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Managerial Competencies and Education 4.0 in Nigerian Tertiary Education

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Abstract

This paper discusses managerial competencies and Nigeria's readiness to integrate them into Nigerian tertiary education to support the widespread adoption of Education 4.0. It also proposed potential strategies to help Nigerian tertiary education institutions incorporate managerial competencies and Education 4.0 into their curricula. To understand the current situation of managerial competencies in Nigerian tertiary education, the paper conducted a literature review of existing research. The search shows the total of 483 result sun evenly distributed from 2010to 2023 related to Education 4.0,withhigh of 137 in 2022.The analysis of the publications on Education 4.0 proves that the research field is developing fast, though publications authored by researchers from developing countries prevail in the search results. At the same time, most of the selected publications came out in the Scopus-indexed low-quartile or discontinued journals. A disproportionately low number of articles published by authors from the OECD countries depletes the quality of the research field. It was also found that managerial competencies have not been given a high level of attention or emphasis in Nigerian tertiary education, making it difficult for educational institutions to effectively implement Education 4.0 strategies. To address this, the paper proposed several strategies that Nigerian tertiary education institutions should consider. Specifically, the paper suggests that institutions should focus on developing managerial competencies, such as problem-solving, decision-making, and communication skills, as well as technology-related competencies, such as computer literacy, coding, and programming.

Introduction

The world has recently witnessed an increase in globalization, where the economies of many nations are interlinking to encourage foreign trade through technological advances and connectivity (Carnevale & Hatak, 2020) [10]. This upsurge has also increased rivalry in the local and international markets, encouraging organizations to hire and retain highly talented workers. Several companies depend on their employees to gain an advantage in the competitive market. Therefore, they are strongly related to the efficiency and effectiveness of their human resources (Anwar & Abdullah, 2021) [5].

However, these myriad changes that have beclouded the modern business procedures of business organizations in recent times, together with the fundamental and core changes like work and work organization, the dynamic nature of the competitive business environment, and the need to ensure a meeting of stakeholders' interest in the way the organizations are run, a need for new styles in human resource management has arisen (Alkhodary *et al*., 2015) [3]. One of these emerging themes is "competency". The terms "competence" and "competency" gradually became fore in the late 1980s and in the 1990s to express what the target of assessment and development initiatives should be, particularly relevant to management (Rotman *et al*., 2018). "Competency" has been a catchphrase in organizational literature for several years. Some treat the competencies of the corporation as an entity, while others treat the competencies of employees (Łupicka & Grzybowska, 2018) [19].

The term "managerial competencies" is often used to recognize managers' competence in their functional area, mainly in evolving and enhancing their decisions and task performance, as documented by (Alkhodary *et al*., 2015) [3]. Managerial competencies are concerned with people's behaviors; recognizing and raising the competencies of managers regarding their roles in decision-making, activities, and exact tasks will be of great importance in the quest for constant effective performance (Okpara *et al*., 2019) [24]. Hence, the emphasis of the concept of competency is largely to assist organizations in coping with environmental change and the quest to integrate an organization's human resource strategy and its corporate strategy (Brooks *et al*., 2018) [7]. The need to study managerial competencies and their associated relationship to employee performance appears

imperative and, therefore, this paper's main area of interest. Myriad research concerns are related to the business environment and the emerging technologies that shape the production process, the business itself, and the managers' competencies. Hence, the new global economy occurs in conditions of increasing competition, economic crises, and the daily aging of technology and knowledge. Thus, success is achieved by those firms in which the crucial factor among all resources is the human factor, particularly personnel management. The post-industrial stage of the development of world society Industry 4.0 (IR4.0) contributes to changes in the existing traditional technologies of personnel management to be more adaptive and organic, which, accordingly, requires the continuous development of managers at all levels of the hierarchy (Miranda *et al.*, 2021) [21].

