Journal homepage:
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International Journal of Educational Management, Rivers State University.

Artificial Intelligence (AI)-Driven Decision Support Systems for Sustainable Administration of Public Universities in Rivers State, Nigeria

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Abstract

The integration of Artificial Intelligence (AI) in the administration of public universities has the potential to greatly enhance decision-making processes, ultimately leading to more sustainable and efficient institutions. The manual handling of vast data from various silos in the traditional manner is proving to be outdated and unsustainable. To effectively work towards achieving sustainable development goals, universities must capitalize on Artificial Intelligence technologies for informed decision-making, resulting in enhanced operational efficiency and improved student outcomes. This paper examines AI-driven decision support systems for sustainable administration of public universities in Rivers State, focusing on the potentials and challenges associated with its utilization. By leveraging on artificial intelligence, the decision support system analyze the vast data and enables institutions to make informed decisions regarding document management, student outcome prediction, resource allocation, and strategic planning, ultimately contributing to a more sustainable future for these universities. This potential enables the AI system to address current challenges and consequently paves way for advancement. The paper concludes that AI technologies have become very imperative for the effective and sustainable administration of public universities in Rivers State, Nigeria. The paper recommends inter alia that the administration of higher institutions in Rivers State should implement the application of AI technologies for enhanced operational and administrative effectiveness.

Keywords: Artificial Intelligence, Decision Support System, Sustainable Development, Public Universities

Introduction

Educational management is considered as an integral part in the realization of sustainable development. Sustainable development entails responsible management of resources to ensure their availability for future generations. In other to achieve quality education which is one of the sustainable development goals (SDGs), artificial intelligence (AI)-driven decision support systems need to be integrated into various aspects of educational processes. AI-driven decision support systems in education leverage artificial intelligence (AI) technologies such as adaptive learning platforms, intelligent tutoring systems, and personalized contents recommendations to enhance decision-making processes, as well as supporting students within educational institutions (Aballa, Akintayo, &Eneh, 2024). These systems harness the

power of data analytics, predictive modeling, and machine learning to optimize students' enrolment, resource allocation, strategic planning and curriculum development (Zhang & Goyal, 2024).

Artificial intelligence (AI) which is an aspect of computer science involves development of AI algorithms, and programming machine language (ML) modeled after the decision-making processes of the human brain, that can learn from available vast data and make increasingly more accurate classifications or predictions over time (Rouse, 2024). It replicates human capabilities through combination of advanced technologies that enable it sense, comprehend, learn and act with a level of intelligence comparable to human cognition (Widodo, Korwa, &Nuraini,2023).They explained further that AI systems perceive environment, recognize objects, imitate patterns, and learn from past experiences which enable it to contribute to decision-making and solve complex problems, hence making its usage in many industries, including education successful for sustainable development.

Sustainable development goals (SDGs) are a set of 17 global objectives adopted in 2015 by the United Nations to achieve a sustainable future by 2030 (Avurakoghene & Oredein 2023). They are intended to address pressing global challenges such as: climate change and environmental degradation, poverty and inequality, economic instability, inequality, social justice and human rights. The need for sustainability in education is crucial and include but not limited to practices that ensure long-term accessibility, effective use of resources and environmental considerations. According to UNESCO (2024), education for sustainable development (ESD) is a lifelong learning process that equips learners of all ages with skills, knowledge and values that would enable them make informed decisions, take action to change society and care for the planet. An educational system designed to be able to support learners of all ages, adapt to changing circumstances- socially, environmentally, economically, and reduce its impact on the environment is referred to as sustainable learning (Alshahrani, 2023). AI is playing an essential role in the actualization of the SDGs, by increasing the effectiveness of sustainable learning. Educational administrators utilizing AI can access a decision support system to identify and improve slow processes, offer guidance and training to employees for increased efficiency and sustainable growth.

