

Assessing the Impact of the Fifth Industrial Revolution on Teacher Education in Rivers State.

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Abstract

This study is an assessment of the impact of the fifth industrial revolution on teacher education programmes in Rivers State. Three research objectives and questions guided the study. The study was anchored on the technological pedagogical content knowledge (TPACK) and social constructivist theories. The descriptive survey research design was adopted. The sample size for this study was 20 and 18 respondents, respectively, from the two teacher education institutions in the state, making a total of 38 respondents. The instrument adopted in the research was a self-structured questionnaire titled “Impact of the Fifth Industrial Revolution on Teacher Education” (IFTIRTEQ). The reliability of the instrument was established by test-retest, which indicated a coefficient of 0.70. The responses were analysed using mean scores and standard deviation. From the analysis, the study clearly revealed, among others, the rate of awareness among student teachers on the integration of 5IR technologies in teacher education programmes. It was also revealed that the impacts of 5IR improve collaborative learning, retention, and other practical skills in the learning process. Based on the findings, it was recommended, among others, that there should be a strong policy framework to support the positive impacts of advanced technologies in teacher education programmes. This will assist in repositioning the teacher education programmes.

Key Words: Impact, 5IR, Teacher training, Technological collaboration, Future Education.

Introduction

The growing concern for teacher training and education all over the globe is aimed at encouraging an effective service delivery system amidst evolving technologies. However, at the national level, teacher education is seen as one that can take the form of pre-service, in-service, or on-the-job training. In Rivers, among other States in Nigeria, teacher education was predicated on the gradual concerns for the establishment of schools. As a result, teacher education was mainly reflected in the establishment of teachers' training colleges (Gabriel, 2013). Notably, the essence of this concern was meant to produce a well-planned form of education that will systematically equip teachers in terms of ethical, intellectual competencies, dispositions, emotional, and so forth. This is because a well-planned system of education enables the requisite dispositions for the teaching/learning process. More so, it is a cornerstone of interpreting and implementing educational blueprint for character modifications that shapes the attainment of national development (Jibril, 2007 & Gabriel, 2013). According to Osuji (2009) and Okoroma in Echezue (2024), teacher education is the anchor point for development and wealth creation of any given society. The progress of society is dependent on well-motivated, conscientious, and efficient teachers in the system. On this basis, teacher education is an intended preparatory programme for persons with the intention of pursuing a career in the teaching profession. Thus, the process enables pedagogical skills for the purposes of improving the quality of the education system. For this reason, certified teachers are those with the Nigeria Certificate of Education (NCE), Bachelor of Education (B.Ed.), Bachelor of Science in Education (B.Sc. Ed), Post Graduate Diploma in Education (PGDE), Masters of Education (M.Ed.), Masters of Science Education (MSc. Ed.) or Doctor of Philosophy in Education (Ph.D.) (Dagogo, 2020). Besides, Nwite and Nwankwo (2017) presented the objectives of teacher education in Nigeria as enshrined in section 5 (b) of the national policy on education as follows:

1. To produce highly motivated, conscientious, and efficient classroom teachers for all levels of our educational system.
2. To encourage further the spirit of enquiry and creativity in teachers
3. To enhance teachers' commitment to the teaching profession and
4. To provide teachers with the intellectual and professional background for their assignment and make them adaptable to changing situations among others.

On the other hand, the objectives will ensure quality teacher education programmes as recommended in the SGD4. But, the attainment of the objectives is not possible without the review of the curriculum to accommodate the integration of the fifth industrial revolution (5IR) advanced technologies. The 5IR advanced technologies include robotics, AI, human educators, virtual and augmented reality, among other technologies that improve efficiency, effectiveness, and an innovative, engaging learning process (Ekwueme et al, 2024). Similarly, Adigun et al. (2025) noted the rapid advancement in technology and increasing demand for collaborative services as a major driver of changes in the learning process. Adigun et al further reiterated the need to leverage the potential of emerging technologies to establish a stronger teacher education programme that is linked to global best practices of learning.