The IR4 revolution is not only for business transformation, the educational sector is receiving innovative transformation in terms of educational practices, skill sets, competencies, teaching and learning methodologies (including flipped classroom, blended learning, self-regulated learning, project-based learning, inquiry-based learning, student-centered pedagogy), digital tools used at all educational levels. The new slogan "Education 4.0" covers this change string (Tikhonova & Raitskaya, 2023a) [30]. There are various explanations of the concept mostly aligned with IR4.0.

Consequently, these changes present a new vista, among which is the digitalization of the education system. Traditional educational methodology cannot meet modern society's demands, as proved by urgent situations such as the COVID-19 pandemic or today's economic confusion (Sheveleva *et al.*, 2023) [27]. An inventive student-centered method that boosts critical thinking and the capacity to solve non-standard problems is becoming the basis of the so-called competency-based approach, the leading instructional trend worldwide. Digital disruptive tools, including test systems, widely promoted within this approach, are integral to our lives and have great potential in overcoming contemporary crises.

Consequently, this present study will extol the virtues of IR4.0 to tertiary education. This is because tertiary institutions encourage educators and researchers to lead initiatives and projects in educational innovation by designing and developing new practices, methodologies, and applied technologies (Smith *et al.*, 2021) [28]. It has been argued that these initiatives and projects must align with the requirements of educational institutions to respond to emerging social contexts, considering paradigm shift to technological innovation as drivers to achieve these innovative solutions (Reguera & Lopez, 2021) [25]. These solutions will enhance teaching-learning and management processes and create conducive environments for vital pedagogical procedures.

Therefore, innovation results have been applied on a big scale for new teaching-learning programs in higher education, with continuing education and lifelong learning programs. Innovative distance learning programs have been developed, primarily using connectivity, digitalization, and virtualization platforms (Reguera & Lopez, 2021) [25]. However, there is an absence of information, design methodologies, and evaluation mechanisms that permit designers and educators to use technologies and emerging pedagogy procedures to provide innovative solutions,

especially for tertiary institution programs. Hence, building reference frameworks to guide designers during the design and implementation processes is essential. The remainder of this paper is structured as follows: The next section presents a review background of IR transition from IR1.0 to IR4.0 concerning education. IR is hereafter referred to as Education 1.0 to Education 4.0. Section 3 discusses the concept of Education 4.0 in tertiary education and defines the proposed core components shaping Education 4.0.

Background summary of the evolution of the Industrial Revolution (IR)

The first IR happened in the 18th century, and the education sector thrived, indicating the start of the period of Education 1.0. The period was considered by systems mechanization occasioned by the advent of technologies for education to enable paper-making machines, mechanical printing, the graphite pencil, the ballpoint pen, and the typewriter. This period is considered significant to educational philosophies based on instruction, essentialism, and behaviorism. The educator was seen as a learned, and the student had, in most cases, a passive role. Thus, in the period of Education 1.0, the teacher was the epicenter of education, responsible for shaping and disseminating the critical information needed by the students (Reguera & Lopez, 2021) [25].

IR 2.0 coincided with education 2.0 at the beginning of the 20th century, characterized by mass production, industrialization, and electricity. The period served as the primary source of information: Open-source materials from libraries. Hence, the advancement in educational technology brought pertinent contributions to this sector and the beginning of electronic devices, such as printers, calculators, and computers, in classroom instructions. The educational philosophies in this period were principally pedagogical and constructivist. The teacher's role changed from a learned to a reference and information source to help develop the mechanism for professional implementation, and the student's role is passively constant. However, an active role for students emerged when they became "owners of the knowledge." The learning approach was also teacher-centered, but peer assessment was introduced, with the teacher still being essential. Again, the period practiced correspondence education and broadcast education appeared. Additionally, education 3.0 developed in the third IR at the end of the 20th century and rotated primarily around computerization, automation, and control. In this new communication era, the students and teachers began transitioning to an idea where they were no longer required to participate in a synchronous session for learning to happen. The teaching-learning processes were supported by multiple resources such as multimedia, online tools, and virtual laboratories. This teaching-learning approach was more haunt logical and connective. Each teacher was regarded as an orchestrator, curator, and collaborator, and the students were empowered to build their knowledge.

