Industrial Revolution 4.0: Challenge in the Management of Tertiary Educational Institutions in Nigeria

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Abstract

The world has passed through various industrial revolutions where various technologies were initiated to subdue the environment for the betterment of man and society. Industry 4.0 is an epoch where artificial intelligence and robotics perform tasks hitherto preserved for man. It is a period that has changed the educational landscape and enhanced efficiency and productivity. The paper is on Industrial Revolution 4.0, the challenge in managing tertiary educational institutions in Nigeria. The upsurge of smart machines has provided opportunities and benefits for educational institutions and made education affordable, accessible and reach the underserved and the vulnerable in society. The integration of digital technologies not only enhance communication but also assist teachers and students with various platforms for personalized learning at individual pace and connivances. The paper discusses the various challenges inhibiting educational institutions from effective integration of Industry 4.0 as the paucity of funds to procure the basic smart machines and the required skills for integration of digital technology. The researcher opines that procurement of digital technology is not the silver bullet that will enhance efficiency and productivity in educational institutions but the ability to exploit the potential of digital technology. The study suggests that the federal government through legislation should ensure that the budgetary allocation to education should not be less than 20% of an annual budget, constantly review curricula to be in tandem with Industry 4.0 and continuously skilling and reskilling academic lecturers on the use of smart machines.

Keywords: Industrial revolution, Management, Tertiary education.

Introduction

Since the inception of humanity, there have been concerted efforts to subdue the environment and make it habitable. Different generations have adopted different techniques to improve the environment and to ensure that their abode is devoid of obstacles and inhibitors that are inimical to the development of man and society. In search of laudable ways to make life meaningful individuals and nations make friends and establish relationships between nations. In

the process, trades are established, tools are manufactured, and technologies are developed to ensure that the environment is subdued for the benefit of man and society. It is the instinct to survive that early man invented "tools and harnessed the power of fire". This is the genesis of early technology used by early men for their survival. Within this period, people worked on their farms with their hands for subsistence living. These changed with the invention of machines which are used for the production of farm products in faster and easier ways.

This is the prelude to the concept of the first industrial revolution. It is pertinent to emphasise that the industrial revolution is a global transmission from one technology to another for effective and efficient technology to provide plausible solutions to the needs of society. The first industrial revolution started in the eighteenth century with the hallmark of the invention of the steam engine and the construction of railroads. During this period we witnessed the mechanization of agricultural products and that paved the way for industrialization. The second industrial revolution spanned from the end of the nineteenth century to the early twentieth century. During this period, electricity was invented and it boosted industrial activities to large-scale production. (Lasi et al 2014). The third industrial revolution was associated with the invention of information technology, computers and the internet in the 1960s. It is also called the computer or digital revolution where technology is the main drive of the system (Klaus, 2018). It was a period of digitalization and the invention of computers, the internet, automation and the discovery of nuclear energy. The Fourth Industrial Revolution same as Industrial 4.0 or Industrial Revolution 4.0 is the epoch of the Internet of Things (IoT), robotics, virtual reality (VR), and artificial intelligence (AI).

Industrial 4.0 opened the digital world and provided a vista of opportunities to change the landscape of the educational system. Teaching and learning are enhanced with digital technology and distance is no longer a constraint. It is enlightening to observe that the industrialized world has integrated Industrial 4.0 into their educational system and the benefits are enormous: in teaching, learning, research, and every facet of educational management. A cursory look at the Nigerian educational system in the twenty-first it seems that educational institutions in Nigeria are yet to fully automate the system to reap the benefits of digital technology. In the process deny the students the benefits of digital technology. The teacher teaches with archaic teaching methods with obsolete technology. The upsurge of new technology like robotics, cloud computing, and artificial

intelligence is causing academic eruption and changing the workplace. This prompts several unanswered questions: How is the Nigerian education system prepared for the fourth industrial revolution? Do we have the required manpower with the necessary skills to meet the demand of Industry 4.0? Does tertiary education have the basic educational infrastructures to meet the rising technology demand of Industry 4.0? Is the pedagogical content in tandem with the fourth industrial revolution? It is in search of plausible solutions to the above-mentioned challenges that the paper discusses the Industrial Revolution 4.0: challenges of management of tertiary educational institutions in Nigeria. So, the paper is structured after the introduction, and theoretical analysis. clarification of related concepts, management of tertiary education, nexus between the industrial revolution and tertiary education, benefits of technology and tertiary education, challenges, conclusion and suggestions.

