



Vaasan yliopisto
UNIVERSITY OF VAASA

OSUVA Open
Science

This is a self-archived – parallel published version of this article in the publication archive of the University of Vaasa. It might differ from the original.

Digitalization of education: opportunities and challenges for sustainable higher education and learning

Author(s): Azizuddin, Mohammad; Shamsuzzoha, Ahm; Iqbal, Mohammad

Title: Digitalization of education: opportunities and challenges for sustainable higher education and learning

Year: 2024

Version: Accepted manuscript

Copyright ©2024 Computers and Industrial Engineering.

Please cite the original version:

Azizuddin, M., Shamsuzzoha, A., & Iqbal, M. (2024). Digitalization of education: opportunities and challenges for sustainable higher education and learning. In Y. Dessouky, & A. Shamayleh (Eds.) *50th International Conference on Computers & Industrial Engineering (CIE50): Sustainable Digital Transformation*, 1011-1020.
<https://www.proceedings.com/72579.html>



DIGITALIZATION OF EDUCATION: OPPORTUNITIES AND CHALLENGES FOR SUSTAINABLE HIGHER EDUCATION AND LEARNING

MOHAMMAD AZIZUDDIN¹, AHM SHAMSUZZOHA², MOHAMMAD IQBAL³

¹ School of Strategy and Leadership
Coventry University, United Kingdom
E-mail: ad7655@coventry.ac.uk

² School of Technology and Innovations
Digital Economy Research Platform
University of Vaasa, Finland
E-mail: ahsh@uwasa.fi

³ School of technology
Department of Industrial and Production Engineering
Shahjalal University of Science and Technology, Bangladesh
E-mail: iqbalm-ipe@sust.edu

ABSTRACT

This research paper aims to scholarly understand and take part in debates regarding the digitalization of education with sustainable higher education and learning. The invention and practice of digital facilities in higher education during and after the Covid-19 era have created ample opportunities as well as various challenges for higher education worldwide. Based on such circumstances, this study identified two research questions, namely: (i) What are the added opportunities digitalization of education offers to maintain sustainable education and learning, and (ii) What are the accompanying challenges behind the digitalization of education and how to address them? This paper is a qualitative study based on gleaned data from both primary and secondary sources. The findings implicate academics and university senior management to reassess the study curriculum and delivery, and adopt and offer dynamic academic programs of higher education, considering the impact of digitalization of education on sustainable higher education and learning. In this study, a research-enriched learning curriculum and effective delivery with an innovative pedagogical approach are also proposed.

Keywords: Digitalization, Sustainable higher education, SDGs, Active learning, Curriculum design, Innovative pedagogy

1 INTRODUCTION

To achieve the SDGs targets, higher education institutions (HEIs) would be required to initiate and deliver various learning activities commensurate with time and space relations as a means of promoting the sustainability approach [1] (Fleaca, 2018). Importantly, "digital education itself should seek mechanisms that enable the direct contribution to other SDGs on a more regular basis," collaborating with a large part of the educational community [2,3] (García-Hernández, 2020; Kabadayi et al., 2022).

Digitalization of education is a critical element in ensuring sustainable higher education and learning. This study intends to add the theoretical perspective of the digitalization of education phenomenon to the context of sustainable higher education and learning [4] (Ullah & Azizuddin, 2018). Sustainable higher education and learning can be regarded as the optimum



educational environment that supports overall social, economic, environmental, and political development, otherwise known as sustainable development. Digital innovation in higher education learning delivery gained momentum during Covid-19 [5,6,7] (Fuji et al., 2022; Webb et al., 2021; Legg-Jack, 2021). The use of online learning delivery may serve to overcome the crisis period. However, the provision of the use of remote delivery platforms and other digital software in higher education hampers sustainable education with soft skills and creative learning. The challenges are more than the opportunities. Based on such circumstances, this study is identified two research questions (RQs), namely:

RQ 1: What are the added opportunities/values that digitalization of education offers to maintain sustainable education and learning?

