KEY FACTORS AFFECTING AWARENESS LEVEL OF INDUSTRY 4.0 TECHNOLOGIES AMONG LECTURERS AND STUDENTS IN A HIGHER INSTITUTION OF LEARNING

Ijaola, I. A.[1], Omolayo, O. H.[2], Akerele, A. O.[3]

[1]Department of Building Technology, School of Environmental Studies, Yaba College of Technology, Yaba, Lagos State. Nigeria. Email: iredbuilder@gmail.com
[2]Department of Building Technology, School of Environmental Studies, Yaba College of Technology, Yaba, Lagos State. Nigeria. Email: bosunomolayo@yahoo.com
[3]Department of Building Technology, School of Environmental Studies, Yaba College of Technology, Yaba, Lagos State. Nigeria. Email: bimpeakerele@gmail.com

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Abstract

One of the ways of promoting a shift to an industrialized economy is by teaching and adopting Industry 4.0 in higher institutions of learning. However, the awareness level of Industry 4.0 is relatively low, hence it is necessary to investigate the factors responsible for the low awareness rate. The study aims at investigating the factors affecting the awareness level of Industry 4.0 technology among lecturers and students with the view to introducing it into their curriculum. Adopting a qualitative research design and a census sampling technique, an open-ended questionnaire was used in eliciting information from lecturers and students while thematic analysis was used in categorising the factors. It was discovered that the key factors affecting lecturers' awareness level can be categorised into three while that of students into eight. The study thus concluded that information factors were the major factors affecting the awareness level of industry 4.0 technology among lecturers and students. Professional bodies should organise workshops and seminars where information on Industry 4.0 will be disseminated to lecturers and students.

Keywords: Industry 4.0 technology, innovative curriculum, key factors, lecturers, students.

1. INTRODUCTION

The target of Sustainable Development Goal (SDG) 9 is to build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation (United Nations Industrial Development Organisation, UNIDO, 2016). This target can be achieved in the construction industry through the adoption of Industry 4.0 technology. Industry 4.0 introduces the concept of innovative technology in the manufacturing industry and likewise the construction industry (Pheng & Hou, 2019; You & Feng, 2020). With this adoption, the construction industry in Nigeria can shift into a production and industrialized economy thereby promoting SDG 9 goal of sustainable industrialization and fostering innovation.

The active involvement of lecturers and students in the transformation into an industrialized economy is crucial for fostering a skilled workforce, driving innovation, promoting entrepreneurship, and ensuring sustainable economic growth (Cebrián & Junyent, 2008; Youtie &Shapira, 2008). Collaboration between academia and industries is essential in shaping a successful and prosperous industrialized nation (Murmann, 2003). Thus, it is essential to understand the knowledge level of Industry 4.0 among lecturers and students.

Gazquez et al. (2021) reported a lack of skills, knowledge and competencies among students of higher education in key enabling technologies of Industry 4.0 while Legg-Jack (2021) concluded that educational institutions in Nigeria are unable to integrate Industry 4.0 technologies into teaching and learning. Furthermore, Ismail et al. (2020) discovered that higher education students' knowledge of Industry 4.0 is weak because students are not accustomed to the use of Industry 4.0 technologies. Many factors are responsible for the weak level of knowledge of Industry 4.0, particularly among building students and lecturers. While most studies focused on the awareness or knowledge level of Industry 4.0 among students and lecturers in higher educational institutions, others focused on the factors influencing the adoption or application level of Industry 4.0. For example, Tinmaz and Lee (2019) investigated the readiness of university students for Industry 4.0 revolution. They concluded that students are not adequately aware of Industry 4.0 fundamentals, thus they are skeptical of its implementation. Al-Maskari et al. (2022) investigated factors affecting students' preparedness for Industry 4.0 in higher education institutions. The factors are students' characteristics, knowledge of Industry 4.0 technologies, and organizational dimension. Rojas-Berrio et al. (2022) considered the factors influencing the adoption of Industry 4.0 technologies in manufacturing SMEs while Yuksel (2022) determined the factors affecting Industry 4.0 applications in some selected companies. However, the focus of these previous studies was on factors affecting the adoption or application of Industry 4.0 and not on the awareness level. Hence, this study intends to fill this gap by exploring the factors affecting the awareness level of Industry 4.0 among building students and lecturers in higher educational institutions to promote a shift to an industrialized economy in the construction industry through Industry 4.0.