Theoretical Analysis

Theories are constructs or ideas that are used to guide, predict, and understand not only behaviour but explain social issues as they affect society. It is on this note that the study is hinged on Human Capital Theory. Awodiji and Naicker (2023) opine that Human Capital Development was pioneered by University of Chicago economists led by Schultz in 1961 and 1962 and Backer in 1962. The fundamental assumption of Human Capital Theory is that human capital is an investment in man and this can be acquired through education and training. The more an individual acquires education the more increase in productivity. The increase in productivity will eventually lead to an increase in salary, eradication of poverty, and less unemployability. Hung and Ramsdem (2023), aver that investment in human capital through education will be an instrument for professional and social mobility with an improved standard of living. According to Korres cited in Robinson and Pope (2023), it is the lack of investment in human capital that distinguishes the poor countries from the rich countries. By implication, poor countries do not invest massively in human capital.

This theory is apt because there are symbolic relation between the fourth industrial revolution and tertiary education for the attainment of economic growth and development of society. Industry 4.0 witnessed a surge in industrial development through advancement in technology in smart machines and intelligent robotics. Higher education is very instrumental for the attainment of these goals through the inculcation of technological know-how to graduates

which will boost their employability and reduce the level of poverty in society. It is pertinent to state that it is through the acquisition and production of new forms of knowledge that prosperity, economics and development can be achieved. Higher education offers the platform for skilled manpower and professional development to equate to the fourth industrial revolution. Thus, higher education is critical for the success of Industry 4.0.

Again, Human Capital Theory appears to be the main driving discussion on the knowledge economy (Robinson and Pope, 2023). The Human Capital Theory was anchored on the buzzword that education and training are pivotal to raising the professional competencies and social mobility of not only the immediate family but also intergenerational. Despite the benefits of Human Capital Theory it also garnered some criticism, mainly that it is too economist without taking into cognizance other non-materials like the social and cultural dimension into account.

Concept of Industrial Revolution 4.0

The term Industrial 4.0 was publicly introduced in 2011 at the Hannover Fair (Xu et al, 2021: Vogel-Heuser and Hess, 2016). Latif, Pervin, and Karim, (2021) opine that the final report of the Industry 4.0 working group was published in April 2013 stating the vision and priority areas for action. Since then the concept has made an inroads into every cranny of society. Industry 4.0 is an epoch where smart technology is integrated with smart machines that can communicate, diagnose, analyze and make decisions without the help of humans (Moore, 2020). According to Tri, Hong and Dung, (2021), Industry 4.0 is the era of the integration of digital technology, biotechnology and artificial intelligence. To, Schulze (2019), the fourth industrial revolution is the process of melting the barriers of the physical technological and biological spheres.

Industrial 4.0 has caused a paradigm shift in the entire phases of human engagement. It has changed and enhanced communication and the ways humans relate. It has added value to society by solving practical societal problems. In the same vein, the education system is not an exemption: it has changed the landscape and broken the educational walls and learners can now learn on their own time and convenience. It becomes necessary to explore Industrial 4.0 in educational institutions.