In the study conducted by Ekwueme et al (2024) to investigate the librarians and the fifth industrial revolution: navigating skills, challenges, and strategies for effective library services in open and distance learning. It was found that collaborative and digital skills are essential for a quality service delivery system to the learners. In another related study based on the perception of technological integrations as a catalyst for teacher education, Oladele and Ndlovu (2024) discovered the positive perceptions of technological integration to enhance teacher training programmes. The finding indicated how important technological integration is in achieving the pedagogical process. Therefore, Vurayai (2024) stated the impacts of the advanced technologies on higher education as one that has encapsulated its potential in terms of transforming the way through which knowledge is produced, accessed, and disseminated using various innovative pedagogical approaches. On this basis, the cutting-edge technologies of the 5IR are gradually shaping and changing the process of education. Accordingly, Egwuasi (2019) acknowledged the integration and utilization of 5IR learning facilities as significant in the teachers' training process, because it is capable of providing the needed access to learning materials and exchange of ideas to shape the soft skills of learners.

The question, therefore, is how the integration of the fifth industrial revolution can influence the pedagogical practices of teacher training programmes? How would teacher education evolve with the advent of the fifth industrial revolution? It is against this backdrop that this study seeks to assess the impact of the fifth industrial revolution on teacher education programmes in Rivers State, Nigeria.

Research Objectives

This study aims to assess the impact of the fifth industrial revolution (5IR) on teacher education in Rivers State.

The specific objectives are to:

1. Examine teachers' perceptions on the integration of 5IR technologies in teacher education programmes in Rivers State.
2. ascertain the impact of 5IR technologies on teacher education programmes in River State.
3. Identify the challenges of integrating the 5IR technologies in teacher education programmes in Rivers State.

Research Questions

The following research questions guided this study:

1. What are the perceptions of teachers on the integration of 5IR technologies in teacher education programmes in Rivers State?
2. What are the impacts of 5IR technologies on teacher education programmes in River State?
3. What are the challenges of integrating the 5IR technologies in teacher education programmes in Rivers State?

Theoretical Framework

The technological pedagogical content knowledge (TPACK) and social constructivist theories propounded by Mishra and Koehler in 2006 and Shulman in 1986 were adopted in this study. The theory of technological pedagogical content knowledge explained the requirement for teacher knowledge and understanding on the eve of technological integration. While constructivist theory explained the relevance of integrating technology in teachers' professional development to boost experience, communication, and understanding of reality. Therefore, both theories are relevant to this study because of the experience and knowledge gained through technological collaboration in the course of learning interactions.

Literature Review

Perception of the Fifth Industrial Revolution

The 5IR is an acronym that stands for Fifth Industrial Revolution. In recent years, there has been a growing technological trend resulting from previous knowledge. However, from a historical perspective, the fifth industrial revolution is a buildup from other recorded revolutions, especially the Fourth Industrial Revolution (4IR). The first industrial revolution, according to Ekwueme et al (2024), started in the mid-18th century (1750-1850). It was a period marked by significant advancement in the agricultural sector, and the use of machines as a replacement for manual workloads in the manufacturing and mining sectors. Khoza (2021) affirmed that it was a century marked by radical changes and innovations in various industrial activities. It brought about the invention of the steam engine for mechanical production. The second industrial revolution occurred between 1850-1940. It was a follow-up from the first industrial revolution; it was a time of innovation, such as pipe, water, gas, and electricity to drive industrial growth. The emergence of the third (3IR) revolution was a result of the post-war experience of World War II. The 1960s brought about the digital age. It witnessed an upsurge in modern inventions such as computers, consoles, and cell phones, among others, leading to a revolution in communication and productivity. The era used computers to assist in teachers' made instructions. The fourth (4IR) revolution was a breakthrough for the interconnectivity of technologies. These technologies include Artificial Intelligence (AI), robots, cloud storage technology, fusion of physical, digital, and biological spheres known as a cyber-physical system. Apriliyanti in Ekwueme et al succinctly referred to the era as the time of Internet of Things (IOT), 3D printing, and AI shaping period. Besides, the 5IR is built on the 4IR to bring about a sustainable, resilient environment. The 5IR is aimed at balancing automation and human intervention. It is an enabler of critical thinking and the adaptability of the use of machines. As Ikenga and Sijde (2024) referred to the 5IR as a strategic integration of the human workforce in collaboration with robotic machines for business and social networks because of its velocity, scope, and systems impact. It is a key driving force for artificial intelligence, gene editing, and biotechnology, and their like (Vurayai, 2025). The integration of the fifth industrial revolution (5IR) redefines the skills and competencies required in the present hi-tech era, especially in the educational sector. This is so because education plays a major role in the invention and adaptation of technologies. Gray et al. (2012) defined the concept of perception