RQ 2: What are the accompanying challenges behind the digitalization of education, and how to address them?

This study begins with a descriptive discussion and moves to an in-depth analysis to generalize likely outcomes [8,9,10] (Zifcak, 1992; Finnegan, 1998; Nooteboom, 2003). The findings of the study implicate both higher education academics and management, as literature on the digitalization of education with sustainable learning in higher education has been scarce [11,12] (Azizuddin, 2016; Azizuddin & Hossain, 2021). It calls for higher education institutions to reassess active learning methods for sustainable education and research that create skilled human resources, meeting the requirements for national development.

The rest of the article is organized as follows. The second section presents the literature review related to defining the key concepts of digitalization, sustainability, and sustainable higher education and learning and highlights a theoretical framework that extensively displays the relationship between digitalization and sustainable higher education. The study methodology is outlined in Section 3, while the overall study findings are discussed in Section 4, providing a constructive summary of the discussion that includes recommendations for a research-enriched learning curriculum and effective delivery with an innovative pedagogical approach. General managerial implications are highlighted in Section 5, whereas the study is concluded in Section 6, along with future study directions.

2 THEORETICAL FRAMEWORK

This is to situate a theoretical framework of this study with a solid academic rigor, connecting its set aims and objectives [11] (Azizuddin, 2016). There is substantial research on sustainable development, economic growth, and quality education; however, there is a noticeable lack of academic work on quality education with digitalization focusing on SDGs [13] (Littlewood & Holt, 2018). The theoretical perspective of this study is informed by the literature on digitalization, education, and sustainability within institution-specific knowledge and the theoretical underpinnings in the area of educational science.

Although the literature on digitalization and sustainable higher education and learning is not so well produced, some studies are still there and paved the way for this study. Digitalization is the inclusion of information technology and a change in the operational environment from tradition to modernity [14]. It includes information searching, saving, organizing, dissemination, and utilization. The digitalization of education is considered as the use of online facilities with digital artifacts to manage, disseminate and deliver education and learning that changes the teaching-learning environment [2] (Garcia-Hernandez et al., 2023). Sustainable higher education and learning is the optimum educational environment and learning achievement and the key to sustainable development.

2.1 Digitalization of education

The digitalization of education is the process that involves the "innovative incorporation of modern technology and digital tools to support and strengthen teaching and learning activities" in the classroom [2,15] (Casillas-Martín et al., 2020; Garcia-Hernandez et al., 2023). The innovative digital artifacts have been used in real life outside academia. This helps learners to be familiar with and fit themselves with the ever-changing competitive job market. The use of modern information technology and tools in education and learning delivery includes digital artifacts, Artificial intelligence (AI) tools that facilitate teaching and learning in higher education. They comprise different digital learning platforms, e.g., Blackboard, Aula, Canvas, Moodle, Engagely, MS Teams, Zoom, various types of artificial intelligence (AI) tools, Conversation and translation tools, Spellcheckers, Paraphrasers and Grammar checkers, ChatGPT, etc. A glimpse of the digital platform and tools may be shown in Table 1 and Table 2 below.

Table 1: Widely used learning management and delivery platforms and tools

Learning Management	Learning Delivery
<ul style="list-style-type: none"> • Moodles • Blackboard • Canvas • Aula • Google Classroom • 	<ul style="list-style-type: none"> • Zoom • MS Teams • Engagely • Duolingo • Seesaw • Slack

Source: Authors' compilation 2023

Table 2: Types of Artificial Intelligence Tools

Type 1	Type 2	Type 3	Type 4
<ul style="list-style-type: none"> • Conversation & translation tools • Speech - text • Predictive text 	<ul style="list-style-type: none"> • Spellcheckers • Paraphrasers • Grammar checkers 	<ul style="list-style-type: none"> • Essay bots • Text generators • Kahoot • Socrative 	<ul style="list-style-type: none"> • Artefact generators: Programming code, graphics, artworks, maths, music
<ul style="list-style-type: none"> • Google Translate • DeepL • Dragon 	<ul style="list-style-type: none"> • Grammarly • Quillbot • ChatGPT 	<ul style="list-style-type: none"> • Perplexity.ai • Edmodo • Canva • Chimp writer 	<ul style="list-style-type: none"> • Github Co-pilot, • Dal-e-2 • Melobites.com • Midjourney