Future drivers of the industrialized economy need a sound knowledge of the innovative technologies required to promote this shift. Therefore, the factors affecting the awareness level of these innovative technologies among students and lecturers must be investigated for maximizing the potential benefits, overcoming challenges, and promoting a sustainable and inclusive adoption of advanced digital technologies across industries and societies.

2. LITERATURE REVIEW

Industry 4.0 is a concept that combines several technologies to produce a system that is autonomous, knowledge and sensor-based and self-regulating (Dalmarco et al., 2019). It is a concept that represents the practical application of the smart thinking approach in manufacturing environments (Bartodziej, 2017). Industry 4.0 signifies a complete transformation of the manufacturing process through the implementation of digitalization and automation across all its stages (Tay et al., 2018). In other words, industry 4.0 is the application of novel technologies characterized by digitalization and automation at every stage of production.

Different authors adopt different concepts for describing industry 4.0 technologies. Rüßmann, et al. (2015) adopted the original nine technologies of Industry 4.0; namely, Autonomous robots, simulation, horizontal and vertical system integration, the industrial of things, cybersecurity, the cloud, additive manufacturing, augmented reality, big data and analysis. Tay et al. (2018) also adopted nine technologies in describing Industry 4.0 namely; Cyber-Physical systems, Internet of Things, big data and analytics, augmented reality, additive manufacturing, simulation, horizontal and vertical system integration, autonomous robots, and cloud computing. Other authors such as Ujakpa et al. (2020) and Adepoju & Aigbavboa (2020) adopted more than the original nine technologies. Ujakpa et al. (2020) industry 4.0 technologies include; Smart factories, augmented reality, Internet of Things, cloud computing, machine learning, AI, data

security/protection & privacy, social web, wearable technologies, robotics, smart sensors, simulation, human-machine interface, 3D Printing while Adepoju & Aigbavboa (2020) concept includes; Social media, mobile computing, automation, internet of Services, internet of things, Building Information Modelling (BIM), 3D printing, big data, Human-Computer Interaction (HCI), Product Lifecycle Management (PLM), prefabrication/modularization, cloud computing, additive manufacturing, Radio-frequency Identification (RFID), Robotics, augmented/virtual/mixed reality, Cyber-Physical Systems (CPS) embedded systems.

2.1. Factors Affecting the Awareness Level of Industry 4.0

There are several factors affecting the awareness level of Industry 4.0 and these factors differ based on the specific context and industry. The factors are also interconnected and can influence each other. In higher institutions of learning, the factors differ from players in the industry. The factors include variety of definitions of Industry 4.0 and complexity of the concepts and cultural perception (Dikhanbayeva et al., 2021); Economic factors (Al Turk, & Weheba, 2022); Education and training (Vijaya et al., 2023) and technology complexity (Dikhanbayeva et al., 2021). A critical analysis of these factors from the perspective of students and lecturers will assist in the understanding of the awareness level and the subsequent adoption into the curriculum to produce future generations that will promote an industrialized economy through the construction industry in Nigeria.

3. METHODOLOGY

A qualitative research design was adopted in this study while an open-ended questionnaire was used to elicit information on factors affecting the awareness level of Industry 4.0 among students and lecturers. An open-ended question was used because it gives the respondents the freedom to describe the situations and provide extensive answers without being restricted to available answers (Saunders et al., 2016). A census sampling technique was adopted in distributing the questionnaires. Census sampling is a sampling technique in which the population is part of the survey (Saunders et al., 2016). This was adopted because data were required from all students of levels 1, 2, 3 and 4 and from all lecturers in the Department of Building Technology. 237 questionnaires were distributed to students while 15 questionnaires were distributed to lecturers. A total of 162 students' questionnaires were returned and valid for analysis representing a 68% response rate while 6 lecturers' questionnaires were returned and valid for analysis representing a 40% response rate. Students and lecturers were asked to state in few words the factors affecting their awareness level of Industry 4.0. Thematic analysis was then employed in categorising the factors.

