Fourth Industrial Revolution and Education Change: Perception of Colleges of Education Teachers

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Abstract
The study examined the perception of Colleges of Education lecturers regarding educational changes associated with the Fourth Industrial Revolution (4IR) in Kwara State, Nigeria. The study adopted a descriptive survey research design. The population comprised lecturers from four Colleges of Education, consisting of two public and two private institutions. A sample of 110 lecturers was selected using multistage sampling procedure involving purposive, proportionate, and simple random sampling techniques. Data were collected using a researcher-designed questionnaire titled *Fourth Industrial Revolution and Educational Change Questionnaire (4IRECQ)*. The instrument was validated by experts in Educational Technology and Measurement and Evaluation, while a Cronbach Alpha reliability coefficient of 0.84 was obtained. Mean and standard deviation were used to answer the research questions, while t-test and Analysis of Variance (ANOVA) were used to test differences based on selected demographic variables at 0.05 level of significance. The findings revealed that lecturers possessed positive perceptions regarding educational changes associated with the 4IR and acknowledged the relevance of digital technologies in teacher education. The study further revealed moderate technological readiness among lecturers, although inadequate infrastructure, poor internet connectivity, unstable electricity supply, and limited professional development opportunities remained major challenges. The study concluded that effective implementation of 4IR-driven education in Colleges of Education requires improved institutional support, digital infrastructure, and continuous staff development.

Keywords: Fourth Industrial Revolution, Educational change, Teacher perception, Technology integration

1. Introduction

The emergence of the Fourth Industrial Revolution (4IR) has continued to reshape different sectors of society, including education. Unlike earlier industrial revolutions that were driven mainly by mechanization, electricity, and automation, the 4IR is characterized by rapid integration of digital technologies such as artificial intelligence, robotics, big data, cloud computing, virtual reality, and the Internet of Things into human activities. These technologies are gradually changing how people communicate, work, learn, and solve problems. In education, the implications are particularly significant because schools and teacher training institutions are expected to prepare learners for a society that is increasingly technology-driven and knowledge-based. This changing reality has placed fresh demands on teachers, school managers, curriculum planners, and educational institutions across the world.

Within the discourse on Education 4.0, attention has shifted from traditional teacher-centred instruction to more flexible, technology-supported, and learner-driven approaches. 4IR requires a redefinition of the roles of teachers, students, and school administrators in order to align educational practices with emerging societal realities. Teachers are no longer expected to function merely as transmitters of knowledge; they are increasingly required to become facilitators of learning, digital guides, collaborators, and innovators capable of integrating technology into teaching and assessment processes (Himmetoglu *et al*., 2020) [7]. This expectation is particularly relevant in teacher education institutions because they are responsible for preparing future teachers who will work in digitally evolving classrooms.

Globally, universities and teacher education institutions have begun to respond to these changes through curriculum reforms, digital integration, and professional development initiatives. Research has shown that successful adaptation to the 4IR depends greatly on the readiness of teachers and educational leaders to embrace technological transformation. For instance, Awodiji and Naicker (2023) [4] observed that school leaders require continuous professional development to effectively manage the demands associated with the 4IR era. Their study further emphasized that leadership preparedness influences institutional capacity to implement technology-driven educational reforms. Similarly, Ahiaku and Muyambi (2024) argued that teachers and school management remain central to empowering learners with the competencies needed for participation in the modern digital economy.

In many developed and emerging economies, educational institutions are already experimenting with smart classrooms, online learning systems, digital assessment platforms, simulation-based learning, and artificial intelligence-assisted instruction. However, the extent to which these innovations are effectively adopted varies considerably across contexts. In Africa, and particularly within sub-Saharan Africa, the transition appears slower due to infrastructural limitations, inadequate digital literacy, unstable electricity supply, weak internet connectivity, insufficient funding, and limited institutional readiness. Studies from South Africa have revealed concerns regarding the preparedness of teachers and institutions for effective 4IR implementation. For example, Van Wyk and Waghid (2023) found that many pre-service teachers still lack adequate preparedness for 4IR-oriented teaching and learning practices despite growing awareness of digital transformation in education.

