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Unlocking the Potential of Education in Nigeria's Industry 4.0 Era: Overcoming Challenges of Digital Transformation

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Abstrak

Pengenalan Industri 4.0 telah membawa kemajuan teknologi luar biasa yang telah mengubah banyak industri berbeda di seluruh dunia. Ketika Nigeria berjuang untuk mengikuti revolusi digital, negara ini menghadapi banyak kendala pendidikan. Hambatan utama terhadap keberhasilan penerapan transformasi digital dalam sistem pendidikan Nigeria dibahas. Penelitian ini bertujuan untuk menganalisis pentingnya membina kemitraan antara badan pemerintah, eksekutif bisnis, dan institusi akademis. Metode penelitian menggunakan Systematic Literature Review (SLR). Proses pengumpulan data dilakukan dengan mengidentifikasi dan mengevaluasi artikel ilmiah yang relevan dengan topik. Setelah mengidentifikasi artikel yang relevan, proses analisis data dimulai dengan membaca secara menyeluruh setiap artikel terpilih. Studi ini menemukan bahwa kolaborasi dapat mempermudah berbagi informasi, sumber daya, dan keahlian, sehingga menciptakan lingkungan bagi revolusi digital dalam pendidikan. Kesimpulannya, Nigeria harus mengatasi beberapa kendala untuk sepenuhnya mewujudkan potensi pendidikan di era Industri 4.0. Dengan berinvestasi di bidang infrastruktur, pelatihan guru, pengembangan kurikulum, kolaborasi, penelitian, dan inklusivitas, Nigeria dapat mewujudkan janji transformasi digital untuk meningkatkan sistem pendidikannya dan mempersiapkan tenaga kerja masa depan untuk menghadapi tuntutan era digital.

***Kata kunci*:** *Transformasi Digital, Adaptasi Era Industri 4.0, Pembangunan Ekonomi.*

Abstract

The introduction of Industry 4.0 has led to enormous technology advancements that have altered many different industries throughout the world. As Nigeria struggles to stay up with the digital revolution, it faces numerous educational obstacles. The primary obstacles to the successful implementation of digital transformation in the Nigerian educational system are examined. This study aims to analyze the importance of fostering partnerships between governmental bodies, business executives and academic institutions. The research method uses Systematic Literature Review (SLR). The data collection process is carried out by identifying and evaluating scientific articles that are relevant to the topic. After identifying relevant articles, the data analysis process began by thoroughly reading each selected article. The study found collaboration can make it easier to share information, resources and expertise, creating environment for the digital revolution of education. In conclusion, Nigeria must overcome several obstacles to fully realize the potential of education in the age of Industry 4.0. By investing in infrastructure, teacher training, curriculum development, collaborations, research, and inclusivity, Nigeria may embrace the promise of digital transformation to enhance its educational system and prepare its future workforce for the demands of the digital era.

Keywords: Digital Transformation, Adapting Industry 4.0 Era, Economic development.

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1. INTRODUCTION

In recent years, the concept of Industry 4.0 has gained significant attention worldwide. The concept of Industry 4.0 refers to the current technological advancements and digital transformation that are reshaping various industries globally (Kergroach, 2017; Rahmadani et al., 2020). It encompasses the integration of cyber-physical systems, the Internet of Things (IoT), artificial intelligence (AI) and other technologies to enable automation, data exchange and smart production. This revolution has had a profound impact on industries such as manufacturing, healthcare, transportation, and finance, among others (Robandi et al., 2019; Tsang et al., 2021). The rapid advancement and adoption of technology in Industry 4.0 have created a demand for a highly skilled workforce. To leverage the opportunities presented by this era, individuals need to acquire the necessary knowledge and skills to adapt to the changing demands of the job market. It can also foster critical thinking,

problem-solving, creativity and adaptability which are essential for thriving in a rapidly evolving digital landscape. By equipping individuals with these skills, education can help bridge the skills gap and ensure a smooth transition into the Industry 4.0 era (Fearnley & Amora, 2020; Lee, 2022; Schlegel et al., 2021). This transformation has had a profound impact globally, revolutionizing traditional business models and creating new opportunities for growth and innovation. This global phenomenon has revolutionized how businesses operate, leading to increased efficiency, productivity and competitiveness (Abdurrahmansyah et al., 2022; Ananyin et al., 2018; Lampropoulos et al., 2019). In this era of rapid technological advancement, education plays a crucial role in preparing individuals to navigate the challenges and seize the opportunities presented by Industry 4.0. The traditional education system must adapt to equip students with the necessary knowledge and skills required to thrive in a digital economy (Angiolini et al., 2020; Yeni & Cagiltay., 2017). By embracing digital transformation in education, Nigeria can unlock its potential and ensure its workforce remains competitive and relevant in the global market.