However, the IR4.0 and the technologies, innovative pedagogical procedures, and best practices that depict this current period comprise what is known as Education 4.0. The diagram in Figure 1 assembles the relevant concepts of the higher education transition from Education 1.0 to the current IR4.0. The infographic's sources to define the structure are the works of various authors whose research elements were included in this section (Miranda *et al.*, 2021) [21].

Table 1: Summary of the evolution of Education 4.0

	Education 1.0	Education 2.0	Education 3.0	Education 4.0
Period	Late 18th Century	Early 20th Century	Late 20th Century	Present
Philosophy	Essentialism, behaviorism and instructivism.	Andragogical, constructivist.	Heutagogical connectivist.	Heutagogical, peeragogical and cybergogical.
Education Role	Sage.	Guide, information source	Orchestrator, curator and collaborator	Mentor, coach, independence, trajector designer.
Student Role	Largely passive.	Emerging active "owning of the teacher importance.	Active, "Knowledge ownership", initial independence.	Acitve, high independence, trajectory designer.
Approach	Teacher-centered.	Peer assessment encouraged high teacherimportance.	Co-constructed, first student-centered.	Mostly student-centered.
Learning outcome	Grades, graduation degree.	License to professional practicing.	Prepared for practice and scenario analysis.	Training of key competencies both soft and hard.
Enablers	Mechanical printing, graphite pencil, ballpoint pen, typewriter.	First computers, electronic devices and calculators.	Computers and widespread use of the internet.	ICTs tools and platforms powered by IoT.
Information Source	Standard texts	Adopted texts and open-source material (physical).	Texts, case studies, second-hand experience.	Based on online sources.
Facilities	Universities/ classrooms.	Blended laboratories and classrooms.	Blended and flexible physical shared spaces.	Cyber and physical spaces are both shared and individual.
Industrial Technology	Mechanical systems, steam-powered.	Mass production, industrialization, and electricity.	Internet access, automatization, and control.	Connectivity, digitalization, and virtualization.

Adopted from (Miranda *et al*., 2021) [21]

Further, the important aspects of the pedagogy in Education 4.0, are the challenges Industry 4.0 and Work 4.0 make regarding graduates' employability i.e. Skill sets, pedagogical approaches applied, and effective online ways of teaching and learning, mixed environments, and the synopsis of the research to explore the emerging field education (Akimov *et al*., 2023) [2]. The concept of Education 4.0, therefore, is an incorporation of the cyber and physical worlds by presenting new technologies (Sony & Naik, 2020) [29]. The essence of transformations in education 4.0 embraces the following features; vertical networking in smart production; horizontal integration via global value chain networks; through-engineering across the entire value chain; and acceleration of production through exponential technologies (Tikhonova & Raitskaya, 2023b) [31]. Students with Education 4.0 must get ready for Industry 4.0 and Work 4.0. The technologies related to Industry 4.0 reduce the life cycle of most professions. Thus, the concept of Education 4.0 symbolized "the effects of the systematic changes occasioned by the IR4" through Education 4.0 (Oliveira & Saraiva, 2023). It indicates "self-regulated learning, critical thinking, collaborative and teamwork skills supported by digital expertise" (Thite *et al*., 2021).