Public universities in Rivers State handle large amounts of data using the traditional documentation process which heavily relies on paper usage, with each document often being duplicated and submitted to multiple offices – sometimes more than three times. When

multiplied by thousands of students across these public universities, this practice results in substantial deforestation and incurs significant financial costs. Students often need to request success letters, transcripts, and certificates from their universities for various purposes, such as pursuing further education, applying for scholarships, or career advancement. Typically, universities rely on historical physical records stored in their archives to decide whether to issue such documents. However, students are still required to submit the documents they provided during their enrollment and registration processes. The process of retrieving a student's file from the archives can take anywhere from two weeks to several months. In some cases, the file may be completely missing, prompting the university to request that the student resubmit all relevant documents all over again. Once the file is retrieved, processing the request can take additional weeks as the documents move through multiple administrative desks. This inefficient process leads to significant time delays, mismanagement of resources, decreased satisfaction resulting in reduced retention rates and negative word-of-mouth. All of which compromise student success and institutional effectiveness. There have been various studies on the use of AI to enhance student learning experience and performance, predict student outcomes and ease admission processes. However, there seem to be a dearth with regards to leveraging AI in automating documentation processes, this paper therefore seeks to examine this gap. AI-driven DSS, integrate data from different silos, using predictive analytics, machine learning, and data visualization. Implementing AI-driven DSS can reduce the manual stress on staff and administrators in public institutions, help them make faster and more efficient decisions, thereby reducing processing times, improving resource management as well as enhance the reputation of these institutions.

The purpose of this study is to examine the potential of AI-driven decision support systems (DSS) in promoting sustainable administration within public universities in Rivers State, Nigeria. By addressing the challenges of inefficiency, resource mismanagement, and decision-making delay often faced by these institutions, the study aims to highlight how AI technologies can enhance administrative processes, improve accountability and foster long-term sustainability in university governance.

Concept of Sustainable University

Sustainable university administration refers to the ability of universities to operate efficiently, maintain resources, and achieve their goals over time. It involves the integration of sustainable development principles and practices into the management and functions of a university

(Muentes, Alcívar, León, & Chata, 2023). It involves: Environmental sustainability, which entails reducing the institution's ecological impact through energy-efficient methods, waste management, and sustainable use of resources. Social sustainability, which focuses on fostering social justice, equity, and inclusivity within the institution and its community. Economic sustainability, which involves ensuring the financial stability, supporting economic growth and advancement. According to Lane (2021), a sustainable university places sustainability at the core of its research and teaching activities. It is committed to addressing current needs while ensuring that future generations can meet their own needs without compromise.

Sustainable university administration is significant due to its ability to prepare students for a sustainable future by providing them with knowledge, values and skills necessary to address global sustainability issues (Katarína, 2021). It plays a crucial role in minimizing the institution's environmental footprint and promoting sustainable practices (Muentes, Alcívar, León, &Chata2023). Additionally, it enhances the reputation and appeal of the institution by showcasing dedication to sustainability, hence attracting students, staff and partners. Moreover, it supports community development by contributing to local economic progress, social justice, and community involvement. It also encourages innovation, entrepreneurship, and job creation in a sustainable manner, while ensuring the institution's long-term viability by promoting financial sustainability and maintaining its relevance and impacts. By addressing global challenges, sustainable university administration contributes to the achievement of the United Nations' Development Goals (SDGs).

Theoretical Framework

The theoretical framework to this study examined the Systems Theory of Ludwig von Bertanlaffy which posits that an organization is a complex of an interconnected system where each part contributes to the whole.

Systems Theory (Ludwig Von Bertalanffy)

The theory was posited by Ludwig von Bertalanffy, an Austrian-Canadian biologist and philosopher, in the 1940s. The theory views organizations as complex, dynamic systems comprising interdependent elements that must be strategically aligned and coordinated to achieve optimal performance, efficiency, and success (Chikere & Nwoka, 2015). Similarly, a university functions as a system made up of interconnected subsystems, such as academic departments, administration, and finance, all working together to achieve the shared objective of academic excellence. Systems Theory emphasizes that the institutions should be viewed as

integrated systems, rather than separate functions or departments for effective coordination and collaboration among these subsystems.

