

THE FOURTH INDUSTRIAL REVOLUTION AND ITS IMPACT ON LEARNING IN ACADEMIC INSTITUTIONS

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ABSTRACT

This paper captures the contemporary effort to raise societal awareness about the fourth industrial revolution and its impact on learning in academic institutions. Current graduates face a technologically transformed world where many opportunities and challenges for formal education systems are created by the Internet of Things (IoT), artificial intelligence (AI), nanotechnology, quantum and cloud computing, big data, and data science. Academic institutions face questions concerning their destiny, predominantly engagement, equally, learners reflect around life after graduation. Artificial intelligence-driven technologies are transforming the world so that contemporary ideas like "post-work" are progressively defining the present period. As a result, the paper delves into the historical background of 4IR, 4IR and education, emerging technologies in 4IR, and education 4.0, as well as challenges and recommendations. The paper posited that there should be a synergy between education and labour market to effectively educate students with the necessary skills for 4IR. The paper recommended that Educators should ensure interdisciplinary teaching, research, and innovation. The management should also make initiatives in the development of infrastructure and human, technological, and financial resources to have a functioning educational system prepared for involvement in the 4IR.

Keywords: Fourth Industrial Revolution, Technological Progress, Artificial Intelligence, Academic Institution

INTRODUCTION

The entire ecosystem is currently experiencing its fourth revolution after having seen three preceding ones. A revolution is an enormous shift in the method by which things are done. Expanding upon the digital revolution, the Fourth Industrial Revolution (4IR) is a knowledge

society, a conglomeration of digital, biological, and physical technologies. It has sparked a surge of human endeavours, and the way people connect, communicate, and behave has drastically changed and has been referred to as the "new normal." Consequently, all humanity adjusted to the new norm. Academic institutions have been impacted by the significant transformation of the educational system. As a result, school libraries' settings, services, and collections have changed, necessitating the retraining of academic institutions in the area curriculum to help students fit this 4IR. On this note, this paper captures the contemporary effort to raise social awareness about the effects of the fourth industrial revolution on education in higher education (Omotoso & Jatto 2024).

The fourth industrial revolution (Spotti & Windelband 2020) found that the fourth industrial revolution had commenced, among other studies. In the modern workforce, both human and digital capital are used. There has been a lot of discussion on how the socioeconomic and technological advancements of contemporary society will impact education policies, the goals, and the trajectory of education. According to the World Economic Forum (2020) studies, 4IR will both create possibilities and disrupt future employment and required skills. The fourth industrial revolution is linked to several innovations that aim to impose virtualization, networks, and digitization on many facets of daily life.

Nevertheless, little is being achieved concerning training learners towards instructional programmes in schools that are adapted to the knowledge and skills needed by employees in the 4IR. According to Buhler et al. (2021), graduates in library and information science lack the abilities required by employers in the twenty-first century. The inadequate curricula that these young librarians were trained with are the main cause of this. The majority of library schools lack computer laboratories where students can be exposed to electronic formats for processing and disseminating information due to pedagogical and curriculum deficiencies. As a result, most schools continue to train students using the outdated curriculum, while computer applications and online information services have replaced the traditional method of librarianship (Ujakpa et al., 2020).

Furthermore, curricula of contemporary practice must be implemented for LIS graduates to enable them to survive the Fourth Industrial Revolution. The 4IR's emergence has inferences for learning, with a particular focus on curriculum development. Given that the core curriculum for library and information science prepares students for the emerging 4IR environment, the impact of responding to 4IR is even more significant. Furthermore, the 4IR will ultimately result in a shift toward improving new competencies and modernizing library and information science curricula to better reflect current trends. The 4IR implications also challenge conventional boundaries between disciplines. It calls for multidisciplinary and collaborative competencies that incorporate

expertise from the domains of information technology, electronics, and mechanical manufacturing (Grim, 2020).

The curriculum should include cross-curricular learning and transferable skills to prepare students for new and even not expected jobs. Universities should promote online and technologically enhanced learning, particularly for LIS professionals. Artificial intelligence has created and changed many jobs; it should enable educators to effectively educate students from varied backgrounds and open up library schools to a larger global society (Al-Maskari, et al., 2024). Students should remain relevant in job environments.