The situation appears similar in several teacher education systems across Africa where policy discussions on technology integration often move faster than actual implementation. Teacher education institutions must undergo a paradigm shift in curriculum design, pedagogical practice, and institutional orientation if they are to remain relevant within the 4IR era (Atibuni *et al*., 2022) [3]. Their position suggests that conventional approaches to teacher preparation may no longer adequately address the realities of digital transformation.

In the Nigerian context, discussions surrounding educational technology and digital learning have increased considerably in recent years, especially after the COVID-19 pandemic exposed the fragility of many educational systems. During the pandemic, several schools and tertiary institutions struggled to sustain teaching and learning activities due to inadequate digital infrastructure and low technological preparedness among educators and learners. Although efforts have been made by government agencies and institutions to promote ICT integration in education, many Colleges of Education still operate within environments characterized by poor internet access, irregular electricity supply, insufficient digital facilities, overcrowded classrooms, and inadequate staff training in emerging technologies. As a result, the implementation of 4IR-driven educational practices remains inconsistent and uneven.

Colleges of Education occupy a particularly strategic position within the Nigerian educational system because they serve as major institutions for training teachers for primary and junior secondary schools. The quality of teachers produced by these institutions has direct implications for the future of education in the country. Yet, despite the growing emphasis on digital transformation, there are concerns that many teacher educators may not possess the competencies, institutional support, or technological exposure required to effectively prepare student-teachers for contemporary classrooms. This concern becomes more serious when viewed against the increasing demand for graduates who can function effectively within digitally connected societies and labour markets.

Existing literature has examined several dimensions of the 4IR in education, including institutional readiness, teacher preparedness, curriculum reform, and technology integration. For instance, Ayanwale *et al*. (2022) [5] investigated mathematics teachers' readiness for the 4IR and reported varying levels of preparedness among teachers. Similarly, J. I. Oladele and Mandla Ndlovu explored perceptions of technological integration in STEAM teacher education and highlighted the increasing recognition of technology as a catalyst for instructional improvement (Oladele & Ndlovu, 2024) [15]. Other studies have focused on students' preparedness and perceptions regarding digital learning environments (Al-Maskari *et al*., 2024; Agustina *et al*., 2024) [1,2].

Although these studies contribute meaningfully to the growing body of literature on 4IR and education, some important gaps remain. First, many available studies are concentrated in developed countries or a few African contexts such as South Africa, while empirical evidence from Nigerian Colleges of Education remains relatively limited. Second, a considerable number of studies focus primarily on students, pre-service teachers, or institutional leadership, with less attention given to the perceptions of teacher educators themselves. Yet, teacher educators play a critical role in shaping how future teachers understand and apply technology in teaching and learning. Third, several studies emphasize technological readiness without adequately examining how teachers perceive broader educational changes associated with the 4IR, including curriculum transformation, instructional delivery, assessment practices, professional identity, and institutional support systems.

There is also a practical gap between policy aspirations and classroom realities within many Nigerian teacher training institutions. While national educational policies increasingly recognize the importance of ICT and digital competence, implementation often faces institutional and systemic challenges. In some Colleges of Education, instructional practices still rely heavily on conventional lecture methods with limited use of digital tools. Some lecturers may possess basic technological awareness but lack confidence in applying advanced digital pedagogies. Others may perceive the 4IR as a distant or abstract concept that has little

connection with their daily teaching experiences. These varying perceptions can influence the willingness of teachers to adopt innovative instructional practices.

The need to examine teachers' perceptions becomes important because perception shapes behaviour, readiness, and acceptance of change. Teachers who view technological transformation positively are more likely to experiment with digital teaching methods and encourage innovation among learners. On the other hand, negative perceptions or uncertainty may hinder implementation efforts even when infrastructure is available. Understanding how teachers in Colleges of Education perceive educational changes associated with the 4IR can therefore provide useful insight into existing challenges, institutional needs, and possible areas for intervention.

This study is also significant because Nigeria is currently experiencing increasing pressure to align its educational system with global technological realities. The demand for digitally competent graduates continues to grow across sectors of the economy. Teacher education institutions cannot remain isolated from these developments because the future workforce depends largely on the quality and orientation of teachers produced within such institutions. The application of information technology in teaching has become an important component of modern higher education systems (Van Truong & Dung, 2024) [17]. Consequently, understanding the perceptions of teacher educators toward 4IR-related educational changes may contribute to policy development, curriculum improvement, staff development programmes, and institutional planning within Nigerian Colleges of Education.

