Rima International Journal of Education (RIJE), Vol. 4 Issue 4: Sept 2025; Page: 14-27 ISSN: 2756 - 6749

Prospects and Impediments of the Application of Artificial Intelligence for Enhanced Open, Distance and Flexible Education in Nigeria

*[1]Abdullahi Abubakar Yunusa & [2]Nafiu Yusuf

*[1&2]Department of Curriculum Studies & Educational Technology, Faculty of Education, and Extension Services, Usmanu Danfodiyo University, Sokoto, Nigeria, abdullahi.yunusa@udusok.edu.ng[1], and yusufnafiu38@yahoo.com[3]
Orcid ID: 0000-0001-7077-8828[1]

Abstract

Artificial Intelligence (AI) is revolutionizing various facets of human life, education in particular. As AI-driven technologies permeate different sectors, the educational landscape, particularly in open, distance, and flexible education (ODFE), is experiencing transformative changes. This paper discussed the critical role and impact of AI on open, distance, and flexible education, highlighting both the prospects and challenges associated with its integration. AI has the potential to significantly enhance ODFE by personalizing educational experiences, boosting student engagement, and delivering real-time feedback. However, the adoption of AI in ODFE is not without hurdles. Some of the key challenges identified in the discussion includes concerns over data privacy, inadequate knowledge and training, algorithmic bias, insufficient technological infrastructure, and ethical considerations. This paper illuminates the potential benefits of AI in ODFE while also addressing the critical challenges that must be navigated to ensure optimal benefits of this phenomenal dynamic technology.

Keywords: Artificial intelligence (AI), open, distance, flexible education, challenges. Prospects

Introduction

Technological advancements have consistently driven progress, transforming various aspects of human life. In recent decades, society has experienced significant technological revolutions across multiple sectors, impacting production, employment, and daily activities (Albuquerque, 2019). One of the most notable developments is the Fourth Industrial Revolution (4IR), which has been the focus of extensive research and is considered a strategy to improve competitiveness in business production (Gázquez et al., 2021; Schwab, 2017; Xu et al., 2018). Described in 2016 by Klaus Schwab, the founder of the World Economic Forum, 4IR refers to the integration of the

offline and online worlds, driven by innovations such as the Internet of Things (IoT), big data, and Artificial Intelligence (AI), among others. These technologies are reshaping industries and influencing the global job market (Eberhard et al., 2017).

AI has been defined in various ways depending on the context of its application. While some experts described it as the creation of intelligent agents that perceived their environment and perform tasks to maximize success (Russell & Norvig, 2019; Auwal et al., 2023; Ismail et al., 2024). Others view AI as technology facilitating interaction between humans and machines, whether through physical integration or virtual connections (Kaufman, 2020). AI is also understood as the study of how to enable computers to perform tasks that currently require human intelligence (Ertel, 2018). Despite concerns about the potential for AI to surpass human control, it is important to remember that these technologies are products of human creation, designed to solve specific challenges (Pinto, 2005). AI has been used in educational settings for over 30 years, though its effects on teaching and learning in higher education are still being explored. Research has largely focused on four areas: Profiling and Prediction, Assessment and Evaluation, Adaptive Systems and Personalization, and Intelligent Tutoring Systems (Zawacki-Richter et al., 2019). AI has demonstrated potential in providing greater support and personalized tutoring for students. However, concerns about ethical issues, such as data privacy and the potential threat to educators' employment, persist (Peters & Jandric, 2019; Wogu et al., 2019; Zawacki-Richter et al., 2019).