This paper posits that curriculum development should be employed to address the issue of providing opportunities to acquire skills relevant to 4IR job opportunities. The criteria based on the 4IR should be characterized and described in the new curriculum. It is crucial to approach learning to realize practical applications in the future. In addition, library schools must swiftly grasp the significance of leveraging these new 4IR curricula into practice to keep library and information science education viable and relevant as a crucial part of society's response to 4IR. The use of computer instruction should be of utmost importance in this curriculum to promote 4IR literacy. Acquiring knowledge of the aforementioned modalities equips students for their future responsibilities in the 4IR workforce. (Omotoso & Jatto, 2024).

Overview of the Industrial Revolution

The term "Industrial Revolution" refers to the introduction and development of technologies during specific historical periods associated with the digital transformation of society. The 18th century saw the first industrial revolution (1IR) occurring. Mechanical manufacturing and steam pressure were introduced (Philbeck & Nicholas, 2019). These shifts brought new opportunities, tasks, and skills. Several countries could advance, expand reinforce, and expand their economies due to the 1IR. Organization improvement remained the primary emphasis of the 1IR. Around the world, the 1IR has been attributed to multiple factors, including urbanization, new skills, and enhanced living standards. The IIR introduced a concept for an innovative curriculum in the educational field that focused on offering an array of degree options as well as fresh initiatives in general education that provided full comprehension of emerging fields.

Emanating is the Second Industrial Revolution (2IR) which began in the early 19th century and was the continuation of the preceding era. Extensive technical infrastructure, including power and new internal combustion-based open conveyance systems, additionally standardization, technical intricacy, and industrial flawlessness, experienced a significant transformation during the revolution (Agarwal & Agarwal 2017), as cited by Kayembe & Nel 2019. The most significant innovation was the discovery of electricity, which allowed various businesses to function and grow. Mineral exploration was also made possible by this technical breakthrough. The 2IR was

distinguished by the number of machines, most of which were electrically powered. Innovative educational institutions are proliferating in the education sector due to the introduction of powerful new technology. The goal of this era was to make industrial classes possible and to give everyone access to education (Uleanya 2022).

The third industrial revolution (3IR) commenced in the mid-1950s, resulting in the emergence of computers, the Internet, and notable technological advancements in the realms of manufacturing, distribution, and energy sectors, as delineated by Roberts (2015). This epoch is distinguished by computerized and web-based interconnectivity. The proliferation of education has been markedly amplified owing to the globalized dissemination of academic research, propelled by online technology. The proliferation of innovative educational institutions and curricula has fundamentally reshaped the first two industrial revolutions, affording the opportunity for bolstering workforce capabilities and driving the substantial economic and manufacturing expansion characteristic of the 20th century. The third industrial revolution has decisively restructured education by effecting instant and cost-free access to information, consequently shifting emphasis towards active learning pedagogies, and advocating collaboration among diverse teams and peer learning environments (Mazur, 2019).

The 4th Industrial Revolution (4IR) is indeed a significant and evolving era marked by disruptive technologies and transformative trends that are reshaping our daily lives and work environments. According to Mian et al. (2020), the full extent of the impact of 4IR technologies is yet to be fully understood, but it is anticipated to have a profound influence on all facets of human existence. The past industrial revolutions have been largely fueled by advancements in technology, driving rapid growth in both the public and private sectors. Presently, technology continues to play a pivotal role in giving life to new concepts and ideas, including virtual worlds, smart cities, big data, the Internet of Things (IoT), and artificial intelligence, all of which are shaping the landscape of development in this new era. It's evident that throughout these revolutions, the focus has been on enhancing lives and simplifying business operations and service delivery. Therefore, it is imperative for academic institutions to be proactive in responding to these changes, as they play a critical role in equipping students with the skills and knowledge needed in these rapidly emerging areas.