Management of Tertiary Educational Institutions

Tertiary educational institutions are where higher education is acquired after completing post-basic education. It is where higher certificates are obtained and it consists of universities, polytechnics, professional bodies and other specialized institutions. Examples are the colleges of

education, health, science and institutions of technology. Physical and virtual education, public or private institutions where learners acquire higher intellectual skills, positive values, virtues and knowledge after secondary education. Tertiary education institutions are organized for higher education where intellectual research, development, training and other learning activities are carried out for the development of society. (Alemu, 2018). It becomes imperative to expatiate the essence of tertiary education institutions; education, training, learning and research. The core value is not only the generation of knowledge but also to preservation and dispersing of knowledge to solve the problems of society. According to UNESCO, tertiary educational institutions are not only the provision of lifelong learning but to mobilize resources, develop skills, foster knowledge and disseminate among diverse people. These laudable goals cannot be achieved without adequate planning and monitoring. This brings to the fore the concept of management.

Management is a generic concept that has elicited various definitions from various scholars from different academia. Therefore, it is important to enumerate some of the definitions. Management is the exercise of formal authority over the activities of people in an organization which involves interaction and joint cooperative efforts to achieve set goals (Oriji, 2021: Patrick, 2016). In the same vein, Franklin (2002), defines management as a distinctive activity or process that involves planning, organizing, directing, coordinating and controlling the performance of others to achieve predetermined goals. Olulube, (2013), sees management as a process of achieving organizational objectives within the limited resources in the most effective and efficient ways through the activities of others. From the array of definitions management is a conscious effort of man to use men and materials to achieve predetermined goals and in the process ensure the utmost utilization of the limited resources.

In cognizance of the laudable role of tertiary educational institutions: a factory where leaders and professionals are built, it becomes incumbent that such institutions are managed to attain the goals of education as enshrined in the national policy on education. It is enlightening to note that the educational institutions of the twenty-first century are technology-driven. So, educational institutions should integrate smart machines and technology if they must remain relevant and competitive in a knowledge-driven economy. A knowledge-driven economy is an economy where technology has eliminated the barriers between physical technologies and biological spheres. It is a phase where smart machines perform tasks hitherto reserved for humans.

It is an era where technology is displacing humans in doing tasks that diagnose problems and make decisions. It is an epoch of biotechnology, artificial intelligence and virtual reality.

Nexus between Industry 4.0 and Tertiary Education

Tertiary education is globally acknowledged as not only a pacesetter in economic development but also a driver of prosperity. Tertiary education's mandate is to provide the necessary skills and competent workforce that will drive the industry. In response, the industry is expected to absolve the trained workforce for the development of society. So, there are symbolic relationship between tertiary education and industrial. The upsurge of industrial 4.0 has not only transformed the educational landscape but revolutionized the way teaching and learning are conducted. The integration of smart machine and smart technology in tertiary education is a departure from the traditional methods. The diffusion of digital technology like the use of the internet, cloud computing, and smart technology that aids and enhances learning, teaching, and research and will lead to the attainment of educational goals.

Again, it is incumbent on tertiary education to adjust the pedagogical contents to ensure that the changes that thrum up as a result of Industrial Revolution 4.0 are integrated into teaching and learning. It is incumbent on tertiary education to fill these gaps and perceptible caused by Industry 4.0 (Fahim et al, 2021). Tertiary education should unavoidably adjust to the latest trend in technology rather than oppose it. In so doing, education 4.0 should create a quality workforce that has the potential for innovation, creativity, critical thinking, and problem-solving. Education 4.0 should be able to produce professionals who could innovatively solve current and future challenges using the available physical and digital resources. (Aina, 2022). The author avers that tertiary education will not only provide graduates who will fit and adapt to Industry Revolution 4.0 but also graduates who will be proficient in the use of digital technology and response to the technology that meets human needs. It should be able to produce graduates who have communication and collaborative skills that will enhance teaching and research. Graduates that have high knowledge competence with relevant skills that will fit into Industry 4.0. In so doing, the collaboration of Industry 4.0 and tertiary education will be significant.