Education 4.0 in Teaching and Learning
Teaching and learning have been based on the classroom method for all its history and currently, a dominant process all over the world (Tikhonova & Raitskaya, 2023b) [31]. The recent pedagogical models applied in teaching and learning are shifting towards other methods, including e-learning or internet-based learning, blended learning which is a mixture of face-to-face and electronic-based learning; with instructional modalities classroom, distance, and self-paced learning; instructional designs; and delivery media, self-regulated learning, project-based learning, revised face-to-face learning to provide for a combination of face-to-face, remote, and online interaction (Sharma & Jones, 2019) [26]. Sharma and Jones (2019) [26] further regard revised face-to-face learning as a set of problem-solving, study groups,

presentations, formative assessments, and formative peer evaluations. Traditional lectures turn into interactive lectures that no longer look like a teacher's monologue.
Hence, these new pedagogies of Education 4.0 are being modified unevenly all over the global scale, with emerging countries such as Nigeria being far behind the frontrunners. The economies of the former are not ready for Education 4.0. Their educational systems are less developed and under-equipped to sponsor novel educational initiatives (Chigbu *et al*., 2023). Additionally, Research in Education 4.0 is ongoing and on the rise, for example, the search query "Education 4.0" in the titles, abstracts, or keywords in the Scopus database showed 483 results (as of March 5, 2023), spread from 2010 to 2023. However, the first article dates to 2010-2013, and the concept of Education 4.0 increased not earlier than 2019 after it was accepted by the European Union in 2016 and pronounced by the World Economic Forum in 2019. The trend toward more publications is certain, pointing to 137 documents in 2023 (see Table 2). Nevertheless, the subject area of Education 4.0 is still getting its shape, and there are numerous reviews on the topic (Tikhonova & Raitskaya, 2023b) [31].

Research on Education 4.0
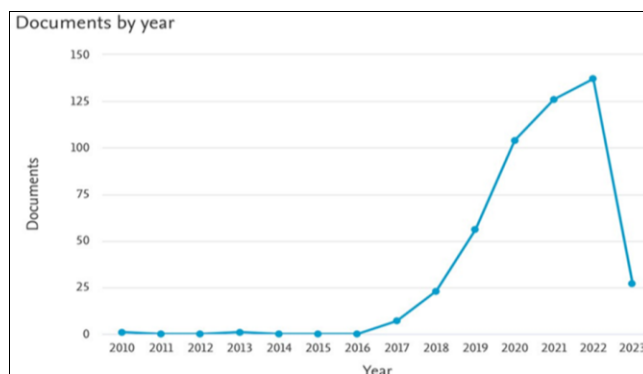
Source: Scopus Databaseas of March 5, 2023. Scopus database. Copyright 2023 by Elsevier

Additionally, the research result is fully explained in Table 2 below how each category stood as of 5th March 2023.

Table 2: Scopus Data Base Search Results on Education 4.0

Features	Number (Percentage)
Total Search Results	483
Articles	195 (40.4 %)
Review Papers	16 (3.3 %)
Conferences Papers	224 (46.4 %)
Book Chapters	31 (6.4 %)
Journals and Other Sources	205
Authors	318
Most Prolific Author – Ramírez-Montoya, M.S. (Tecnologico de Monterrey, Monterrey, Mexico)	15
One-Authored Documents	57
Top Cited Publication (Benešová & Tupa, 2017) [6]	282
Country with the Highest Results – Malaysia	66
Most Productive Year 2022	137

Scopus Data Base
Of all the total number of search results, 16 including 7 were relevant reviews in English e.g., (Ahmad *et al.*, 2022; Butt *et al.*, 2020; Chaka, 2022; Costan *et al.*, 2021; Dao *et al.*, 2023; González-pérez & Ramírez-montoya, 2022; Sharma & Jones, 2019) [1, 9, 11, 12, 13, 14, 26]. Although some reviews and other publications were from journals, none of the quartiles or publishers with doubtful reputations were disjointed (Dao *et al.*, 2023) [13]. The most productive countries in this area of scholarship are; Malaysia (*n*=66), Mexico (*n*=62), Indonesia (*n*=60), India (*n*=44), Germany (*n*=29), Spain (*n*=26), Romania (n=21), Brazil (*n*=19), United States (*n*=17), and Russian Federation (*n*=15).