The 4IR and Education 4.0

The integration of computer-based learning methods has indeed brought about a substantial transformation in the realm of education. The advent of the fourth industrial revolution has precipitated the emergence of advanced technologies, notably Artificial Intelligence (AI), extensive repositories of information and research, online networks, and the Internet of Things (IoT). These advancements have catalyzed the onset of an era characterized by virtual reality and virtual augmented computer (VAC) entertainment. It is incumbent upon educational institutions

to harness the potential of information and communication technologies, encompassing both online and traditional modalities, to optimize students' learning proficiencies. In this epoch, human development assumes paramount significance in meeting the escalating requisites for knowledge and expertise. As a corollary, a discernible shift toward innovative, discerning teaching and learning methodologies is evident (Sharma, 2019).

Education 4.0, an integral component of the Fourth Industrial Revolution (4IR), is designed to deliver an enriching educational experience closely aligned with real-world work experiences. This educational approach has demonstrated notable efficacy and efficiency in imparting students with the requisite skills for success in professional environments. Digital technology assumes a critical role in this paradigm, offering advantages such as enhanced engagement, improved communication, and authentic learning experiences (Admiraal et al., 2019). To ensure continued relevance, academic institutions must identify and integrate innovative programs into their curricula to prepare students for Industry 4.0 and sustainable, multifaceted career pathways. Moreover, Education 4.0 presents diverse avenues for higher education institutions to synchronize their offerings and curricula with the demands of the workforce (Salmon, 2019). Through the transformation of lecture delivery and the provision of digital learning environments, tools, and services, Education 4.0 is positioned to cultivate well-prepared graduates primed to make meaningful contributions to the global workforce (Hussin, 2018).

Emerging Technologies for 4IR

The World Economic Forum has projected that 65% of children currently enrolled in primary education will eventually pursue careers that do not yet exist. Historically, the traditional model of attending universities and colleges to obtain degrees for lifelong careers is undergoing significant transformation due to the fourth industrial revolution. Advancements in robotics, artificial intelligence, and biotechnology are anticipated to supersede many conventional industry roles within large corporations, shaping a workforce that will differ substantially from its present form.

The evolution of technology has profoundly revolutionized the provision of library and information services to users (West & David, 2021). In response, the Nigeria University Commission (NUC) is urged to initiate the implementation of an updated curriculum promptly. Substantial modifications to the library and information science curriculum are warranted to ensure that students acquire proficiency in emerging domains such as data science, artificial intelligence, robotics, and related areas. Moreover, to attain literacy in the Fourth Industrial Revolution (4IR), a concerted emphasis on computer applications, programming, software development, JavaScript, network systems, and analogous disciplines is imperative. This technological shift will inevitably influence the instructional paradigms of educators. As online learning and artificial intelligence continue to advance, the formulation of new principles

becomes imperative to furnish digital pedagogy with a robust theoretical foundation. The transformative effects of digital education on spatial dynamics and the cultivation of novel learning cultures challenge conventional conceptions of human existence, underscoring the multidimensional nature of this phenomenon (Bayne & Jandric, 2017).

Robotics use in industry may affect human life in both positive and harmful ways (Zeruodi, 2020). From a negative perspective, robots could be viewed as a danger to human work because they drastically lower labor costs and decrease the possibility of human error. Zeruodi (2020) stated that robots could increase overall labor demand and productivity wages, but primarily for highly skilled people. Individuals must, however, take advantage of their relative recompences, such as their mental capacity and capacity for creative problem-solving, to achieve multifaceted circumstances. These advantages might be pointedly reinforced by curricula in nations where people work with robots, as these nations' levels of automation adaptation are higher and easier than those of other nations, where automation adoption is slower.

Developing New Skills for the 4IR

Numerous studies unequivocally demonstrate the substantial impact of the 4IR on the workforce. They consistently indicate that the adoption of 4IR will undoubtedly reduce employment opportunities for low-skilled workers. According to a 2018 report from the World Economic Forum, the restructured division of labor between human workers and machine algorithms will inevitably yield a minimum of 133 million new jobs worldwide by 2022. Employees will need to undergo extensive retraining and upskilling as a result (Baldwin, 2019). It is important to equip students on the use of this new technology aptly and ethically.

