in utilizing AI-driven applications for sustainable curriculum and instructional management in the digital age in Delta State. This finding further discovered that the principals were inefficient in utilizing AI-driven applications especially in those areas connected to using AI-based learning analytics such as Google classroom with tracking features and Moodle LMS to monitor students’ academic performance in the digital age. They were also inefficient in using AI-driven platforms such as Magic School AI and Microsoft Copilot for education to support curriculum planning and instructional delivery in the digital age, applying AI tools such as Khan Academy (Khanmigo) and Century Tech for personalized learning and student-centred instruction, using AI systems such as Dream Box Learning and ALEKS (Assessment and Learning in Knowledge Spaces) to identify students’ learning difficulties and instructional needs, and in integrating AI applications such as TeachFX and GoReact in supervising classroom instruction in the digital age. Thus, the above finding implies that many principals were unable to effectively apply AI tools such as learning analytics systems, adaptive instructional platforms and intelligent tutoring systems to support curriculum planning, instructional supervision and learner-centred teaching. This finding indicated a gap in digital leadership competence among principals, particularly in the use of AI technologies to enhance teaching and learning processes, which can be attributed to several factors. This present study finding aligns and agrees with the findings of Holmes et al. (2019), who indicated that although AI has strong potential to enhance instructional delivery through personalized learning and data-driven curriculum design, its effectiveness depends heavily on educators’ and school leaders’ ability to integrate it meaningfully into instructional systems. Similarly, Luckin et al. (2016) study found that without strong leadership capacity, AI tools remain underutilized in improving classroom instruction. Furthermore, the present study finding agrees with the findings of Zawacki-Richter et al. (2019), who found that AI applications in education were often concentrated in research and higher education settings, with limited adoption at the secondary school level due to leadership inefficiencies and lack of digital competence.

It was also discovered through this finding that the public secondary school principals were inefficient in utilizing AI-driven applications for sustainable personnel management in the digital age in Delta State. This finding further reported that the principals were inefficient in integrating AI-driven applications in personnel management areas, especially in utilizing AI-generated data from Microsoft Power BI with Copilot and Tableau Pulse (Salesforce AI) for making administrative decisions in the digital age in school. They were inefficient in relying on AI predictive tools such as IBM watsonx and Microsoft Azure Machine Learning for planning school activities and policies in the digital age, using AI dashboards such as Microsoft Power BI with Copilot and Oracle analytics cloud to guide resource allocation decisions in the digital age, utilizing AI systems such as civitas learning and D2L Brightspace insights to analyze student performance for decision-making for the school, and in using AI tools such as Microsoft Copilot and Google Gemini for workspace to improve

efficiency in school problem-solving processes. This further implies that AI tools that could support teacher recruitment, staff appraisal, attendance monitoring and professional development planning were not efficiently utilized. And this inefficiency may hinder effective human resource management in schools, leading to poor staff monitoring, weak performance evaluation systems and limited data-driven staff development strategies. This finding is consistent and corroborates with the findings of Selwyn (2022), who indicated that although AI systems can significantly enhance human resource management in education by automating administrative tasks and improving decision-making efficiency, many school leaders lack the necessary digital literacy to utilize these tools effectively. Similarly, the OECD (2023) confirmed that inefficiency in leadership remained a major barrier to effective AI integration in school personnel management systems. Additionally, UNESCO (2024) reported that while AI-driven HR systems are increasingly available, their impact in many developing educational systems remained limited due to leadership inadequate training and weak implementation structures.

The finding of this study further indicated that the public secondary school principals were inefficient in utilizing AI-driven applications for sustainable decision-making management in the digital age in Delta State. This finding further discovered that the principals were inefficient in utilizing AI-driven applications in decision-making areas, especially in using AI-generated data from Microsoft Power BI with Copilot and Tableau Pulse (Salesforce AI) for making administrative decisions in the digital age in schools. They were also inefficient towards relying on AI predictive tools such as IBM watsonx and Microsoft Azure Machine Learning for planning school activities and policies in the digital age, using AI dashboards such as Microsoft Power BI with Copilot and Oracle analytics cloud to guide resource allocation decisions, utilizing AI systems such as civitas learning and D2L Brightspace insights to analyze student performance for decision-making in the digital age, and also in using AI tools such as Microsoft Copilot and Google Gemini for workspace to improve efficiency in school problem-solving processes. This finding implies that AI-based decision-support systems, predictive analytics and digital dashboards were not efficiently used to guide school planning, policy implementation and administrative decisions. This inefficiency limited the principals' ability to make evidence-based decisions, resulting in reliance on intuition and traditional administrative approaches rather than data-driven systems. The present study finding corroborates and relates with the findings of Holmes et al. (2019), who found that while AI systems can significantly improve decision-making in education through predictive analytics and real-time data interpretation, many school leaders were not adequately prepared to interpret or apply AI-generated insights. Similarly, this finding aligns with Zawacki-Richter et al. (2019), who found that digital decision-support systems were underutilized in school leadership due to lack of technical competence and institutional readiness. Furthermore, the OECD (2023) confirmed that effective decision-making in the digital age requires strong data literacy and AI competence among educational leaders, which remains a challenge in many school systems, including secondary schools.