4. ANALYSIS

To determine the factors affecting the awareness level of industry 4.0 technologies, lecturers were given the freedom to state their opinion on the factors. Their statements were coded and classified into key factors using thematic analysis. Lecturers perceived six variables as the factors affecting their awareness level of industry 4.0 technologies. The six variables were further coded into 3 key factors namely, information factors, educational and training factors and resources factors. Information factors consist of variables that relate to inadequate information on industry 4.0 technologies. Educational factors relate to variables on education and training on industry 4.0 technologies while resource factors imply lack of equipment to execute work using industry 4.0-related equipment.

A total of 123 responses on factors affecting awareness level of industry 4.0 technologies among students were valid and coded into 8 variables namely; compliance factors, economic factors, educational and training factors, information factors, negligence factors, resources factors, social factors and technology/Network factors. The implication is that the listed factors influence the knowledge level of industry 4.0 among students.

5. DISCUSSION

Promoting an industrialized economy through Industry 4.0 technologies involves integrating advanced digital technologies into the construction industry. Hence, the study investigated the factors affecting the awareness level of Industry 4.0 among students and lecturers of the department of building in a higher institution of learning using open-ended questions. From the perspective of lecturers, three key factors were identified namely, information factors, education and training factors and resources factors. Vijaya et al. (2023) cited education and training as a factor also. The implication is that the level of education and training in technology and digital skills can significantly impact awareness level of industry 4.0. This was clearly explained by Ismail et al. (2020) when they concluded that students are not accustomed to the use of Industry 4.0 technology during teaching and learning, hence their awareness level is low. Furthermore, the availability and accessibility of accurate and comprehensive information about Industry 4.0 technologies will greatly impact awareness. If information is readily available through various channels like media, the internet, seminars, workshops, and educational institutions, it can increase the awareness level among students and lecturers.

The key factors affecting student's awareness level of industry 4.0 technologies are compliance factors, economic factors, educational and training factors, information factors, negligence factors, resources factors, social factors and technological factors. Previous authors (Vijaya et al., 2023; Dikhanbayeva et al., 2021; Al Turk, & Weheba, 2022) cited these factors. The factor with the highest variable is information factors, followed by educational and training factors. This shows the importance of information dissemination to increasing awareness level of Industry 4.0 among students.

6. CONCLUSION AND IMPLICATIONS

Promoting a shift to an industrialized economy in the construction industry amid global socio-economic disruptions can be achieved by investigating the factors affecting the awareness level of Industry 4.0 among future drivers of the economy (students). Subsequently, this study examined the factors affecting the awareness level and discovered three key factors from the perspective of lecturers and eight key factors from students. It is thus concluded that the key factors affecting the awareness level of Industry 4.0 among participants in academia are compliance factors, economic factors, educational and training factors, information factors, negligence factors, resources factors, social factors and technological factors. To achieve sustainable development in the economy of Nigeria through an industrialized economy, participants in all sectors of the economy particularly the construction sector should consider the factors affecting the awareness level of innovative technologies that will promote a shift to an industrialized economy. This can be achieved by disseminating information on Industry 4.0 among students, educating them through seminars, workshops, and the inclusion of technologies in their curriculum.

7. LIMITATIONS AND FURTHER STUDIES

This study investigated the factors affecting the awareness level of Industry 4.0 using a qualitative research design. Future studies can examine the factors discovered in this study using a quantitative research design via close-ended questionnaires. This will help to achieve triangulation of results. Furthermore, this study is limited in that only one higher education institution was considered, future studies should investigate the factors from multiple higher education institutions.

AUTHOR DECLARATIONS

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