Some OECD nations contributed to Education 4.0, but the field "cannot develop strongly" (Dao *et al.*, 2023) [13]. The contribution on the part of many emerging countries confirms the fact that their interest in Education 4.0 outperforms the one of technology-driven nations. Further, the most regular keyword "Education 4.0" was included in 367 publications out of 483 (75.98 %). Other most general key words were Industry4.0 (151publications), students (147), engineering education (145), technology (123), and e-learning (81). Additional keywords in the search results covered artificial intelligence, augmented reality, the Internet of Things, and others. Almost all most frequent words conformed with the findings of there view mentioned. The spread in the thematic area of publications covered is rather wide. However, the reviewed most cited articles were from general features of Education 4.0 (Himmetoglu, & Bayrak, 2021; Mansor *et al.*, 2020 [20]), requirements for Education 4.0 and qualification in Industry 4.0 (Benešová & Tupa, 2017) [6], digital transformation towards Education 4.0 (Jain & Jain, 2022; Katyeudo & de Souza, 2022) [17, 18], andcountry-related issues of Education 4.0 (Anito & Morales, 2019; Buasuwan, 2018) [4, 8]. The analysis was subject to the articles only with numerous citations.

Nigeria's readiness for the adoption of Education 4.0
Nigeria as one of the emerging economies is making giant strides in the adoption of Education 4.0. For example, Nwagwu (2020) [22] indicated that mass unawareness, low computer literacy level, and cost were identified as critical factors affecting the acceptance of Education 4.0 by students and lecturers in Nigerian universities. Additionally, a recent article by the OECD Development Matters suggests that Nigeria's education system should focus more on foundational skills development, ensuring that children acquire the basic numeracy and literacy skills that are building blocks for a life of learning (OECD, 2023) [23]. The article also highlights the need for the post-COVID-19 education system to be better prepared for shocks and technologically driven. Overall, Nigeria is making progress in the adoption of Education 4.0, but there are still challenges that need to be addressed to ensure that the benefits of technology in education are fully realized (Nwagwu, 2020) [22].

Conclusion
Digitalization is changing values and fields of activity in existing industries. Technological advances caused by Industry 4.0 are developing at an incredibly fast pace, changing the way we live, work, and function in society. Artificial intelligence, robotics, Big Data and the Internet of Things have a combined impact on the labor market and the economy as a whole. Future employees must be proficient not only in new technologies themselves but, equally importantly, in values associated with the use of these technologies. Qualities such as creativity, flexibility, and adaptability are a must as well. Taking full advantage of opportunities offered by advanced technologies requires a similar revolution in education for the successful training of specialists with new necessary competencies.

TheresearchonEducation4.0is still in the infant stage in Nigeria and ontherisewhiletheIR4 is making some evident progress to Industry 4.0. The outline stated above may direct potential researchers through the new vista for research. The focus on this prospective area is certain to bring more findings and publications shortly. It would be rational for researchers to analyze national and regional experiences in encouraging the concept, and compare country-related experiences and the best practices in promoting the appropriate teaching and learning models in face-to-face, online, and mixed environments. Further, research may embrace skills, both on a national and World scale; competencies of Industry 4.0, specific to various sectors of the economy; teaching and learning approaches in Education 4.0; and new educational frameworks and environments.

Specifically, the paper suggested that institutions should focus on developing managerial competencies, such as problem-solving, decision-making, and communication skills, as well as technology-related competencies, such as computer literacy, coding, and programming. Additionally, the paper proposed that institutions should create courses and curricula that focus on the application of managerial competencies in the context of Education 4.0. Finally, it suggested that institutions should foster a culture of collaboration and debate through seminars, conferences, and other activities to encourage thoughtful dialogue and discussion about managerial competencies and Education 4.0.

Overall, this paper has highlighted the importance of incorporating managerial competencies into Nigerian tertiary education to support the successful implementation of Education 4.0. It has proposed potential strategies that Nigerian tertiary education institutions should consider to develop and implement these competencies. These strategies could pave the way for Nigerian educational institutions to effectively transition into the modern, digital era.

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