It is imperative to state the obvious that industry will continue to evolve. For instance, the last three industrial revolutions came with their unique features and it is incumbent on tertiary education to align their curriculum to cater to the needs of industry. The World Economy Forum

identifies ten skills that are crucial for Industry 4.0 and are crucial in the attainment of tertiary education goals and they are; emotional intelligence, cognitive flexibility, creativity, critical thinking, and collaboration. In addition, Industry 4.0 requires certain skills like people management, negotiation, knowledge production, and management: judgment, decision-making, emotional intelligence, service orientation, and cognitive flexibility (Latif et al, 2021: Verwey, 2022)

Other skills are communication skills, adaptation, and the traditional role of tertiary education in research and development. The onus is on tertiary education institutions to serve as the platform to realign the teaching profession to satisfy the ever-changing demands of the market. To achieve this, there is a need for a total overhaul of tertiary education approach to teaching, learning and research. Also, the tertiary education will continue to upskill its human capacity, revamp instructional facilities, and adopt lifelong learning as a learning strategy. In so doing, there will be a significant relationship between the industry and higher education.

Benefits of Industrial 4.0 in Tertiary Education

Globally, technology is adjudged as the midwife to not only national development but also economic growth. It is a truism that smart technology has provided a vista of opportunities and benefits to individuals and society. The integration of industrial 4.0 will help to refurbish the entire educational system according to the needs and demands of the twenty-first century. It will open opportunities for the students and teachers to acquire the necessary skills that will make them competitive in the global market. It is interesting to note that the core function of the university is anchored on tripartite functions of teaching/ learning, research and community development. It is on this note that the benefits of industrial 4.0 to tertiary education will be discussed on the triple functions.

Research: It is one of the core mandates of educational institutions and the responsibility of the lecturer is to embark on research and write otherwise perish. This mantra has encouraged lecturers to seek new ideas and knowledge to enable the upward movement of the stratum. The upsurge of smart machines has helped edge-cutting technology to enhance academic writing. There are various smart machines and digital technology that can be implored by a researcher that enhance academic writing. Khedkar (2023), opines that artificial intelligence helps to improve research writing through editing and paraphrasing. AI-powered software helps researchers check accurate

grammar and style suggestions. Examples of such software are Grammerly and Perfrctit among others. Another artificial intelligence a researcher can leverage for effective and efficient writing of academic papers is the search engine. A search engine is a smart machine that is used to search for information online and it is based on keywords or user behavior. Examples of search engines are Google, Ask.Com, Bing etc. The importance of search engine in research writing cannot be overemphasized because it helps researchers to scan the volume of information/ data within a short time. Thus, helps the researcher acquire knowledge, store knowledge and disseminate knowledge. These are triple pivots on which tertiary education revolves.

Research conducted by Malik et al, (2023), affirmed that ChatGPT, AI-powered technology helps researchers in content generation and research proposal but quickly cautioned researchers to redefine the generated content. This means in the use of AI researchers should not accept content generated hook line and sinker. There is the human factor and research should not undermine it. In like manner, there are AI-powered machines that generate abstracts once the topic is generated.

Furthermore, there are AI-powered technologies that help in the calculation and analysis of data, prominent among them are the Statistical Package for Social Sciences SPSS, Minitab etc. Plagiarism Hunt, Plagiarism Checker and Copyleak are software that are used to check plagiarism while Zotero and Endnote are used for the management of references. In sum, the use of artificial intelligence in research writing has not only enhanced efficiency and productivity but able to help researchers to manage time effectively.

*Teaching/Learning***:** are fundamental in educational institutions because it is the whole essence of education. The quintessence of education is to seek knowledge, preserve knowledge and disseminate knowledge for the betterment of man and society. The fourth industrial revolution has provided ample opportunity to enhance the core functions of education. With the upsurge of smart machines and digital technologies, the educational landscape is revitalized for greater efficiency and making education accessible to the underserved in society. With the help of computers and accessories, a researcher can collect information, process and share it in a very fast and efficient way without regard to time and location (Wordu, 2020). Gocen and Aydemir (2020), opine that the integration of artificial intelligence has helped to improve access to better learning opportunities and platforms for vulnerable, unserved and isolated communities. It has encouraged personalized learning with individuals choosing the platform best suited and moving at their paces and their

convenience. The use of computer-aided learning has made learning an activity and exciting, unlike traditional teaching where the learner is very passive and allows the teacher to give out information.