Competences are shaped not only by the relatively stable abilities within a profession or area of expertise but also by the ongoing evolution of dynamically changing capabilities acquired through skills and methods for acting in a constantly changing environment. This is because the 4IR is predicted to challenge the stability of the structure (Xing & Marwala, 2017). Students ought to possess the competence necessary to handle the idea of an uncertain future. To support transdisciplinary knowledge, the competence model should include the skills needed to deal with global openness as well as the capacity to assess and analyze future-oriented development.

The rapid rate of change brought about by the 4IR revolution will necessitate a robust expansion of current programs for skill upgrading. Students must receive the education that will enable them to build and mold how they employ the fastest-emerging technologies of today when they graduate. Gaining expertise enables innovative solutions to unidentified issues. Given the rapid advancement of artificial intelligence, students must learn skills that robots cannot. In other words, to outsmart robots at problem-solving, humans must always think creatively. Additionally, students who receive the appropriate instruction and training can join the 4IR workforce.

Impact of 4IR on Higher Education

Artificial intelligence has resulted in the "Industrial Revolution 4.0," which has had a comparable impact on many crafts and industries. Higher education has also been impacted by this revolution, which aims to raise educational standards for all people and change society to create better jobs. Positive changes in the higher education system are being brought about by Industrial 4.0, which is shifting from task-based to human-centered characteristics.

Early adoption of technologies

The early adoption of innovations is crucial for least-developed countries, as it can greatly enhance their economic prospects. These countries can catch up and surpass others in the technological race by adopting and applying new technology well. In comparison, slower adopters constantly have to catch up with advancements, which is a hurdle (Lee, 2021). To propel the expansion of their value chains and, eventually, their economies, developing nations must acknowledge and use cutting-edge technologies. But developing nations face challenges when it comes to obtaining innovations, mostly because of matters like patents and licencing. Despite these obstacles, developing countries can use open-source technologies—like blockchain—to get beyond them and customize technology to meet their unique requirements (Adhikari, 2019). It is possible to embrace and modify open-source technology, like the blockchain, to meet specific functional needs.

Internet connectivity

Therefore, one may claim that internet connectivity in sub-Saharan Africa will rise dramatically with the advent of 4IR technologies (Deloitte, 2018). Research on the readiness of nations well-positioned for production development in the era of 4IR technologies has been done by the World Economic Forum. Significant inefficiencies have occurred from a lack of internet connectivity for wireless radio frequencies in emerging economies due to concerns with control, ownership, and sovereignty over resources. Having access to fast internet is essential if one wants to invest in 4IR new technologies.

Capacity Building

Building capacity is a crucial step in addressing the controls and support needed for strategic innovation. To achieve increased efficiency, a new strategy that leverages digital technology more effectively integrates information, and may involve reconfiguring predictive maintenance, control and decision support systems, integrated operations planning, and shared values must be implemented (Deloitte, 2018). Furthermore, it is critical to understand the roles involved in putting regulatory frameworks for corporations and governments into place if we are to fully utilize the dynamics of the Fourth Industrial Revolution (4IR) for resource ownership and control,

particularly in industries like mining and how disputes have resulted from developing economy industries' access to and control over resources demonstrate the intricacies involved. Given that the Industrial Revolution is centered on both humans and machines, it will close the gap between science and technology. One of the main focuses of adaptation in IR 4.0 will be to support multidisciplinary research, education, and innovation. According to Xing & Marwala (2017), "Integrating human and machine interaction for mutual benefit has become the goal of every university."