Source: Authors' compilation, 2023

2.2 Digitalization of education and SDGs

Digitalization of education is critical to meet up United Nations (UN) Sustainable Development Goals by 2030 [16,17] (Lozano-Díaz and Fernández-Prados, 2020; Clark et al., 2022). The SDGs have approved several resolutions on how to address the growth of human activity in a sustainable manner. Among the seventeen SDGs, SDGs 4, 8, 9, 13, and 17 have addressed quality education, sustainable economic growth, and strengthening the implementation modes for sustainable development (UNKP, 2016). Several SDGs coincide directly or indirectly with the concept of digitalization of education. For instance, SDG 4 (Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all), SDG 13 (Take urgent action to combat climate change and its impacts), and SDG 9 (Build resilient



infrastructure, promote inclusive and sustainable industrialization and foster innovation) are close enough to meet up sustainability through digitalization in education. Any of these SDGs can address promoting strong academic performance in students at all educational levels, which is also essential for developing responsible citizens [14] (Yashalova & Vasiltssov, 2020).

In today's knowledge society, digital technologies and tools mediate in several daily aspects, including education, health, and government management [18] (Nevado-Peña et al., 2019). Digitalization of education and learning is not only a notion, but it is also a set of realities that have led to innovative approaches to teaching and employing technology as a tool for learning [19] (Minerva, 2021). More specifically, digital education aims to produce autonomous people who take on both individual and group responsibilities through enhancing abilities, including problem-solving, critical thinking, creativity, teamwork, and communication that ultimately provide a substantial contribution to sustainable development [14] (Yashalova & Vasiltssov, 2020).

2.3 Research gaps in the digitalization of education

Although several studies have been done on the digitization of the global education system, there are still substantial research gaps in this growing area of research. First of all, the selection of proper tools and technologies is essential to digitalize education. Secondly, educating and training the teachers/trainers to foster the digitalization of education is considered a study gap. Thirdly, it is necessary to decide and design the digitalization level in each sector, such as primary, secondary, and tertiary, which are not the same but differ substantially in the ways of offering education. Fourthly, there is a research gap in empowering students with a core set of digital skills. Fifthly, an online-based virtual learning environment can be created to ensure a seamless digital learning environment and so on.

3 STUDY METHODOLOGY

The methodology used in this study reported in this paper includes a discussion of the digitalization of education and the critical observation on sustainable higher education and learning. To answer the identified research questions, this study adopted a qualitative approach of research with gleaned data, using inductive content analysis to investigate the phenomenon of digitalization of education and its problems and prospects for active learning in higher education. The qualitative study is considered most appropriate, where the data collection and analysis frequently happen concurrently rather than sequentially, and the data themselves reflect choices made throughout the study process [20,21] (Devers, 1999; Patton, 2015). To clarify more, the research is mainly based on secondary data; however, it is substantiated by the primary information too. As the digitalization of education in higher education get momentum, we have reviewed relevant research publications, university websites, and other online sources for required information. Several well-known major multi-purpose databases such as Web of Science, ProQuest, Emerald, Science Direct, Google Scholar, and EBSCO were used during this literature search, along with some keywords such as 'digitalization,' 'education,' 'learning, sustainable education,' 'learning challenges', etc., were used to look for more articles from Internet sources to increase the amount of useful literature in the field of interest [22] (Azizuddin et al., 2021).