Furthermore, recent discussions have extended beyond the 4IR toward the Fifth Industrial Revolution (5IR), which emphasizes collaboration between humans and intelligent technologies. Teacher education institutions must begin to anticipate future educational transformations rather than merely reacting to existing ones (Echezu & Dimkpa, 2025) [6]. This further strengthens the relevance of investigating how teacher educators currently perceive ongoing technological and educational shifts. Against this background, the present study examines the perception of Colleges of Education teachers regarding educational changes associated with the Fourth Industrial Revolution. Specifically, the study seeks to determine how teachers perceive the relevance, opportunities, challenges, and implications of the 4IR within teacher education institutions in Nigeria.

The objectives of the study are to:

1. examine teachers' perceptions of educational changes associated with the Fourth Industrial Revolution in Colleges of Education;
2. determine the perceived level of technological readiness among Colleges of Education teachers;
3. identify challenges affecting the integration of 4IR-related technologies in teaching and learning;
4. examine the perceived implications of the Fourth Industrial Revolution for curriculum delivery and teacher preparation.

The study is guided by the following research questions:

1. What are the perceptions of Colleges of Education teachers regarding educational changes associated with the Fourth Industrial Revolution?
2. How ready are Colleges of Education teachers for technology-driven teaching within the context of the Fourth Industrial Revolution?
3. What challenges affect the integration of 4IR-related technologies in Colleges of Education?
4. What implications does the Fourth Industrial Revolution have for curriculum delivery and teacher preparation in Colleges of Education?

2. Methods

This study adopted a descriptive survey research design. The design was considered appropriate because the study sought to obtain the opinions and perceptions of lecturers regarding educational changes associated with the Fourth Industrial Revolution (4IR) in Colleges of Education. The descriptive survey approach made it possible to gather data from lecturers across different institutions without manipulating any variable. It also provided an opportunity to examine prevailing conditions relating to technological readiness, digital integration, and perceived challenges within teacher education institutions in Kwara State.

The population for the study comprised lecturers in Colleges of Education in Kwara State, Nigeria. The study covered four Colleges of Education, consisting of two public and two private institutions. These institutions were selected because both public and private Colleges of Education are actively involved in teacher preparation, although they often differ in terms of infrastructure, funding, technological facilities, and administrative support. Including both categories therefore provided broader insight into lecturers' perceptions of educational change within the context of the 4IR.

A sample size of 110 lecturers was used for the study. The respondents were selected using a multistage sampling procedure. In the first stage, purposive sampling was used to select the four Colleges of Education included in the study based on ownership structure (public and private). In the second stage, proportionate sampling technique was employed to allocate the number of respondents across the selected institutions. Thereafter, simple random sampling technique was used to select lecturers from different schools and departments within the institutions. This procedure helped to ensure fair representation of lecturers across the selected Colleges of Education.

Data for the study were collected using a researcher-designed questionnaire titled *Fourth Industrial Revolution and Educational Change Questionnaire (4IRECQ)*. The instrument was developed after reviewing related literature on the Fourth Industrial Revolution, technology integration, teacher preparedness, and educational transformation. The questionnaire was divided into two sections. Section A focused on demographic information of respondents such as gender, qualification, teaching experience, and institution type, while Section B contained items measuring lecturers' perceptions of educational change associated with the 4IR. The instrument covered areas such as technological readiness, use of digital technologies in teaching, institutional

support, perceived benefits of 4IR-driven education, and challenges affecting implementation.

The questionnaire was structured on a four-point Likert rating scale of Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). The four-point scale was preferred in order to reduce neutral responses and encourage respondents to express clearer opinions regarding issues raised in the study.

To ensure the validity of the instrument, the questionnaire was subjected to face and content validation by three experts in Educational Technology and Measurement and Evaluation from tertiary institutions in Nigeria. Their observations and suggestions were used to revise ambiguous statements and improve the clarity and relevance of the items. In order to establish the reliability of the instrument, a pilot study was conducted using 20 lecturers from a College of Education outside the study area but with similar characteristics to the selected institutions. The data obtained from the pilot study were analyzed using Cronbach Alpha reliability method, and a reliability coefficient of 0.84 was obtained. The coefficient was considered adequate for the study since it indicated that the instrument possessed acceptable internal consistency.