This theory is applicable to the study of AI-driven Decision Support Systems (DSS), as it underscores how an AI system interacts with and impacts various administrative and academic functions. The implementation of AI-enabled systems facilitates real-time data sharing and decision-making, enabling access to critical data across silos. This interconnectedness enhances institutional coherence and efficiency, aligning with the holistic perspective of systems theory.

Overview of AI applications in education

The application of AI in education comprises a diverse range of tools and technologies that are transforming the field of education. Personalized learning, intelligent teaching platforms, ChatGPT, chatbots, automated knowledge evaluation, virtual reality and extended reality are some examples of such applications (James, 2024; Mithu & Ajith, 2024). They explained further that AI adapts to the pace and needs of individual learners, providing personalized learning experience, while intelligent teaching platforms provide customized feedback and guidance. It automates administrative tasks such as scheduling, and resource allocation, allowing educators focus more on engaging with students (Hambali, Olasupo & Dalhatu, 2020), while also enabling students to concentrate on their academic pursuits instead of being involved in prolonged registration procedures. AI-powered virtual assistants support students with study tips that enhances their learning experience outside the class. Funda (2024) opined that AI systems can track performance and identify learners that are at risk of falling behind, enabling educator's timely intervention. AI-powered translation tools enable non-native speaker understand the educational materials and equally support special need students, promoting inclusivity in diverse classroom. By providing individualized learning opportunities, predicting learning outcomes, automating administrative tasks, supporting students with special needs, and facilitating resource planning, artificial intelligence (AI) in education seeks to increase efficiency, inclusivity, and impact (James, 2024).

Additionally, the use of AI in education addresses important problems like data-driven decision-making, ethical dilemmas, and the potential for future developments in the integration of virtual reality, adaptive learning systems, and universal access to high-quality education, which will ultimately change learning paradigms (Pranav, Nausheen, &Surinder, 2024). Nevertheless, Bobula (2024) emphasized that adoption of AI in higher education has challenges such as ethical concerns like bias in AI decision-making, data privacy, and surveillance. Nargis

and Kumari (2024), added that there is need by institutions to acquire robust infrastructure that can support AI adoption, and train instructors, students and administrative personnel on effective use of AI-powered tools. According to Gulyamov (2024), some administrative and teaching tasks may be automated, potentially displacing jobs, therefore, over-reliance on AI may diminish human interaction and critical thinking skills. He emphasized the need for continuous evaluation of AI systems and collaboration among experts and stakeholders for optimizing AI in decision-making. It is important that AI systems are accurate, secure and can be integrated with existing infrastructure.

Several case studies demonstrate the effectiveness of AI-driven Decision Support Systems (DSS) in education globally, higher institutions in Nigeria are also leveraging AI to enhance various educational processes. Aderuyi and Amaewhule (2024), examined the adoption of AI to sustain lecturers' academic integrity, they concluded that while lack of competence and career progression can drive lecturers to academic fraud, AI provide them with personalized learning. Afonughe, Onah, Uzoma, Andor, and Orisakwe (2021), investigated the integration of AI-chatbot into teaching and learning in South-South, Nigeria. They found out that universities in South-South are yet to integrate the AI-chatbot into administration task and education, and that traditional approach of teaching and handling administrative tasks are still in use. By implementing AI-driven systems institutions can create a more efficient, effective, and student-centric environment, ultimately driving success and excellence.

Sarjiyus, Goni, and Jamilu (2019) developed an intelligent decision-support system for university admission and placement of potential students in Nigerian universities. Their findings showed that the system chose the most qualified applicants, while placing other eligible applicants who did not meet the requirements for a particular program into alternative courses that are available and for which they qualified. Neelakrishnan (2024) provided decision support system for redefining enterprise data management with AI-powered automation to show how AI technologies can enhance data accuracy, processing efficiency and decision-making capabilities. The results indicated that the implementation of AI-driven automation leads to significant improvement in processing speed and data accuracy. Widodo, Korwa, and Nuraini, (2023) developed a system to identify and implement strategies for the implementation of artificial intelligence in lecturer performance evaluation systems in higher education. They focused on how to improve the efficiency of lecturers' evaluation process, objectivity, accuracy, and providing meaningful feedback to the lecturers. The result revealed that implementing

artificial intelligence in the lecturers' performance evaluation system succeeded in improving the accuracy of the evaluation.