In open, distance, and flexible education, AI's applicability is particularly significant. As we all recognize, distance education inherently relies on a technological framework, which can be effectively enhanced by AI through Machine Learning (ML) techniques, and specifically Deep Learning (DL) methods (Yu et al., 2017). DL allows for the analysis of complex, multi-layered data, enabling AI to utilize the vast amount of information available in the ODFE learning environments to improve educational outcomes (LeCun et al., 2015). For instance, AI can track students' engagement, predict academic performance, and personalize learning experiences. Since 2016, when the first AI-powered teaching assistant was introduced at the Georgia Institute of Technology (Goel & Polepeddi, 2016), AI-driven tutoring systems have been increasingly adopted worldwide. These systems can handle routine tasks such as grading and providing assistance in online forums, allowing educators to

focus on more complex and creative activities. However, recent evidence suggests that the implementation of AI technology may lead to a reduction in teaching positions (Kim et al., 2020; Melim & Moraes, 2021). A situation that may not be entirely true. Despite these progress, significant challenges arise. Concerns regarding data privacy, algorithmic bias in decision-making processes, and the ethical implications of AI implementation loom large (Kizilcec & Halawa, 2022). The reliance on AI for educational tasks also raises questions about the future roles of educators and the potential for depersonalization in student-teacher interactions (Liang & Wang, 2023). As AI continues to play wider roles in education, addressing these challenges will be crucial to ensuring that its implementation enhances, rather than diminishes, the quality of open and distance learning. Against this background, this paper aims to identify the vast potentials of AI in enhancing the ODFE as well as highlight the associated impediments to these positive strides. By so doing, the paper contributes to the growing discourse and rapid transformation of the education landscape by emerging technologies particularly the Artificial Intelligence induced revolution. Consequently, informing policy and theoretical decisions in that regard.

To provide a clearer contexts for the discussion on the influence of AI on Open, Distance and E-Learning, it is pertinent to understand the different conceptions of AI the human-made intelligence in the Literature.

AI: A human- made Intelligence

The Internet has played a pivotal role in the development and integration of artificial intelligence (AI) into all facets of everyday life (Huawei Technologies), sparking extensive research across various contexts and disciplines. AI, as a concept, has been defined differently by various scholars. The ODFE as always requires conceptual/terminological clarification (Jegede, 2024), for instance, Moumita and Thirugnanam (2021) describe it as "machine-based systems that are guided by human-defined goals, make predictions, make recommendations, and make decisions based on them that affect real or virtual contexts" (p. 23). Similarly, Auwal, Yunusa, and Salisu (2023) defined AI as "a branch of computer science that makes computers mimic human behavior to help perform better in science and technology." Patricia and Joan (2024) further elaborate that AI involves "computer systems that integrate processes mimicking human intelligence, such as learning, adapting, analyzing, adjusting, correcting, and using data to address complex

issues." Evidently, from the foregoing definitions it can be concluded that AI is fundamentally rooted in human intelligence and seeks to replicate human functions by processing large data sets, creating machines capable of tasks requiring human intelligence, and designing self-learning systems (Moumita & Thirugnanam, 2021). AI's advancement is considered critical for supporting distance learning and continuing the education processes (Gulnora, Farida, & Sayidolim, 2022). AI encompasses various branches of learning, including machine learning, which utilizes algorithms to identify patterns in educational data through recurring training (Sdenka et al., 2023), relying on repeated data processing to distinguish between patterns (Patricia & Joan, 2024). Automation, as a technological tool, offers solutions to everyday and educational challenges, enhancing learning speed, response, and overall efficiency (Rahman et al., 2023). Deep learning represents an advanced stage of AI, extending beyond machine learning by using large data sets to simulate and predict educational outcomes (Sdenka et al., 2023). Deep learning is crucial for distance education, as it organizes and arranges various forms of knowledge, emphasizing fundamental importance and involving analytical abilities, cross-referencing, imaginative reconstruction, and free thinking (Rahman et al., 2023).

Natural Language Processing (NLP) refers to a computer's ability to understand, interpret, and generate human language, including speech and text (Abdulaziz, & Khalifa N., 2023). Lastly, computer vision is defined as the ability of computers to analyze and interpret visual information, such as images and video (Abdulaziz, Abdel Magid, & Khalifa N., 2023).