To thrive in this digital age, individuals need to acquire the necessary skills and knowledge to effectively navigate technological advancements and adapt to the changing demands of the job market. However, Nigeria faces various challenges in embracing digital transformation in education. These challenges include the lack of infrastructure, limited access to technology and internet connectivity, inadequate funding and a shortage of qualified teachers. These factors hinder the effective integration of digital tools and technologies into the education system, limiting the potential for growth and development (Angiolini et al., 2020; Gopalan et al., 2020). Furthermore, collaboration between the government, private sector, and educational institutions is essential to drive digital transformation in education. Public-private partnerships can provide the necessary funding, expertise and resources to implement innovative solutions and initiatives. This collaboration can also foster research and development in education technology, leading to the creation of tailored solutions that cater to the specific needs of Nigerian students and educators (Bosman & Fernhaber, 2019; Divjak & Tomić, 2011).

The key features of Industry 4.0 are characterized by the use of automation technologies such as robotics and autonomous systems, to streamline production processes and improve efficiency. These technologies can perform repetitive tasks with high precision, reduce human error and increase productivity (Gandasari et al., 2020; Kowang et al., 2020). AI plays a crucial role in Industry 4.0 by enabling machines to learn from data, make decisions and perform tasks that typically require human intelligence. Machine learning algorithms, natural language processing and computer vision are examples of AI technologies that are being integrated (Almeida & Simoes, 2019; Machay et al., 2022). In Industry 4.0, IoT enables machines, products and systems to communicate and collaborate, leading to improved efficiency, predictive maintenance and real-time monitoring of production processes. The objective of this research is to analyze the challenges faced by Nigeria in embracing digital transformation in education and propose solutions to unlock its potential.

2. METHODS

The research method uses Systematic Literature Review (SLR) is a research method used to collect, review and synthesize relevant literature in a particular research field (Manfra, 2019). This method has systematic steps designed to minimize research bias and ensure that all relevant literature has been examined. This approach is particularly useful for investigating the potential of education in Nigeria's industry 4.0 era: overcoming challenges of digital transformation. The data collection process is carried out by identifying and evaluating scientific articles that are relevant to the topic. This data includes findings,

research results, and other related information contained in these articles. A literature search was conducted through academic databases, such as PubMed, ERIC, and Google Scholar, using appropriate keywords such as “potential of education,” “industry 4.0,” and “digital transformation.” After identifying relevant articles, the data analysis process began by thoroughly reading each selected article. Relevant data such as findings of positive or negative impacts of school-university partnerships and professional learning communities were extracted. Next, this data is analyzed to identify patterns, trends, and consistencies in the findings. Compiling a summary and synthesis of the findings helps in understanding the overall impact. The analysis also allows identification of potential of education in Nigeria's industry 4.0 era: overcoming challenges of digital transformation. The results of this analysis form the basis for drawing up the conclusions in the SLR report, which presents a comprehensive picture of the impact of the partnership based on existing evidence in the literature.

3. RESULTS AND DISCUSSION

Results

The Current State of Education in Nigeria

In Nigeria, education plays a vital role in the socio-economic development of the country. The education system in Nigeria follows a 6-3-3-4 structure, consisting of six years of primary education, three years of junior secondary education, three years of senior secondary education, and four years of tertiary education. Primary education is compulsory and serves as the foundation for a child's educational journey while tertiary education provides higher learning opportunities. Despite the significance of education, the Nigerian education system faces numerous challenges that hamper its effectiveness and quality (Igwe et al., 2021; Nwajiuba et al., 2020). Many public schools in Nigeria lack basic amenities such as classrooms, libraries, laboratories and sanitary facilities. Many schools in Nigeria, particularly in rural areas, lack basic infrastructure such as classrooms, libraries, laboratories, and proper sanitation facilities (Adams Ogirima & Onyiyeche Emilia, 2018; Suleiman, 2021). Inadequate infrastructure hampers the learning environment and affects the quality of education. Access to quality education remains a significant challenge, especially in rural and underserved areas. Factors like poverty, distance to schools and gender disparities contribute to limited access, leading to an increase in the number of out-of-school children.

The education system often suffers from outdated curricula that do not align with the demands of the modern workforce and the Industry 4.0 era. The lack of emphasis on practical skills, digital literacy and emerging technologies hinders students' preparedness for the evolving job market (Andarwulan et al., 2021; Fatimah & Santiana, 2017). The shortage of qualified and well-trained teachers is prevalent in Nigeria's education system. Many teachers lack adequate training which affects the quality of instruction and hamper students' learning outcomes. The education sector in Nigeria often faces budgetary constraints, resulting in insufficient funding for schools, teacher salaries and educational resources. This lack of funding impacts the overall quality of education (Campbell, 2018; Florence Aduke, 2015).