as an ingrained in the mind that drives actions and the essence of moral judgment. Perception, according to Merriam-Webster (2024), is the power to realize what is not evident to the average mind. It therefore implies a rapid response to a concern. Oladele and Ndlovu (2024) asserted that the perceptions on the integration of technologies in teacher training programmes are based on their ability to improve retention, help in their personal learning styles, and interpersonal skills. In essence, the 5IR represents a shift from technological progression that is not only industrial-based, but also for the welfare of people in countless spheres of human endeavours to solve social problems using physical and virtual space (Vieira, et al, 2023).

Impact on Teacher Education

The impact of the 5IR advanced technologies has currently shaped the landscape of teacher education programmes from an industrial-based to a knowledge-based economy (Vurayai, 2025). According to Ayanwale et al., (2022), the impact of emerging technologies on teacher education is very significant to the development of new approaches in the teaching and learning process. Besides, Oladele and Ndlovu (2024) stated that the impacts of technologies in teacher education programmes promote student collaboration skills, communication skills, personal learning styles, interpersonal skills, and critical thinking, among others. Also, it is a new approach that focuses on providing practical learning skills in areas of learners' specialization. The impact of advanced technologies in teacher education is meant to prepare the students for the demands of the new industrial economy by providing real-life experiences in the learning process. For this reason, it is vital to adequately implement teacher education programmes with cutting-edge technologies. Consequently, the integration of these advanced technologies serves as an effective digital resource in the sector to enhance outcomes in the process of teacher education (Amaechi-An et al, 2024). Integrating technology into teacher education enhances accessibility, flexibility, and effectiveness, where online platforms such as virtual reality, simulation, and AI (Artificial Intelligence) driven tools could provide a rich learning experience (Ajah and Chigozie, 2019). Professional development of teachers should therefore encompass the knowledge of the subject, understanding the pedagogy, teaching techniques, and the incorporation of 5th industrial revolution technologies in the process to improve teacher professional performances (Amaechi-Ani et al 2024). Besides, the essence of teacher competencies in the 5th industrial revolution largely depends on their contemporary technological abilities. On this basis, Anik and Rahman (2025) strongly supported

the integration of advanced technologies in higher education programmes to drive the demands of the fifth industrial revolution (5IR). The basis of the 5IR emphasizes is anchored on human-machine (AI) collaboration to enhance the learning process. It is further noted by the authors that while AI-powered tools such as ChatGPT, Google Bard, Grammarly, and QuillBot are very significant to the benefits of academic programmes, it is very important to address some academic concerns arising from these technologies. Based on this reason, Vurayai (2025) again encapsulated the potential influence of these technologies as one that is presently transforming the way knowledge is being produced, accessed, and disseminated using the innovative pedagogical approach in higher education. The deployment of rapid automated learning tools has equally enhanced efficiency in learning interactions and profiling, as a result, growing the need for students to be trained. The effective use of fifth industrial revolution technologies to impact positively on teachers' competence, attitude, skills, and knowledge, among other key factors, is mostly considered by researchers. Accordingly, how this revolution is applied to teachers' training and education is dependent on adequate provisions of funds, facilities, and security, among other factors (Ayanwale et al., 2022). Against this backdrop, Gordon and Gabriel (2021) asserted the need to prioritize the new approach of learning as a way of improving human capital development in both the formal and informal sectors. This is to provide more access and opportunities to education.