In addition, we have informally discussed with five randomly selected higher education academics around the globe via telephone and WhatsApp calls. This serves as the primary data that substantiate and support the secondary information for this study. Our personal experiences as insiders are also reflected in the paper [23] (Polanyi, 1964). This will cross-examine and validate the data from different sources and help generalize the likely outcome

following a practice of interpretive and inferential data analysis [9] (Finnegan, 1998). A systematic qualitative study of available digitalization of education and learning literature, such as published books, journal articles, research papers, library work, and document analysis, is also used as the source of information for this research. Methodological filters are followed to limit the literature through the exclusion of a systematic review [24,30] (Creswell, 2002; 2009).

4 STUDY FINDINGS

4.1 Opportunities in the digitalization of education and learning

Digitalization of education consists of contemporary technology and digital tools that provide higher quality education and contributes to extending the learning environment beyond virtual or distance learning [25] (Alonso-García et al., 2019). It offers ample opportunities to support and enhance state-of-the-art teaching and learning environment. This digital learning environment incorporates digital tools and gadgets, ensuring a change in educational philosophy that enhances the overall classroom learning environment that, supports educational advancement with expert knowledge, and promotes student job adaptation [26] (Veletsianos et al., 2021). Moreover, to accomplish the sustainability objective in the educational system, this digital platform fosters critical thinking, addresses ethical concerns, and enables the search to ensure commitment in the learning process.

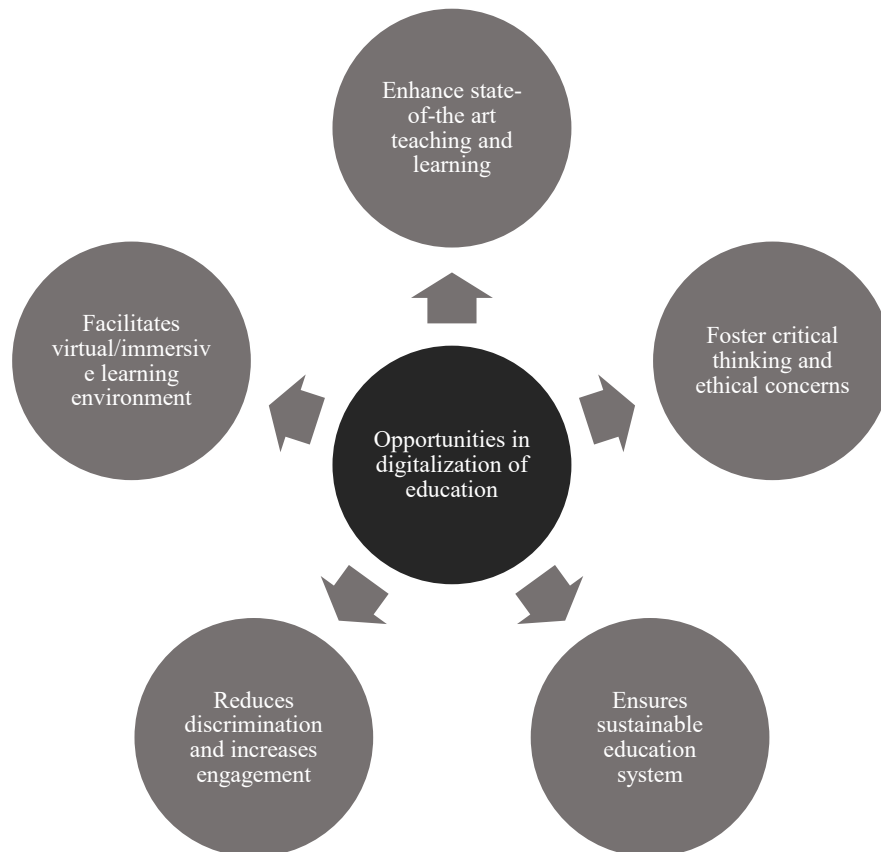


Figure 1: Accompanied opportunities in digitalization of education (Source: Authors' construction, 2023).