Benefits and challenges associated with the adoption of AI-driven systems

The benefits of AI-driven DSS in education are numerous, and they enhance both teaching and administrative processes. AI-driven DSS has the ability to automate routine administrative tasks, such as scheduling and student record-keeping, thereby allowing educators and administrators focus more on engaging with students and improving the learning outcomes Avurakoghene and Oredein (2023). Additionally, Mithu and Ajith, (2024) explained that AI-driven DSS analyzes individual student data, and tailors the educational content to meet the diverse learning preferences and needs of each learner, thereby providing personalized learning experiences. Pranav, Nausheen, and Surinder (2024) added that such personalization enhances student engagement and outcomes. Furthermore, Funda (2024) explained that AI-driven DSS uses predictive analytics to assist educators identify at-risk students, enabling timely interventions through support and hence improving educational effectiveness. According to Funda (2023), AI-driven DSS can learn from historical data, optimize resource allocation strategies, and ensure resources are efficiently utilized to align with organizational goals. This transformative approach streamlines operations and equally foster a data-driven culture, improving operational efficiency and productivity within the universities (Kumar, 2024). The systems support research excellence by selecting and analyzing large volumes of literature with speed and accuracy, identifying patterns and relationships that may not be immediately apparent to human researchers, and also enhance collaboration and knowledge sharing, which invariable improves the quality of the research (Braun, Hummel, Beck & Dabrock, 2020). Other benefits of applying AI in DSS for sustainable development include: reduction in costs, increased accuracy and efficiency, enhanced productivity and better decision-making.

A major challenge is the integration of existing administrative procedures and infrastructure with AI-driven DSS, often due to outdated structures, resistance to change, or a dearth of expertise. AI-driven DSS is data driven, therefore quality and quantity of data must be ensured, the data must be complete, accurate and relevant. According to Abdulsalam, Adnan, Nasr, and Yousra (2023), Uggla and Soneryd (2023), financial constraints poses a significant challenge, educational institutions may lack the necessary resources to adopt these technologies, or educate staff on effective use and interpretation of AI-driven DSS recommendations, thereby slowing the pace of advancement. Cybersecurity and data privacy concern is another challenge

highlighted by James (2024), emphasizing that data collection, storage and usage need to be carefully managed to avoid data compromise or misuse. The pursuit of sustainability goals requires commitment across all institutional levels. However, the issue of inconsistency in stakeholder engagement and buy-in can prevent the adoption of AI-driven DSS and the development of inclusive initiatives, which obstructs progress towards a sustainable future. Funda (2024), stressed that education institutions may encounter opposition arising from established practices or cultural beliefs that do not align with sustainability objectives.

AI-Driven Decision Support Systems in Public Universities: Improving Student Support Services

1. **Machine Learning (ML)**: ML algorithms are employed to analyze large datasets, identify patterns, and make predictions. This helps in enhancing the decision-making capabilities of DSS by learning from historical data and improving over time.
2. **Expert Systems**: These systems use knowledge-based AI to simulate the decision-making ability of a human expert. They are particularly useful in situations requiring specialized knowledge and are often integrated into DSS for tasks like diagnostics and troubleshooting
3. **Data Mining**: AI-driven data mining techniques help in discovering hidden patterns and relationships within large datasets, which can then be used to inform decision-making processes within DSS.
4. **Natural Language Processing (NLP)**: NLP allows DSS to interact with users in natural language, making the systems more accessible and user-friendly. It enables the processing and analysis of unstructured text data, such as emails and reports.
5. **Fuzzy Logic**: This AI technique is used to handle uncertainty and imprecision in decision-making. Fuzzy logic systems are integrated into DSS to enable it make decisions in uncertain environment.
6. Predictive Analytics: This AI technique uses data mining, statistical models, and ML to forecast trends and outcomes.
7. Deep Learning (DL): DL is a subset of ML which uses neutral networks to analyze complex data such as text and images.