Challenges of Employing 4IR in Curriculum Development

The development and application of new technologies bring potential risks that are part of the Fourth Industrial Revolution (4IR). A thorough planning process is necessary to reduce these hazards. Although these new technological developments have the potential to improve our lives, also need to be aware of any risks and unfavorable effects they may have. The following challenges were highlighted and discussed: Inequality and income distribution, a shortage of ICT personnel, a lack of consistency in course content, an abundance of courses, a lack of funding

Inequality and income distribution

There is a lot of discussion surrounding the subject of educational inequality, and new developments in technology could make the situation greater. There is a possibility that those with fewer opportunities may fall behind as only the wealthy can buy the newest instructional technologies. Throughout the previous three industrial revolutions, this pattern has been noted. It is critical to uphold social fairness and consider the state of humanity. We need to pay close attention to how various socioeconomic groups in society are impacted by changes in economic power and technological advancement. It's critical to recognize the risks associated with a globalized society and to advance human rights, freedom, and intercultural understanding. Therefore, it is crucial to develop interpersonal and intercultural abilities (Penprase, 2018).

Funding

One of the main hurdles to the 4IR's effective implementation in Nigerian education continues to be the lack of funding. Even with the recent increase in funding for education, it is still insufficient to completely support educational institutions. Among other things, this has led to lower financing for research and higher educational. Establishing priorities and allocating funding to invest in new technological advances present challenges for educational organisations. Significant funding is necessary for new technology to be implemented successfully in educational settings. The largest costs of training are related to hiring certified instructors and building technology infrastructure (Brown-Martin, 2017).

Lack of ICT Manpower

Changes in the library and information studies curriculum have been made possible by the growth and innovation in ICT. Despite the efforts made by its professional associations to create modular curricula and the requests made by teaching departments to update their curricula to include more IT components. According to Penprase (2018), there are several reasons why LIS schools face difficulties, including a lack of adequate teaching equipment, practical work focused on ICT, a shortage of ICT personnel, a lack of consistency in course content, an abundance of courses, a lack of funding, etc.

Inadequate Educational Standard

The government's lack of investment has resulted in inadequate educational standards and training in technology (Atiku & Boateng, 2019). Students are now being produced who lack the abilities necessary for the modern labor market. The government's ability to deploy new technologies is crucial for the successful adoption of these conditions, as failure to do so will cause the country's economy to regress and fail to achieve 21st-century norms. Graduates will need to have the necessary abilities to work in the 4IR. Proficiencies such as information curation, comprehensive research, digital scanning, data preservation, cloud data management, collaborative practices, educational expertise, analytical thinking, and creativity are imperative as a nod to the fourth industrial revolution. These competencies unequivocally elevate the graduate's employability.

Conclusion

The most recent industrial revolution, known as the 4IR, is characterized by a greater emphasis on ICT, technical innovation, and creative expression. It is imperative that research & development, skills development, and teaching and learning adopt a new digital approach in order to thrive in this digital world. The challenges associated with pedagogical adaptation, professional development for educators, and the allocation of augmented resources and infrastructure investment to propel technological progress were underscored as pivotal obstacles in the transition toward the Fourth Industrial Revolution. Curriculum modifications will put students in a better position to acquire the skills needed for 4IR. Among other things, the 4IR provides more chances for partnerships and involvement in the digital economy.

Recommendations

- 1) To ensure that library and information science education is relevant and sustainable as a key and responsive part of society's response to 4IR, library schools should urgently acknowledge the requirement of incorporating 4IR type of curriculum which will collectively make students ready for the workforce of the future.
- 2) The government should make investments in students' education and training as pertinent stakeholders in order to prepare them for the digital age and new technologies.

- 3) There should remain synergy between the labor market and education so that the students will be well equipped with the rightful skills needed in this 4IR era.
- 4) Educators should keep abreast with the latest developments in education and ensure that proper technological infrastructure is given more weight as a type of 4IR.
- 5) Updated curricula should emphasize the development of 4IR collaborative abilities and the need to cultivate 4IR literacy.
- 6) Restructuring educational institutions to provide new interdisciplinary science programmes is necessary to modify instruction to the requirements of the 4IR.
- 7) The success and advancement of research and development are closely linked to the stimulation of innovation and the promotion of creative potential, meaning that the effectiveness of educational initiatives in the 4IR era depends on fostering innovative talent.

To meet the needs of the 4IR, institutions must constantly evaluate their management systems, self-awareness, methodologies, and technologies.

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