Another landmark in the use of computer aid teaching and learning is the use of Natural Language Processing Technique NLPT. According to Humble and Mozelius (2020), NPLT if applied to education will enhance productivity and efficiency by assisting teachers and students in speech and translation of text: students' social, language and work skills and work-life training. Alluding to the same fact, Sen (2023), agreed that the use of AI-powered algorithms can understand languages and respond to voice commands. If integrated into the pedagogy, Artificial Intelligence will take over the repetitive and low-value tasks and allow the teacher to focus on more high-value tasks that require critical thinking, creativity and empathy. (Sen, 2023). Suk (2023) listed some benefits of artificial intelligence to learning which includes: personalized learning; virtual instructor/intelligent tutoring system with 24/7 digital tutor; automated content creation; seamless assessment and instance feedback; automated grading; and translation of language etc.

Community Service: is the third and most important leg of educational functions that every educational institution must strive to achieve. Though very important but appears it is not given the desired attention. Community service is the programmes and services that the host community benefits from citing the educational institution in the community. It is an organized and planned programme initiated by the educational institution for the betterment of the host community in particular and society in general. (Jacob, Andu & Olatunde-Anyedun, 2022). Some of the benefits the community derives from educational institutions are collaboration with the community in research and providing solutions, concession on admission of students and employment of staff, occupational skill training, and training high-level manpower that will help in serving the community and others.

The integration of digital tools in educational institutions will enhance communication between the community and the university. Ryan (2023), enumerated the following ways through which artificial intelligence boosts the relationship between the community and the university. Personalized contact and communication, understanding individual community members and preferences and interests, and can analyse volumes of work and use it to provide valuable insight into people's behaviour. AI-powered machines can be used for language translation, meeting

assistants recording meeting procedures and disseminating in real time to stakeholders. Without mincing words, the surge of smart machines and digital technologies has improved every facet of educational institutions where it is applied correctly and enhances efficiency and productivity. Despite the benefits of artificial intelligence and smart machines in educational administration researchers should be mindful of ethical considerations in the use of AI and other digital tools. Teaching, learning and research need empathy, critical thinking and creativity. For the utmost achievement of educational policy and more importantly, robotics and artificial intelligence cannot take the place of man for effective teaching and learning but to use digital platforms to enhance professional development.

Challenges of Tertiary Education and Industrial 4.0 in Nigeria

In the past, the federal government of Nigeria has made concerted efforts to integrate technology into the educational system. The National Policy on Education recognized education as the instrument for national development. This is achieved through inculcating the right values and knowledge, skills for self-reliance, and in the world of work (FRN, 2014). To achieve this, the Federal Government launched the National Policy on Computer Education in 1989, and a National Policy for Information Technology in 2001, with the mission statement of "using information technology as the engine room for sustainable development and global competitiveness" (p3). Others are the Schoolnet Nigeria, Computer in Schools Project, One-laptop Per Child, and National Policy on Teacher Education among others. The National Policy on Teacher Education with the vision to "produce quality, highly skilled, knowledgeable, and creative teachers based on explicit performance standards through pre-service in-service programmes to raise a generation of students who can compete globally" (p6).

Despite these efforts, the Nigerian educational system is prevalent in the use of traditional instructional tools devoid of contemporary digital tools. The system is vested with chalks and boards where students gather in a conferred classroom to learn. The teachers are seen as the custodians of knowledge who give it out to students at will. This is in contradiction to the twenty-first-century knowledge-driven education with boundary less academic walls. Where personalized learning is encouraged and teachers are facilitators of knowledge. It is imperative to state that the development of an educational system is hinged not only on the acquisition of digital tools and smart machines but the application and utilization of such tools and machines.