The researcher personally visited the selected Colleges of Education with the assistance of two trained research assistants to administer the questionnaire. Permission was obtained from the management of the institutions before the commencement of data collection. Respondents were informed about the purpose of the study and were assured that the information provided would be treated confidentially and used strictly for academic purposes. Copies of the questionnaire were distributed directly to the lecturers and retrieved after completion. This direct method of administration helped to achieve a high response rate and reduced the chances of questionnaire loss.

The data collected for the study were analyzed using descriptive and inferential statistics. Mean and standard deviation were used to answer the research questions by describing the general perception of lecturers regarding the Fourth Industrial Revolution and educational change. A criterion mean of 2.50 was used as the benchmark for decision-making. Any item with a mean score of 2.50 and above was regarded as accepted, while items with mean scores below 2.50 were regarded as rejected. In addition, inferential statistics involving independent samples t-test and Analysis of Variance (ANOVA) were used to determine whether significant differences existed in lecturers' perceptions based on selected demographic variables such as institution ownership, academic qualification, and years of teaching experience. All hypotheses were tested at 0.05 level of significance.

3. Results

This section presents the analysis of data collected from lecturers in Colleges of Education in Kwara State on their perception of educational changes associated with the Fourth Industrial Revolution (4IR). The presentation of results follows the research questions raised for the study. Descriptive statistics involving mean and standard deviation were used to answer the research questions, while inferential statistics were used to examine differences based on selected demographic variables.

A criterion mean of 2.50 was adopted for decision-making. Therefore, any item with a mean score of 2.50 and above was accepted, while any item with a mean score below 2.50 was rejected.

Research Question One: What are the perceptions of Colleges of Education teachers regarding educational changes associated with the Fourth Industrial Revolution?

Table 1: Mean and Standard Deviation Scores on Lecturers' Perceptions of Educational Changes Associated with the Fourth Industrial Revolution

S/N	Items	Mean	SD	Decision
1	The Fourth Industrial Revolution has changed the methods of teaching in higher institutions.	3.41	0.66	Accepted
2	Digital technologies have improved communication between lecturers and students.	3.28	0.71	Accepted
3	The use of smart technologies has increased students' interest in learning.	3.14	0.75	Accepted
4	Educational institutions must redesign their curriculum to meet 4IR demands.	3.53	0.59	Accepted
5	Traditional teaching methods alone are no longer sufficient in teacher education.	3.36	0.73	Accepted
6	The 4IR has created opportunities for flexible and online learning.	3.45	0.64	Accepted
7	Colleges of Education are under pressure to adopt more technology-driven instruction.	3.38	0.69	Accepted
8	The integration of digital tools enhances teaching effectiveness.	3.30	0.72	Accepted
9	Lecturers require continuous training to cope with technological changes.	3.61	0.55	Accepted
10	The Fourth Industrial Revolution is relevant to teacher education in Nigeria.	3.47	0.63	Accepted
	Grand Mean	3.39	0.67	Accepted

Table 1 shows that all the items recorded mean scores above the criterion mean of 2.50. The grand mean score of 3.39 indicates that lecturers generally had positive perceptions regarding educational changes associated with the Fourth Industrial Revolution. The respondents strongly agreed that lecturers require continuous training to cope with technological changes (M = 3.61), while the least rated item, though still accepted, was related to smart technologies increasing students' interest in learning (M = 3.14). The findings suggest that lecturers acknowledge the growing influence of the 4IR on teacher education and classroom practices.

Research Question Two: How ready are Colleges of Education teachers for technology-driven teaching within the context of the Fourth Industrial Revolution?

Table 2: Technological Readiness of Lecturers for 4IR-Driven Teaching

S/N	Items	Mean	SD	Decision
1	I can effectively use digital tools for classroom instruction.	3.02	0.82	Accepted
2	I am comfortable using online teaching platforms.	2.94	0.88	Accepted
3	I possess adequate digital skills required for modern teaching.	2.87	0.91	Accepted
4	I regularly integrate technology into my teaching activities.	2.73	0.96	Accepted
5	I can use virtual learning resources to support students' learning.	2.81	0.90	Accepted
6	My institution provides opportunities for ICT-related professional development.	2.62	0.99	Accepted
7	I am confident in handling technology-based instructional challenges.	2.69	0.94	Accepted
8	I can effectively assess students using digital platforms.	2.58	0.97	Accepted
9	I have access to adequate digital facilities for teaching.	2.33	1.01	Rejected
10	Internet connectivity in my institution supports effective digital teaching.	2.21	1.08	Rejected
	Grand Mean	2.68	0.95	Accepted