Challenges of integrating the 5IR technologies

There is much evidence on the positive impact of the 5IR technologies in the learning and teaching process. However, the sustainable usage of the technologies is not without challenges. Based on this reason, it becomes very obvious to believe that the 5IR technologies have some challenges that stand to obstruct their useful implementations. Thus, Oladele and Ndlovu (2024)

The challenges faced in integrating technology in teacher training programmes include area lack of access to technology infrastructure, inadequate digital training and support, limited resources to invest in technology infrastructure, inadequate research, and evidence of technology integration effectiveness. They also face resistance from institutional leadership. Similarly, Gurajena et al., (2021) identified other challenges faced by tertiary institutions to include technological, pedagogical, and social challenges. Accordingly, inadequate access to technology infrastructure,

as emphasised, is the most significant factor. The technical problems associated with the lack of technology infrastructure for teachers and students' digital skills pose a serious challenge to digital transformation. Moreso, this challenge has presented the authorities with the necessary conditions to secure equal and high-quality learning environments (Vieira et al, 2023). Some other basic identified issues facing the integration of the 5IR technologies in teacher education programmes are seen as inconsistency in teacher education policy implementation, brain drain syndrome, lack of e-facilities, poor internal quality assurance, inadequate provisions of funds, insecurity, and corruption. (Dagogo), 2020). Presumably, other issues in contention are unreliable electricity supply, limited internet connectivity, lack of innovative capacity and inadequate learning span in the process, shortage of support staff, lack of commitment, paucity of funds, and dearth of critical infrastructure. So in designated schools. Thus, Gordon and Gabriel (2021) considered the challenges of automated learning systems from the perspectives of the individual, technological, content, and contextual issues. The individual dimension represents a lack of personal responsibility required to sustain motivation in a digital learning engagement. Moreover, a closer look at the integration of this innovative technology in the curriculum and instructional strategies poses further challenges because of time limits, resources, and technical support. Besides, the teachers' attitude towards the scheme to enhance practical skill in the classroom instead of the traditional teaching approach is another serious issue of concern (Echezu et al, 2024).

Methodology

The descriptive survey design was adopted in this study. The population of this study comprised all trainee teachers in the state. A purposive sampling technique of two teacher training institutions in the State was used in the study. They are Ignatius Ajuru University of Education, Port Harcourt, and Federal College of Education (Technical), Omoku, Rivers State. The sample size of the study was 50 respondents, 25 respondents each from the respective institutions. The research instrument adopted for data collection was titled "Impact of the Fifth Industrial Revolution on Teacher Education" (IFTIRTEQ). The instrument was structured in a modified 4-point Likert rating scale. The instrument was duly validated by experts in teacher education. The instrument recorded a 0.70 reliability index. The researchers administered a total of fifty, but only twenty (20) and eighteen (18) questionnaires were successfully retrieved from the respective institutions. The data collected

were analysed using mean scores and standard deviation. The criterion mean score of 2.50 was used for the decision.

Data Analysis

Question 1: What are the perceptions on the integration of 5IR technologies in teacher education programmes?

Table 1: Mean scores on perceptions of the integration of 5IR technologies in teacher education programmes.

S/N	Item	X ₁	SD ₁	Remark	X ₂	SD ₂	Remark
1.	5IR technologies are very useful in the achievement of efficient teacher education programmes.	3.50	0.50	Agree	3.15	0.58	
2.	The emergence of 5IR technologies is relevant to teacher education curriculum.	2.50	0.40	Agree	3.89	0.31	Agree
3.	The 5IR technologies enable teacher trainees to develop digital skills for effective professional practices.	3.90	0.30	Agree	3.11	0.29	
4.	The 5IR technologies enhance future careers of trainee teachers.	3.90	0.30	Agree	3.33	0.45	Agree
5.	Teacher education programmes support the integration of 5IR technologies.	1.50	1.41	Disagree	3.78	0.42	Agree
6.	5IR technologies are vital for future educational programmes	3.10	0.57	Agree	3.50	0.50	
	Grand Mean	3.06	0.58	Agree	3.34	0.43	Agree

The analysed data in Table 1 presented the distribution of responses of respondents from FCET and IAUOE on perceptions of integrating 5IR technologies in teacher education programmes. The respondents in FCET responded positively to five out of the six items, while in IAUOE, respondents positively affirmed all six items. The grand mean of 3.06 and standard deviation of

0.58 in FCET respondents and the grand mean of 3.46 and 0.43 in IAUOE responses indicated some levels of agreement on how the integration of 5IR technologies is perceived in teacher education.