Furthermore, the digitalization of education offers the development of gamification and experimental tactics through virtual simulations (even immersive) that support educational innovation processes. This ICT-based platform can help learners to understand reality and abstract concepts that are challenging for some of them, especially those with learning disabilities, while also being incredibly motivating and interesting for them [27] (Ahn, 2020). With this immersive learning platform, a learner can stay out of uncomfortable circumstances or locations. Additionally, this platform offers secure contexts for active experimentation, resulting in higher sustainability in educational learning and training approaches. The deployment of such an e-portfolio can also support raising awareness and encourage more sustainable behavior within both the educator's and learners' communities. Some more opportunities for digitalization in education are highlighted in Figure-1.

4.2 Challenges in the digitalization of education and learning

Although digitalization offers numerous opportunities in the education and learning process, it also presents several difficulties, including the need to gain digital skills and build digital infrastructure and cyber-security. It is a common challenge in the digitalization of education to decide where and how to use new digital technology to create and expand a new learning environment. In traditional teaching and learning (offline teaching), there exist several challenges, such as a lack of specialized skills and expertise, resistance to curriculum change, advancement of ongoing technological changes, expensive costs, and a lack of skilled teachers and their preparational programs.

The challenge related to building digital infrastructure is essential to promote the digitalization of education. Nowadays, digital infrastructure is a core service that is necessary for ensuring both digital teaching and learning environments. The creation of a digital environment is crucial. The accompanied challenges related to the digital infrastructure include fixed broadband, telecommunications, data centers, cloud computing services, APIs, and integration, among other things [28] (Gupta, 2021). Additionally, establishing digital infrastructure through investment is crucial. Moreover, complexity and scale are also obstacles to the establishment of virtual and physical infrastructure as necessary for the digitalization of education [29] (Jain & Lamba, 2021).



Figure 2: Accompanied challenges in digitalization of education (Source: Authors' construction, 2023)

Another common challenge to the digitalization of education is the threat of new cyber-security dangers, such as unauthorized access and information misuse, which are accompanied by new digital technologies and tools. In today's era of cybercrimes, digital infrastructure needs to be protected now more than ever. Other challenges exist, such as technological obsolescences, digital literacy, etc., as depicted in Figure 2.

5 MANAGERIAL IMPLICATIONS

It is believed that in the digitalized educational system, different stakeholders can work together to create and implement a variety of digital skills education and training programs that are suited to particular requirements and learning goals. Such programs and skills can establish a significant milestone for improving students' digital literacy and ensure the greatest potential resides in nurturing an innovative learning environment. To enable digitalization in the educational system, there needs to establish a collaborative framework among stakeholders, including content creators, initiative leaders, academic researchers, and educators. Such a framework helps to accomplish the following goals:

- To create a global network of partners dedicated to advancing collaboration and creating digital skills education and training programs based on the available standards.



- To create a framework for program certification to assess digital skills training programs and to help with curriculum planning.
- To develop credit points that students can obtain for completing learning objectives in programs that are accredited for digital skills. These credits can encourage learning and offer proof of academic success.
- To establish a performance assessment tool so that educational institutions can gauge their degree of proficiency and the outcomes of digital skills education and training.
- To strengthen the pedagogy of digital skills education and training programs by the development of scholarly research and the continual improvement of the available standards.
- To create rigorous ways for assessing the educational effectiveness concerning digitalized education of various programs.

6 CONCLUSIONS WITH FUTURE STUDY DIRECTIONS

To tackle the tide of rising inequality, it is necessary to make sure that the extensive digitalization of the educational sector is taken place inclusively. Additionally, to improve the sustainable growth of the digital economy, it is critical to improve the lives of numerous people through the teaching of digital skills. In digitalized education, an online educational system becomes more crucial to educational institutions. There is more effort needed to help prospective students for successful online education that should concentrate on equipping educational institutions with a foundational set of digital skills.

The most recent manifestation of broader trends in the global economy as a whole is the digitization of the education sector, and the initiatives we outline here can be used to improve teacher preparation programs as well as workforce development programs generally. We must make a determined effort to guarantee that everyone is supported with digital skills education and training to prosper in this digital age since online and offline possibilities are no longer mutually exclusive. The digital world is fusing more and more into our daily lives.