Table 2 reveals that lecturers demonstrated a moderate level of readiness for technology-driven teaching. The grand mean score of 2.68 indicates that respondents generally perceived themselves as reasonably prepared for digital teaching within the 4IR environment. However, two items relating to access to digital facilities (M = 2.33) and internet connectivity (M = 2.21) were rejected, indicating infrastructural challenges within the institutions. The result suggests that although lecturers possess some level of technological competence, institutional support and infrastructure remain inadequate.

Research Question Three: What challenges affect the integration of 4IR-related technologies in Colleges of Education?

Table 3: Challenges Affecting the Integration of 4IR-Related Technologies in Colleges of Education

S/N	Items	Mean	SD	Decision
1	Inadequate funding limits technology integration in Colleges of Education.	3.58	0.61	Accepted
2	Poor internet connectivity affects the use of digital learning resources.	3.63	0.56	Accepted
3	Irregular electricity supply hinders effective use of technology.	3.71	0.49	Accepted
4	Many lecturers lack advanced digital competencies.	3.10	0.81	Accepted
5	Some lecturers resist changes associated with digital teaching.	2.97	0.88	Accepted
6	Inadequate ICT facilities affect technology-driven instruction.	3.52	0.64	Accepted
7	Limited training opportunities reduce lecturers' readiness for 4IR teaching.	3.44	0.67	Accepted
8	Institutional policies do not adequately support digital transformation.	3.08	0.79	Accepted
9	Large class sizes make technology integration difficult.	3.16	0.77	Accepted
10	The cost of digital technologies is too high for many institutions.	3.47	0.66	Accepted
	Grand Mean	3.37	0.69	Accepted

The result in Table 3 indicates that lecturers identified several factors affecting the integration of 4IR-related technologies in Colleges of Education. The grand mean of 3.37 shows strong agreement among respondents regarding the existence of these challenges. Irregular electricity supply (M = 3.71) and poor internet connectivity (M = 3.63) emerged as the major challenges identified by respondents. The finding reflects the infrastructural realities facing many tertiary institutions in Nigeria.

Research Question Four: What implications does the Fourth Industrial Revolution have for curriculum delivery and teacher preparation in Colleges of Education?

Table 4: Implications of the Fourth Industrial Revolution for Curriculum Delivery and Teacher Preparation

S/N	Items	Mean	SD	Decision
1	Teacher education curriculum should include more digital literacy components.	3.66	0.54	Accepted
2	Lecturers need regular retraining on emerging educational technologies.	3.72	0.48	Accepted
3	Student-teachers should be exposed to technology-driven instructional methods.	3.69	0.52	Accepted
4	Colleges of Education should invest more in smart learning facilities.	3.63	0.57	Accepted
5	The 4IR requires changes in teaching practice supervision.	3.29	0.73	Accepted
6	Assessment methods should incorporate digital platforms and online evaluation.	3.24	0.76	Accepted
7	Teacher preparation programmes should focus on problem-solving and innovation skills.	3.55	0.60	Accepted
8	Collaboration between institutions and technology industries is necessary.	3.48	0.65	Accepted
9	Digital competence should become a core requirement for teacher educators.	3.61	0.56	Accepted
10	Curriculum reforms are necessary for Colleges of Education to remain relevant in the 4IR era.	3.70	0.50	Accepted
	Grand Mean	3.56	0.59	Accepted

Table 4 shows that lecturers strongly agreed that the Fourth Industrial Revolution has major implications for curriculum delivery and teacher preparation in Colleges of Education. The grand mean score of 3.56 indicates a high level of agreement among respondents. The highest rated item was the need for regular retraining of lecturers on emerging educational technologies (M = 3.72). The findings imply that curriculum reform, continuous professional development, and investment in digital infrastructure are necessary for effective teacher preparation within the context of the 4IR.