Question 2: What are the impacts of 5IR technologies on teacher education programmes?

Table 2: Mean scores on impacts of 5IR technologies on teacher education programmes

S/N	Item	X ₁	SD ₁	Remark	X ₂	SD ₂	Remark
1.	5IR technologies improve retention in teacher education programmes.	2.75	0.43	Agree	2.67		0.48
2.	5IR technologies enhance collaborative learning process in teacher education programmes.	3.95	0.47	Agree	3.61	0.68	Agree
3.	5IR technologies enable the development of communication skills in teachers education programmes.	3.35	0.41	Agree	3.56	0.49	Agree
4.	Emerging technologies in the 5IR enhances the teacher trainees act of learning and practical skills.	3.30	0.39	Agree	2.89	1.05	Agree
5.	5IR technologies motivate critical thinking in the cause of learning concepts and ideas in teacher education programmes.	1.90	0.20	Disagree	3.22	0.88	Agree
6.	Incorporated curricula need for digital literacy skills to prepare teachers for the demand of 5IR technologies	3.54	0.41	Agree	3.20	0.69	Agree
	Grand Mean	3.13	0.38	Agree	3.19	0.71	Agree

The analysis of data on research question 2, as shown in Table 2, revealed the responses of respondents in both institutions on the impacts of 5IR technologies on teacher education programmes. Respondents provided positive responses to items 1, 2, 3, 4, 5, and 6, respectively, in IAUOE mean responses; while respondents in FCET responded positively to 1, 2, 3, 4, and 6, respectively. However, the grand mean of both responses was above the benchmark of 2.50 and was accepted.

Question 3: What are the challenges of implementing the 5IR technologies in teacher education programmes?

Table 3: Mean scores on challenges of implementing the 5IR technologies in teacher education programmes.

S/N	Item	X ₁	SD ₁	Remark	X ₂	SD ₂	Remark
1.	Inadequate provision of modern technologies in the teacher education programmes.	3.05	0.22	Agree	3.67	0.64	Agree
2.	Lack of professional training of teachers hinder the implementation of 5IR technologies in teacher education.	3.45	0.49	Agree	3.38	0.42	Agree
3.	Resistance to change is a grave issue in the implementation of 5IR in teacher education programmes.	3.55	0.49	Agree	3.44	0.45	Agree
4.	Resource limitation for the implementation of 5IR technologies in teacher education programmes is an issue.	3.20	0.69	Agree	3.33	0.76	Agree
5.	Inadequacies in the provision of technical support to address 5IR related issues in teacher education programmes.	2.05	1.53	Disagree	3.11	0.66	Agree
6.	Lack of leadership support as a result of pedagogical shift in the learning process.	2.76	0.48	Agree	1.90	0.20	Disagree
	Grand Mean	3.01	0.65	Agree	3.14	0.45	Agree

Table 3 presents the responses from respondents in both institutions regarding the challenges of implementing 5IR technologies in teacher education programs. All items in IAUOE mean responses were positive except item 6 with ($X = 1.90$ SD= 0.20), while item 1 with ($X = 3.05$ SD= 0.22), 2 with ($X = 3.45$ SD= 0.49), 3 with ($X = 3.55$ SD=0.49), 4 with ($X = 3.20$ SD=0.69), and 6 ($X = 2.76$ SD=0.48) respectively in the mean responses of FCET were positive. Thus, the grand mean of both responding institutions was higher than the criterion mean score of 2.50 and was accepted as an indication of agreement on the challenges of implementing the 5IR technologies in teacher education programmes.