This study provides a qualitative answer to the research questions related to the digitalization of higher education, learning, and SDGs. The opportunities are beset by challenges. Our research, teaching experience, and the background studies of digital education and SDGs with available literature indicate that the action-oriented quality higher education learning and delivery marching with time, focusing on SDGs, is yet to be developed and exercised by HEIs. However, the end is in sight. A dynamic, innovative pedagogical approach to learning activities with the digitalization of education is a need of the hour. HEIs, as the signatories of UN SDGs, play a crucial role in the target achievement, producing graduates as change agents through their iterative critical and innovative pedagogies and practices.

The study fills the information gaps and provides in-depth inside both for academics and practitioners, as the literature on management education with entrepreneurship in HEIs with SDGs is in scarcity. The research findings have broader implications for HEIs, governments, and international development partners to develop and redevelop appropriate education and development policies and strategies for effective partnerships to act further for UNSDG's target achievement. It also has practical implications for HEIs to reassess the study curriculum and delivery, adopt and offer dynamic academic programs of higher education for international educational development that caters to people's skill development and employability both nationally and internationally.

7 REFERENCES

- [1] Fleaca, E., Fleaca, B., Maiduc, S. 2018. Aligning Strategy with Sustainable Development Goals (SDGs): Process Scoping Diagram for Entrepreneurial Higher Education Institutions (HEIs), *sustainability*, 10(4), pp 1-17.
- [2] García-Hernández, A., García-Valcárcel Muñoz-Repiso, A., Casillas-Martín, S., Cabezas-González, M. 2023. Sustainability in Digital Education: A Systematic Review of Innovative Proposals, *Education Sciences*, 13, 33.
- [3] Kabadayi, A., Skutil, M., Manženová, M. 2022. ICT Equipment in the Kindergartens for Sustainable Education from Kindergarten Principals' Perspectives in the Czech Republic, *TEM Journal (Technology Education Management Informatics)*, 11(2), pp 557-563.
- [4] Ullah, A.K.M.A., Azizuddin, M. 2018. South Asian Student Migration to Nordic Countries: Changing Initial Motivations, *Asian Profile*, 46(1), pp 73-87.
- [5] Fúzi, B., Géring, Z., Szendrei-Pál, E. 2022. Changing expectations related to digitalization and socialisation in higher education. Horizon scanning of pre- and post-COVID-19 discourses, *Educational Review*, 74(3), pp 484-516.
- [6] Webb, A., McQuaid, R.W., Webster, C.W.R. 2021. Moving learning online and the COVID-19 pandemic: a university response, *World Journal of Science, Technology and Sustainable Development*, 18(1), pp 1-19.
- [7] Legg-Jack, D.W. 2021. Digitalization of Teaching and Learning in Nigeria Amid COVID-19 Pandemic: Challenges and Lessons for Education 4.0 and 4IR, *International Journal of Science and Research*, 77(10), pp 156-178.
- [8] Zifcak, S.M. 1992. *Administrative Reform in Whitehall and Canberra in the 1980s: The FMI and FMIP Compared*. London: LSE.
- [9] Finnegan, R. 1998. *Using documents*, In: Sapsford R and Jupp V (eds) *Data Collection and Analysis*. London; Thousand Oaks; and New Delhi: Sage and the Open University, pp 146-149.
- [10] Nooteboom, B. 2003. Generality, specificity and discovery (No. ERS-2003-030-ORG), *ERIM Report Series Research in Management*. Available at: <https://repub.eur.nl/pub/330> (accessed 5 May 2023).
- [11] Azizuddin, M. 2016. Public administration reform research: A perspective on methodological challenges, *South Asian Journal of Policy & Governance*, 38(1), pp 21-33.
- [12] Azizuddin, M., Hossain, A. 2021. Reflections on public administration education with a case of Bangladesh, *Teaching Public Administration*, 39(1), pp 46-66.
- [13] Littlewood, D.C., Holt, D. 2018. How social enterprises can contribute to the Sustainable Development Goals (SDGs) - A conceptual framework. In: Apostolopoulos, N., Al-Dajani, H., Holt, D., Jones, P. and Newbery, R., (eds.) *Entrepreneurship and the Sustainable Development Goals. Contemporary Issues in Entrepreneurship Research*, 8, pp 33-46.
- [14] Yashalova, N.N., Vasiltsov, V.S. 2020. Digital Education: New Challenges and Opportunities, *Science Technology and Information Processing*, 47, pp 260-265.
- [15] Casillas-Martín, S., Cabezas-González, M., García-Valcárcel Muñoz-Repiso, A. 2020. DigiCraft: A Pedagogical Innovative Proposal for the Development of the Digital Competence in Vulnerable Children, *Sustainability*, 12, 9865.
- [16] Lozano-Díaz, A., Fernández-Prados, J.S. 2020. Educating digital citizens: An opportunity to critical and activist perspective of sustainable development goals, *sustainability*, 12(18), 7260.
- [17] Clark, S., MacLachlan, M., Marshall, K., Morahan, N., Carroll, C., Hand, K., O'Sullivan, K. 2022. Including digital connection in the United Nations sustainable development goals: A systems thinking approach for achieving the SDGs, *Sustainability*, 14(3), 1883.
- [18] Nevado-Peña, D., López-Ruiz, V.R., Alfaro-Navarro, J.L. 2019. Improving quality of life perception with ICT use and technological capacity in Europe, *Technology Forecast and. Social Change*, 148, 119734.