Test of Difference Based on Institution Ownership

An independent samples t-test was conducted to determine whether there was a significant difference in lecturers' perceptions based on institution ownership (public and private Colleges of Education)

Table 5: t-test Analysis of Lecturers' Perceptions Based on Institution Ownership

Variable	Institution Type	N	Mean	SD	df	T	p-value	Decision
Perception of 4IR Educational Change	Public Colleges	58	3.42	0.51	108	1.37	0.173	Not Significant
	Private Colleges	52	3.31	0.56				

Table 5 shows that there was no significant difference in lecturers' perceptions of educational change associated with the Fourth Industrial Revolution based on institution ownership since the p-value of 0.173 is greater than the 0.05 level of significance. This implies that lecturers in both public and private Colleges of Education shared relatively similar perceptions regarding the influence of the 4IR on education.

Test of Difference Based on Academic Qualification

Analysis of Variance (ANOVA) was conducted to determine whether there was a significant difference in lecturers' perceptions based on academic qualification

Table 6: ANOVA Analysis of Lecturers' Perceptions Based on Academic Qualification

Source of Variation	Sum of Squares	Df	Mean Square	F	p-value	Decision
Between Groups	1.284	2	0.642	2.11	0.126	Not Significant
Within Groups	32.554	107	0.304			

Table 6 reveals that there was no statistically significant difference in lecturers' perceptions based on academic qualification since the p-value of 0.126 is greater than 0.05 level of significance. The result suggests that lecturers' perceptions of educational changes associated with the 4IR did not significantly differ across qualification categories.

Test of Difference Based on Teaching Experience

Analysis of Variance (ANOVA) was further conducted to determine whether there was a significant difference in lecturers' perceptions based on years of teaching experience.

Table 7: ANOVA Analysis of Lecturers' Perceptions Based on Teaching Experience

Source of Variation	Sum of Squares	df	Mean Square	F	p-value	Decision
Between Groups	2.436	3	0.812	3.47	0.019	Significant
Within Groups	24.801	106	0.234			

Table 7 indicates that there was a statistically significant difference in lecturers' perceptions based on years of teaching experience since the p-value of 0.019 is less than the 0.05 level of significance. This finding suggests that teaching experience influenced how lecturers perceived educational changes associated with the Fourth Industrial Revolution.

4. Discussion

The findings of the study revealed that lecturers in Colleges of Education generally possessed positive perceptions regarding educational changes associated with the Fourth Industrial Revolution. The respondents acknowledged that the 4IR has influenced teaching methods, curriculum delivery, communication processes, and institutional expectations within higher education. This finding reflects the growing awareness among teacher educators that technology-driven instruction is becoming increasingly important in contemporary educational systems. The result supports the position of Himmetoglu, Aydug, and Bayrak (2020) [7], who argued that Education 4.0 requires changes in the traditional roles of teachers, students, and school administrators. Their study emphasized that educational institutions must adapt to new technological realities in order to remain relevant. The present finding also aligns with the study of Ahiaku and Muyambi (2024), who observed that teachers and school management play a crucial role in preparing learners for participation in the digital economy.

The study further showed that lecturers demonstrated a moderate level of readiness for technology-driven teaching within the context of the Fourth Industrial Revolution. The respondents indicated that they possessed basic digital skills and could use some technology-based instructional tools. However, many lecturers expressed concerns regarding limited access to digital facilities and unstable internet connectivity. This suggests that although lecturers may be willing to embrace technological changes, institutional conditions may hinder effective implementation. The finding corroborates the report of Van Wyk and Waghid (2023) [18], who found that pre-service teachers in South Africa were not fully prepared for 4IR-oriented teaching and learning practices despite increasing awareness of technological transformation in education. Similarly, Ayanwale, Ndlovu, and Oladele (2022) [5] reported varying levels of readiness among mathematics teachers in relation to

the demands of the Fourth Industrial Revolution.

The result concerning technological readiness may also be linked to the realities within many Nigerian teacher education institutions where digital infrastructure is still developing. In many Colleges of Education, lecturers often operate within environments characterized by inadequate ICT facilities, irregular electricity supply, and weak internet access. These conditions may reduce opportunities for lecturers to fully integrate digital technologies into classroom instruction. The finding therefore lends support to the observation of Pasi and Dhamak (2026) [16], who noted that institutional readiness and digital integration remain major concerns for higher education institutions seeking to align with the Fourth Industrial Revolution.