Challenges Associated with Digital Transformation of Education In Nigeria

The digital transformation of education in Nigeria is important as the country aims to keep pace with the rapid advancements of Industry 4.0. As technology continues to evolve, educational institutions in Nigeria must adapt and integrate digital tools and strategies into their systems. However, this transition is not without its challenges. One of the primary challenges associated with the digital transformation of education in Nigeria is the lack of infrastructure and access to technology. Many schools, especially in rural areas, lack the

necessary resources and connectivity to fully embrace digital learning (Gupta et al., 2022; Nardo et al., 2022). This digital divide poses a significant obstacle to the widespread adoption of Industry 4.0 technologies in education. Another challenge is the resistance to change from both educators and students. Many teachers may be resistant to incorporating technology into their teaching methods, either due to a lack of knowledge or fear of being replaced by automation. Similarly, students may struggle to adapt to new learning methods that require digital literacy skills. Overcoming this resistance and providing the necessary training and support is crucial for a successful digital transformation (Nesbit & Li, 2004; Vorona et al., 2020). Additionally, the cost of implementing and maintaining digital infrastructure and tools can be prohibitive for many educational institutions in Nigeria. Limited budgets and funding constraints make investing in the necessary technology and training required for a smooth transition to Industry 4.0 in education challenging. Finding sustainable funding models and partnerships is essential to overcome this challenge. Another significant challenge is the need for a comprehensive digital curriculum that aligns with the demands of Industry 4.0.

Transformative Impact of Industry 4.0

Industry 4.0 has revolutionized industries across the world by introducing advanced technologies that enable automation, connectivity and data-driven decision-making. These technologies include the Internet of Things (IoT), artificial intelligence (AI), big data analytics, cloud computing and robotics. Industry 4.0 technologies enable automation and optimization of various processes, leading to increased efficiency and productivity (Fearnley & Amora, 2020; Yu et al., 2022). For example, smart factories equipped with IoT devices can monitor and control production processes in real time, optimizing the use of resources and reducing downtime. Digital transformation allows for greater flexibility and customization in production processes. With the ability to collect and analyze large amounts of data, companies can tailor their products and services to meet individual customer needs. This level of customization increases customer satisfaction and creates a competitive advantage.

Industry 4.0 technologies provide real-time data and analytics, enabling businesses to make informed decisions quickly (Bond et al., 2018; Frankiewicz, B., & Chamorro, 2020). With the integration of AI, machines can analyze vast amounts of data, detect patterns and provide valuable insights, helping organizations optimize their operations and identify new business opportunities. Digital transformation opens up opportunities for new business models and revenue streams. For instance, the rise of sharing economy platforms like Uber and Airbnb is a result of leveraging digital technologies to connect service providers with customers in innovative ways.

Challenges of Digital Transformation in Nigerian Education

One of Nigeria's largest challenges to embracing digital transformation in education is the absence of dependable internet connectivity and access to technology, particularly in schools and rural areas. In other cases, educational institutions lack the technical infrastructure—including PCs, tablets, and smart devices—necessary for effective digital learning. Insufficient internet connectivity further hinders the seamless integration of online learning platforms and access to digital materials (Dina Nailatur Rohmah, 2022; Qodr et al., 2021). Another significant barrier to successful classroom technology utilization is the lack of qualified teachers who possess the technical know-how needed. It's possible that traditional teacher preparation programs don't give educators the skills they need to present and integrate digital information and resources. Due to a lack of qualified teachers to set the example, the potential advantages of digital transformation in education may not completely materialize (Arnaiz-Sánchez et al., 2023; Domike & Odey, 2014). In Nigeria, there are significant issues with the cost and accessibility of digital learning resources. The expense of the gear and

software required for digital learning may be prohibitive for many students and educational institutions. Additionally, if they reside in rural locations with low connectivity, students might not have access to all of the available digital learning materials, such as e-books, online courses and educational apps.

Addressing those Challenges

To address the lack of access to technology and the Internet in schools and rural regions, investment in technology infrastructure and the growth of Internet connectivity are essential. Collaborations between the public and private sectors can assist create computer laboratories, provide equipment and set up dependable internet connections to support digital learning settings. Effective adoption of digital transformation in education can be facilitated by the implementation of comprehensive teacher training programs that emphasize digital literacy, technological integration and modern teaching approaches (Dubinsky et al., 2019; Nawaz & Ghulam, 2010). Teachers can stay current on the newest trends and techniques in digital teaching by attending regular workshops and professional development opportunities. Partnerships between the public, corporate and nonprofit sectors can aid in lowering the cost of and increasing the accessibility of digital learning tools and resources.