This brought to the fore the first challenge inhibiting the use of Industry 4.0 in tertiary education in Nigeria. There is this axiom that you cannot give what you don't have. The traditional educational system at all levels is berated of not having the basic model digital tools that enhance teaching and learning. Tertiary education in Nigeria lacks the digital tools and facilities to enable full automation of technology in their pedagogy (Ogunode, Babayo, Jegede, and Abubakar, 2021: Ogunode, and Ndayebom, 2023). This inhibits the use of technology and smart machines in preparing students for the world of work. According to Okebrorum (2020), in a knowledge economy technology dictates the pace of development and the adoption and utilization determine who succeeds economically. So, it follows that teachers and students are not exposed to digital facilities and are denied the international currency that is used to navigate the world of work. Consequently, teachers and students lack digital tools and knowledge that will enhance the diffusion of high-tech technology.

Another perennial threat to the development of tertiary education in Nigeria is the paucity of funds. Funds and human resources are crucial in the attainment of viable education (Wordu, 2023). Viable education is education that can incorporate digital tools and smart machines in the pedagogical content. Dada, Atobauka and Ogunode (2022), aver that inadequate funding has led to an insufficient supply of digital facilities in tertiary education and subsequently undermining the attainment of educational goals.

It is pertinent to state that for digital learning to be successful there is a need to scrap the old and obsolete curriculum where the school administrators of tertiary education have more interest in the memorization of facts and the award of the degree and shift to lifelong learning with an emphasis on the acquisition of digital skills and knowledge that will enable the recipient in the trajectory of the world of work. The twenty-first education is in a state of fluid and constant change and it behooves the administrators to keep changing the curriculum to be in tandem with the fourth industrial revolution. So, the use of the old curriculum bestowed by the colonial master is a disservice not only to the students but retard economic growth and development. It is enlightening to observe that technologies keep evolving and curricula keep changing to meet the demands of the market. It becomes incumbent on the lecturers who are saddled with the responsibility of implementing the curriculum to unlearn and relearn the epoch of technological evolution. The

challenges keep multiplying based on the evolution of technology, therefore the onus on the administrators of tertiary to keep abreast with new technology and keep training and retraining.

Conclusion

Technology and education have remained the hub for the economic growth and development of society. Education is the process through which individuals acquire the necessary skills, knowledge and tools for societal development. Technology provides platforms to enhance education and increase proficiency and productivity in the attainment of educational goals. At inception, man has witnessed various industrial revolutions from the primitive era to the first industrial revolution witnessed the birth of the steam engine that led to the improvement of transportation. The second industrial revolution led to the production of electricity which in turn boosted industrial activities. The third industrial revolution often called the computer era led to digitalization the invention of the internet and the discovery of nuclear weapons.

The fourth industrial revolution is an epoch of artificial intelligence and reboots that revolutionised the entire human settlement. The age where smart machines are assigned tasks that require human intelligence and reasoning. It is an era where artificial intelligence and robotics have brought promising horizons to educational institutions in every facet of educational management. It has made education affordable and accessible to the underserved, vulnerable and internally displaced persons. More importantly, it enhanced personalized learning where individuals learn at their own pace and time. It becomes imperative that the administrators of tertiary education should pay a premium on human capital development as a sure bet in the attainment of educational goals. Despite these laudable benefits of Industry 4.0, there are plenty of challenges to educational institutions like cases of ethical concern and the associated risk factors. It is against this backdrop that the researcher opined that the procurement of digital and smart technologies is not the silver bullet to enhance productivity in educational institutions but the ability to explore and use the various platforms effectively.

Recommendations

Based on the challenges of Industrial 4.0 to tertiary education the following recommendations were made:

1. The federal government should provide adequate funds through legislation by ensuring that all levels of government shall budget not less than 20% of the annual revenue to education. This will enable tertiary education managers to procure the needed smart machines and digital technology.
2. Technology is constantly changing, and the stakeholders in educational institutions should review the curricula to align with Industry 4.0 and the demand of the market.

3. Lecturers and management staff need continuous training, retraining, skilling and reskilling on the use of digital and smart machines for effective attainment of educational goals.

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