- [19] Minerva, T. 2021. Bridging researches in Digital Education, *Journal of. E-Learning and Knowledge. Science*, 16.
- [20] Devers, K.J. 1999. How will we know "good" qualitative research when we see it? Beginning the dialogue in health services research, *Health services research*, 34(5), 1153.
- [21] Patton, M.Q. 2015. *Qualitative research & evaluation methods: Integrating theory and practice*, 4th ed. Thousand Oaks, CA: SAGE.
- [22] Azizuddin, M., Shamsuzzoha, A., Piya, S. 2021. Influence of Circular Economy Phenomenon to Fulfil Global Sustainable Development Goal: Perspective from Bangladesh, *Sustainability*, 13, 11455.
- [23] Polanyi, M. 1964. *Personal Knowledge*, London: Routledge and Keyon Paul.
- [24] Creswell, J.W. 2009. *Research Design: Qualitative, Quantitative and Mixed Methods Approach*. London: Sage.
- [25] Alonso-García, S., Aznar-Díaz, I., Cáceres-Reche, M.P., Trujillo-Torres, J.M., Romero-Rodríguez, J.M. 2019. Systematic Review of Good Teaching Practices with ICT in Spanish Higher Education: Trends and Challenges for Sustainability, *Sustainability*, 11, 7150.
- [26] Veletsianos, G., VanLeewuen, C.A., Belikov, O., Johnson, N. 2021. An Analysis of Digital Education in Canada in 2017-2019, *International Review of Research in Open and Distributed Learning*, 22, pp 102-107.
- [27] Ahn, J. 2020. Unequal Loneliness in the Digitalized Classroom: Two Loneliness Effects of School Computers and Lessons for Sustainable Education in the E-Learning Era, *Sustainability*, 12, 7889.
- [28] Gupta, G. (2019). Education and digital economy: trends, opportunities and challenges, In *Proceedings of the 2019 4th International Conference on Machine Learning Technologies*, pp 88-92.
- [29] Jain, E., Lamba J. 2021. Management and Digitalization Strategy for Transforming Education Sector. Emerging Challenges, Solutions, and Best Practices for Digital Enterprise Transformation. 10.4018/978-1-7998-8587-0.ch004. (69-83).
- [30] Creswell, J.W. 2002. *Educational Research: Planning, Conducting and Evaluating Quantitative and Qualitative Research*, NJ: Prentice Hall.