Initiatives could be developed to offer discounted technology or access to digital content, especially for children from underprivileged homes. To give students and teachers access to top-notch teaching materials, promote the usage of open educational resources (OER). OER are open source and flexible, aid in bridging the accessibility and cost gaps in online learning materials. By addressing these issues and implementing targeted solutions, Nigeria can get ready for an educational system that has successfully undergone a digital transition. This will give educators and students the tools they need to benefit from the digital era and get ready for Industry 4.0.

Discussion

The Nigerian government should develop a thorough national digital education strategy that specifies precise goals, deadlines, and plans for incorporating technology in classrooms. This plan ought to cover digital accessibility, teacher training, content creation, and infrastructure improvement. Building a solid infrastructure with dependable internet connectivity, providing schools with cutting-edge digital devices, and ensuring access to top-notch educational resources are all necessary steps in creating a digital learning ecosystem (Chen, 2022; Prasetya, 2021). Public-private partnerships have a significant impact on this initiative's ability to secure funding and resources. To lower the cost of educational materials, encourage the usage of open educational resources. Students learning experiences can be improved and made more accessible by encouraging educators to produce and distribute digital content that is in line with the national curriculum. All students can benefit from equal learning opportunities by investing in broadband infrastructure and increasing internet access. Initiatives by commercial organizations focused on corporate social responsibility can make a major difference in increasing students' access to digital resources (Hsieh et al., 2011; Lisenbee & Ford, 2018). Organize ongoing, required teacher education courses that emphasize digital literacy, technology integration, and cutting-edge teaching strategies. Give teachers the knowledge and assurance they need to use technology in the classroom successfully.

International accolades have been accorded to Estonia for its effective use of digital technology in its educational system. The use of digital tools to enhance teaching and learning and prepare students for the digital future has advanced significantly across the country. Estonia has made large efforts in building a solid digital infrastructure, which today offers students access to digital gadgets and high-speed internet connectivity (Grant, 2019;

Han & Ellis, 2019). Because of this infrastructure, both urban and rural communities have equal access to technology. The Estonian government has put in place extensive teacher training programs that emphasize digital literacy and integrating technology. Teachers receive continuous professional development to stay up-to-date with the latest educational technologies. Estonia offers a wide range of digital educational content and resources, including e-textbooks, online courses and interactive learning platforms. This digital content gives learners interesting learning opportunities and is in line with the national curriculum (Byukusenge et al., 2022; Hart et al., 2022). Nigeria can learn several valuable lessons from Estonia's successful digital transformation in education by Investing in robust digital infrastructure, including internet connectivity and access to digital devices which is crucial to ensure equitable access to technology across all regions of the country.

Providing comprehensive and ongoing teacher training programs in digital skills is essential for effective technology integration in classrooms. Teachers should be given the skills and assurance they need to effectively use digital tools. The quality of education may be improved and the unique requirements of Nigerian students can be met by creating and curating digital educational content that is pertinent to Nigeria's context and is in line with the national curriculum. Singapore is well known for its innovative approach to integrating technology into education (Bandur et al., 2022; Kalkan et al., 2020). The nation's educational system has adopted digital transformation successfully to get pupils ready for a fast-changing digital context. With a focus on digital pedagogy that promotes collaborative and individualized learning, Singapore places a strong emphasis on a learner-centric approach to education. Technology is a tool that is utilized to improve critical thinking and participation. Singapore has an extensive national program for teaching digital literacy that begins at a young age and lasts the duration of a student's academic career (Koh et al., 2021; Yamashita et al., 2019). Students who complete this curriculum will have digital literacy and cybersecurity knowledge.

For the creation of cutting-edge educational technologies and resources, the Singaporean government works in partnership with businesses in the private sector and EdTech startups. These partnerships foster a culture of innovation in education. Nigeria can draw valuable insights from Singapore's successful digital transformation in education by emphasizing learner-centric approaches to education, where technology enhances collaboration and personalized learning which can make education more engaging and relevant for Nigerian students. Early introduction to digital literacy programs will aid in laying a solid foundation for kids to traverse the digital world with assurance. Innovative digital learning solutions can be developed and implemented faster in Nigeria by collaborating with private sector businesses and EdTech startups.

4. CONCLUSION

In conclusion, unlocking the potential of education in Nigeria's Industry 4.0 era is crucial for the nation's future prosperity and development. With coordinated efforts and a focus on equipping the workforce with digital skills and competencies, Nigeria can thrive in the digital age and harness the transformative power of technology to advance its society and economy. Nigeria can benefit from focusing on building digital infrastructure, investing in teacher training, developing localized digital content, promoting learner-centric pedagogy, and fostering public-private partnerships. By learning from these best practices and adapting them to their unique context, Nigeria can unlock the potential of education in the Industry 4.0 era by empowering its students for a digitally-driven future.

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