Another important finding of the study was that several challenges continue to affect the integration of 4IR-related technologies in Colleges of Education. Among the major challenges identified were inadequate funding, poor internet connectivity, unstable electricity supply, inadequate ICT facilities, and limited professional development opportunities. These findings reflect the infrastructural and institutional limitations facing many tertiary institutions in developing countries. The result is consistent with the study of Van Truong and Dung (2024) [17], who emphasized that effective application of information technology in higher education depends largely on the availability of supportive infrastructure and institutional investment. The present finding also agrees with Magadza (2025) [12], whose study on South African TVET colleges revealed that stakeholders identified infrastructural limitations and insufficient institutional support as barriers to effective implementation of 4IR-driven education.

The finding relating to inadequate professional development opportunities is particularly significant because the success of technology-driven education depends greatly on the competence and adaptability of teachers. Lecturers who are not regularly exposed to emerging educational technologies may struggle to adopt innovative instructional practices. This supports the position of Awodiji and Naicker (2023) [4], who stressed the importance of continuous professional development in preparing educational leaders and practitioners for the demands of the Fourth Industrial Revolution. In a related manner, Knight (2023) [9] argued that teacher readiness for 4IR-based instruction requires deliberate institutional efforts aimed at strengthening digital competence and pedagogical innovation.

The study further revealed that the Fourth Industrial Revolution has major implications for curriculum delivery and teacher preparation in Colleges of Education. The respondents strongly agreed that teacher education curriculum should incorporate more digital literacy components and that lecturers require continuous retraining on emerging educational technologies. The finding suggests that traditional teacher preparation models may no longer be adequate for preparing future teachers for modern classrooms. This outcome aligns with the views of Atibuni, Manyiraho, and Nabitula (2022) [3], who argued that teacher education institutions must undergo a paradigm shift in curriculum and pedagogical orientation in response to the changing realities of the 4IR.

The finding also supports the arguments of Lumadi (2025) [11] and Khoza (2025) [8], who emphasized the need to rethink educational systems and curriculum structures in ways that respond to both the Fourth and Fifth Industrial Revolutions. Their studies highlighted the importance of curriculum justice, innovation, and relevance within rapidly changing technological societies. Likewise, Magadza (2026) [13] observed that curriculum reform, faculty development, and graduate employability are interconnected issues within the context of the Fourth Industrial Revolution. The present study therefore reinforces the argument that Colleges of Education in Nigeria need to redesign aspects of their teacher preparation programmes in order to equip future teachers with relevant digital and problem-solving competencies.

The study additionally found that institution ownership and academic qualification did not significantly influence lecturers' perceptions regarding educational changes associated with the Fourth Industrial Revolution. This implies that lecturers in both public and private Colleges of Education generally shared similar views concerning the growing importance of digital transformation in education. The finding may suggest that awareness of technological change cuts across institutional

categories regardless of differences in ownership structure. However, the study revealed that years of teaching experience significantly influenced lecturers' perceptions. This outcome indicates that lecturers with varying levels of experience may differ in their adaptation to technological changes and innovation within educational practice.

Overall, the findings of the study demonstrate that lecturers in Colleges of Education recognize the relevance of the Fourth Industrial Revolution to teacher education in Nigeria. Nevertheless, the study equally highlights the persistent infrastructural, institutional, and professional challenges limiting effective implementation of technology-driven teaching and learning within Colleges of Education.

5. Conclusion

The study examined the perception of Colleges of Education lecturers regarding educational changes associated with the Fourth Industrial Revolution in Kwara State, Nigeria. The findings showed that lecturers generally possessed positive perceptions toward the 4IR and acknowledged its relevance to teaching, learning, curriculum delivery, and teacher preparation. The study further revealed that lecturers demonstrated moderate technological readiness, although inadequate infrastructure, poor internet connectivity, unstable electricity supply, and limited professional development opportunities remained major barriers to effective implementation.

The study therefore concludes that while Colleges of Education lecturers are increasingly aware of the need for technology-driven education, substantial institutional support is still required to achieve meaningful integration of 4IR-related innovations within teacher education. Strengthening digital infrastructure, promoting continuous staff development, and reviewing teacher education curriculum are necessary steps toward improving the preparedness of Colleges of Education for emerging technological realities.

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