AI-Driven Decision Sustainable Administrative Practices

AI-driven systems for document management and automation decision Support Systems (DSS) utilize artificial intelligence technologies to enhance the efficiency and accuracy of

administrative processes (Kumar, 2024). These systems according to James (2024), address the issues associated with traditional data management by automating administrative tasks such as scheduling, grading, and resource allocation, thereby enhancing resource utilization, reducing waste, and improving overall efficiency. Kumar (2024), added that the integration of AI in document management not only simplifies workflows but also enhances resource allocation and decision-making via predictive analytics and sentiment analysis.AI-driven systems is transforming administrative decision-making by minimizing waste and improving efficiency. They automate and streamline processes, significantly reducing the time administrative officers spend manually reviewing archived files. By utilizing natural language processing for email organization and virtual assistants for administrative support, AI-driven DSS transform how institutions manage data, ensuring real-time insights and data integrity (Neelakrishnan, 2024). The integration of AI in data management systems has transformative impact which is evident in its ability to automate processes, thereby alleviating the workload of administrative staff, reducing errors, and enhancing collaborative work environments (Widodo, Korwa, &Nuraini,2023).

AI-driven DSS apply predictive analytics to document management by automating document classification, tagging, and categorization. It groups similar documents together for easy management and efficient retrieval, generate concise summaries and forecast document relevance and ranking for improved search results. By leveraging AI-driven DSS, universities can implement sustainable administrative practices, accurately predict resource needs and demands, and effectively plan and allocate staff. These systems also enable forecasting of future resource requirements and minimize equipment and resource downtime through proactive maintenance scheduling.

Ethical Considerations and Future Directions

AI in higher education management faces ethical challenges such as biases in data, leading to unfair results affecting admissions, grading and resource allocation. Privacy concerns arise from vast data collection, raising issues about personal information protection. Users may struggle to understand AI decision-making, making it hard to hold institutions accountable. Reliance on AI may reduce human autonomy, increasing dependence on automated systems. Job displacement due to AI automation raises concerns about future work and the need for up skilling in educational institutions (Gulyamov2024).

Future research in AI for sustainable higher education management should focus on improving decision support systems to enhance resource allocation and institutional efficiency. Universities can use AI-driven analytics to predict enrollment trends, manage budgets, and customize educational offerings to meet student needs, promoting sustainability. George and Wooden (2023), explained that exploring multimodal learning analytics can offer insights into student engagement and performance for personalized learning experiences. Afolabi (2024), opined that research should address data privacy and algorithmic bias to ensure ethical AI use in education. Avurakoghene and Oredein (2023), added that AI can help manage renewable energy resources, optimize energy consumption, and reduce waste in university infrastructures to support eco-friendly initiatives. These efforts can significantly aid in the sustainable transformation of higher education institutions.

Conclusions

AI-driven decision support systems (DSS) are crucial for sustainable higher education management, enhancing operational efficiency and making informed decision. These systems analyze vast amounts of data to provide clear understanding of the situation, facilitating strategic planning, resource optimization, and improved student services, ultimately leading to better educational outcomes and increased student satisfaction. However, the successful implementation of AI in higher education faces challenges, including data quality issues, privacy concerns, and the need for continuous technological advancements. Promoting a culture of collaboration and breaking down data silos within institutions are necessary for maximizing the benefits of AI DSS.

Suggestions

1. AI-driven DSS holds transformative potential, there should be careful consideration of its challenges and ethical implications for effective application.
2. Higher education institutions should integrate AI, DSS with the existing infrastructures to manage resources more efficiently and attain sustainability.

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