Finally, it was found out that the public secondary school principals were inefficient in utilizing AI-driven applications for sustainable teaching-learning resource management in the digital age in Delta State. This finding further reported that the principals were inefficient in utilizing AI-driven applications for teaching-learning resource management especially in areas of using AI systems such as Microsoft Copilot for education and Oracle Fusion Cloud ERP (AI-powered resource management) to manage and allocate teaching-learning resources effectively in the digital age. They were inefficient in utilizing AI platforms such as Follett Destiny Resource Manager and Manage Bac analytics to monitor availability and usage of instructional materials in the digital age, using AI applications such as Magic School AI and Khanmigo (Khan Academy) to recommend relevant digital learning resources for teachers, applying AI tools such as Microsoft Intune and Cisco Meraki Dashboard to track utilization of ICT facilities in the digital age in schools, and in using AI systems such as Microsoft Power BI with Copilot and IBM watsonx to improve resource planning and sustainability in the schools. This further implies that AI tools used for managing instructional materials, tracking resource utilization and recommending digital learning content were not effectively applied. This inefficiency contributed to poor allocation and underutilization of teaching resources, limiting the quality and sustainability of instructional delivery in schools. The finding is

supported by Luckin et al. (2016), who found that although AI systems can optimize resource management through adaptive recommendations and resource tracking, their effectiveness depends on leadership efficiency and system integration. UNESCO (2024) confirmed that many schools failed to fully benefit from AI-enabled resource management systems due to inadequate leadership capacity and poor ICT infrastructure. The present study finding concurs and does not deviate from the findings of Selwyn (2022), who found that digital resource management in education is often constrained by insufficient administrative efficiency, which limited the impact of advanced technologies in school systems. Overall, all the findings of this study consistently indicate that principals in secondary schools in Delta State were not efficient in utilizing AI-driven applications across all dimensions of school management, including curriculum and instruction, personnel management, decision-making and teaching-learning resource management. The reviewed literature strongly supports these findings, highlighting that while AI technologies have the potential to transform educational leadership and management, their effectiveness is largely dependent on principals' digital competence, training and institutional support systems. This situation calls for absolute redress in the secondary school system.

Conclusion and Recommendations

This study submits and concludes that principals in the public secondary schools in Delta State were not efficient (inefficient) in the utilization of AI-driven applications for sustainable school management in the digital age. Specifically, their inefficiency cuts across curriculum and instructional management, personnel management, decision-making and teaching-learning resource management. This indicated that although AI-driven applications have the potential to enhance school effectiveness through improved data analysis, automation and evidence-based decision-making, such benefits are not yet fully realized in majority of the public secondary schools in the State. Consequently, sustainable school management in the digital era is being constrained, thereby, limiting innovation, efficiency and overall educational quality in public secondary schools in Delta State. To address this situation, hence the recommendations made below.

From the findings of this study, the following recommendations were proffered:

1. Delta State Government in conjunction with the Post Primary Education Board (PPEB) and other educational authorities should organize consistent compulsory capacity-building programmes and continuous professional development (CPD) training for principals on AI-driven applications and digital leadership in the areas of curriculum and instructional management in order to enhance principals' efficiency in using AI tools for sustainability of instructional, administrative and decision-making processes in public secondary schools in the digital age.
2. The Post Primary Education Board (PPEB) with support from the Delta State Ministry of Education and other external bodies should mobilize and upgrade ICT infrastructure in the public secondary schools, including AI-enabled management systems and reliable internet connectivity, in order to create an enabling environment for principals' efficiency towards utilization of AI-driven applications for sustainable personnel management in schools especially in the digital age.
3. School principals should be effectively encouraged and supervised by the PPEB to adopt data-driven and AI-supported decision-making practices in all aspects of school administration so as to improve their efficiency in planning, monitoring and evaluating school activities for better outcomes and sustainability in the digital age.
4. Stakeholders such as government agencies, private organizations, parents and international development partners such as UNESCO and UNICEF should be highly encouraged to support the growth of public secondary schools in the State through adequate funding, ICT resource mobilization and building strong partnerships aimed at integrating AI technologies and applications into school teaching and learning resource management systems in the digital age. This would also enhance principals' efficiency in utilizing different AI-driven applications in

teaching and learning resource management in order to ensure its sustainability and improve the long-term effectiveness of public secondary school administration in the digital age.

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