Discussion

The findings of the study for research question one positively revealed that the 5IR technologies are very useful in the achievement of efficient teacher education, relevant to teacher education curriculum, and enable trainee teachers to develop digital skills for effective professional practices. The study further indicated that the 5IR technologies enhance the future careers of trainee teachers, teacher education programmes support the integration of 5IR technologies, and are vital for future educational programmes as possible areas of awareness in the use of the 5IR technologies. The result underpinned the various perceptions about the technologies in the teaching and learning process. This finding is supported by the observations of Ayanwale et al., (2022), who perceived the emerging technologies such as artificial intelligence, robotics, the Internet of Things (IoT), blockchain, and 3D printing, among others, as a process which have changed the pattern of learning. This finding is also corroborated by the findings of Ajah and Chigozie (2019) that the integration of 5IR technologies is a boost to teacher education programmes and professional development. Because it will enhance accessibility, flexibility, and effectiveness in the process. According to Oladele and Ndlovu (2024), the positive perceptions of students on the integration of technologies in teacher training programmes are a result of their ability to improve retention, help in their personal learning styles, and interpersonal skills.

The findings of the study for research question two revealed that the impacts of 5IR technologies on teacher education programmes include the improvement of retention, enhancing the collaborative learning process, enabling the development of communication skills, enhancing trainee teacher learning practical skills, curricula need for digital literacy skills, and motivating critical thinking in the learning of concepts and ideas in teacher education programmes. This finding is supported by the findings of According to Vurayai (2025), the landscape of higher education is currently being shaped by the transition from an industrial economy to a knowledge economy. The findings in line with Ayanwale et al., (2022) presented the impact of emerging technologies on teacher education as significant to the development of new approaches in the teaching and learning process. Besides, Oladele and Ndlovu (2024) stated that the impacts of technologies in teacher education programmes promote student collaboration skills, communication skills, personal learning styles, interpersonal skills, and critical thinking, among others.

The findings of the study for research question three revealed that the challenges of implementing the 5IR technologies in teacher education programmes include inadequate provision of modern technologies, lack of professional training of teachers, resistance to change as a grave issue in the implementation of 5IR technologies, inadequate funding for the implementation of 5IR technologies and lack of technical support to address 5IR related issues in teacher education programmes. The finding is supported by Oladele and Ndlovu (2024) that the challenges faced in integrating technology in teacher training programmes are a lack of access to technology infrastructure, inadequate digital training and support, limited resources to invest in technology infrastructure, inadequate research and evidence of technology integration effectiveness, and resistance from institutional leadership.

Conclusion

Based on the findings of this study, it was concluded that the integration of the fifth industrial revolution technologies (5IR) is perceived as a change that is very significant change to the teacher education programmes. The study also highlighted some of the impacts of implementing the 5IR technologies as improving retention, enhancing the collaborative learning process, enabling the development of communication skills, and enhancing teacher trainees' learning and practical skills, among others. The study also concluded that the challenges of implementing the 5IR technologies in teacher education programmes include inadequate provision of modern technologies, lack of professional training of teachers, resistance to change as a grave issue in the implementation of 5IR technologies, inadequate funding, and lack of technical support to address 5IR related issues among others in teacher education programmes.

Recommendations

Based on the findings of this study, the following recommendations are therefore made:

1. The government should reposition teacher education programmes by introducing a new curriculum that is in line with the 5IR advanced technologies in the teacher training institutions.
2. The stakeholders should leverage the positive impacts of 5IR technologies to improve on teacher competencies and professional development.

3. There should be a strong collaboration between the various stakeholders in the educational sector to address the existing inequities in digital skills, among other issues in the institutions.

References

- Adigun, G.O., Yusuf Ayodeji Ajani, Y.A., & Enakrire, R.T. (2025). The intelligent libraries: Innovation for a sustainable knowledge system in the fifth (5th) industrial revolution. *LIBRI 2024*; 74(3): 211–223. <https://doi.org/10.1515/libri-2023-0111>.
- Ajah, I. A., & Chigozie, O. C. (2019). Exploring the benefits of the 4th industrial revolution: The Nigerian experience. *International Journal of Science and Technology*, 8(1), 17
- Amaechi-Ani, N., Chikelu, J. U., & Nzekwe, G.C. (2024). Teacher education and development: the way forward in repositioning education in the 4th industrial revolution. *Godfrey Okoye University International Journal of Education*, 3(3), <https://doi.org/10.5281/zenodo.13740176>.
- Anik, H.M., & Rahman, S. M. H. (2025). Strategic integration of generative AI in higher education: Analysis of usage, competencies, and policy measures for the science education of Bangladesh. *Hal Open Science*. <https://hal.science/hal-04904869v1>.
- Dagogo A. F. D. (2020). Teacher education: meeting the global demand and challenges in tertiary institutions in Nigeria. *International Journal on Integrated Education*, 3 (6), 87-91.
- Echezu, B.C., & Emmanuel, T. D. (2024). Digital Pedagogies: An Innovation in Teaching Strategies in Nigeria. *Journal of Centre for Distance & e-Learning* Vol. 2, No. 1, 119-124 <https://cdeljourn.unn.edu.ng>.
- Echezu, B.C, John, I., & Udenenwu, A.H. (2024). Virtual Reality in Teacher Education Programs for Improved Educational Outcomes in Nigeria. In W.E. Obiozor, C. N. Oguejiofor, J.C. Olawatayo, A.C. Obuezie, & R. N. Ogbo (Eds), *Indigenous Perspective on Artificial Intelligence and Educational Development*: Patrobas.
- Ekwueme, L.O., Oluwaseun, B.O., Ajie, I.A., Ofodu, P.N., & Ambrose, S.E. (2024). Empowering librarians in the 5IR: Navigating skills, challenges & strategies for library services in open and distance learning. *Lokoja Journal of Information Science research*, 2(1) 79-94.
- Gabriel, A. O. I. (2013). A historical perspective of teacher education in Rivers State of Nigeria: 1967-1998. *An International Multidisciplinary Journal*, 7 (2) 29, 206-226 <http://dx.doi.org/10.4314/afrev.7i2.14>.

- Gordon, B., & Gabriel J. (2021). Benefits, challenges and prospects of integrating e-learning into Nigerian tertiary institutions: A mini review. *International Journal of Education and Development using Information and Communication Technology*, 17 (3), 6-18.
- Ikenga, U. G., & Sijde (2024). *Twenty-first century competencies: About competencies for industry 5.0 and the opportunities for energy economies*, 1-17. <https://www.preprints.org/manuscript/2024.0143/v1/download>
- Jibril, M.A. (2007). Teacher education in Nigeria: An overview. *African Research Review*, 1(2), 130-140. <https://www.ajol.info>.
- Khoza, S. B. (2021). Can teachers' identities come to the rescue in the fourth industrial revolution? *Technology, Knowledge and Learning*. <https://doi.org/10.1007/s10758-021-09560-z>.
- Nwite, O., & Nwankwo, J.M. (2017). The role of teacher education and Nigerian teachers: Implication for sustainable national development. *International Journal of Research in Humanities, Arts and Literature*, 5 (6), 45-52
- Oladele, J. I., & Ndlovu, M. (2024). Perception of technological integrations as a catalyst for steam teacher education. *Journal of Vasyk Stefanyk Precarpathian National University*, (11), 75-90. <http://journals.pnu.edu.ua>.
- Osuji, S. N. (2009). Teacher education curriculum in Nigeria in the perspective of lifelong education. *The Journal of International Social Research*, 2 (8) 276-301
- Vieira, A., Monteiro, P., Azevedo, G., & Jonas, O. (2023). Society 5.0 and education 5.0: A critical reflection. *18th Iberian Conference on Information Systems and Technologies (CISTI)*. <https://www.researchgate.net/publication/373155660>
- Vurayai, S. (2025). The impact of the fourth industrial revolution on Southern African higher education. *International Journal of Knowledge Content Development & Technology*, 15 (1). 51-64. <http://dx.doi.org/10.5865/IJKCT.2025.15.1.051>.