Open, Distance, and Flexible Education (ODFE)

Open, Distance and Flexible education (ODFE) is considered as old as human existence (Jegede, 2024). These form of education offerings has witnessed transformative evolution from correspondent, postal education, distance learning it has now evolved to a more personalized learning system with an advantage of borderless learning opportunity and learning at massive scale. In addition, the recent Corona Virus disruptions of the education sphere (Yunusa et al, 2021) has made ODFE the most viable learning model of the present time. Owing to its dynamism and continual evolution (Bozkurt & Zawcki-Richter, 2021). ODFE does not require enclosed space for learning to take place, it however requires the medium of communication enabled by technology and the internet underscoring the convergence of ODFE and

technology. The ‘open’ in distance learning refer to the flexibility in terms of enrolment criteria, the programme offerings, age, previous level of academic attainment etc. while ‘distance’ defines the separation between the student and the teacher which is one of the key challenges of the model. Moore (2009) refer to it as ‘Transactional distance’

Over the years, the world has seen a shift towards distance education (Yunusa et al., 2021), a mode of learning that contrasts with traditional face-to-face education. Initially limited to a few developed contexts due to the high costs, infrastructure needs, and the adoption of distance education technologies. This form of education served as an alternative or complement to traditional methods. However, global policies promoting technology in education have spurred its adoption, making knowledge more accessible and education available to all (Anderson et al., 2021). The flexibility of distance education, along with the rise of learning management systems, has facilitated its growth, expanding interaction among teachers, students, and educational content. The universality of the concept of open, distance, online and flexible education (hereafter as ODFE) is still shrouded in ambiguity (Yunusa, 2021; Singh & Thurman, 2019). Nonetheless, ODFE is the most significant innovation in the ream education that offers learners convenient choices for learning.

In the wake of the COVID-19 pandemic, distance education was optional and limited. However, the pandemic experience a necessitated sudden shift, as a preventive measure to curb the spread of the virus, and since then, it has become an integral part of educational systems worldwide, alongside traditional face-to-face learning (Magdalena, Magdalena, & Klaudia, 2023). Researchers define distance education as "education that uses computer technologies and learning platforms to provide education to students virtually, supporting regular interaction between students and teachers, either synchronously or asynchronously" (Patricia & Joan, 2024). This system offers features that enhance the educational process, ensuring its continuity and broad accessibility, enabling many students to access educational opportunities regardless of geographical or financial constraints (Gulnora, Farida, & Sayidolim, 2022).

Distance education primarily includes two types: asynchronous and synchronous. Asynchronous distance education allows interaction between teachers and learners at any time, often through educational platforms, recorded lectures, or visual programs. While, Synchronous distance education,

on the other hand, requires real-time interaction, such as attending live lectures online at scheduled times. Additionally, a hybrid model combining synchronous and asynchronous elements has become common, particularly in regions newly adopting distance education (Magdalena, Magdalena, & Klaudia, 2023).

Enhancing Open, Distance, and Flexible Education with AI

As human affairs become more digitalised, navigating the digital space require cutting edge technology, one of which is AI. As Jegede (2024) noted. Today's world including teaching and learning in the ODFL cannot do without navigating the digital landscape. Given this imperative, it is important to highlight how AI is impacting the education offering in ODFE. Moreover, the everchanging dynamics of the 21st century learner requires personalized, flexible, ubiquitous and socially collaborative educational experiences which is enabled by transformative emerging technologies such as the AI. Research shows that AI has significantly influenced open, distance, and flexible education. Ismaila et. al., (2024) posit that the significance of AI has inspired the creation of different resources including tools, curricula materials as well as influenced rethink of teaching approaches and methodologies. Utku (2018) argues that AI's ability to solve complex problems and simulate human intelligence has helped make distance education more effective through applications like machine learning.

AI impacts distance education in several ways, such as the use of intelligent tutoring systems, virtual learning assistants, and collaborative learning platforms (Sdenka, Kejiang, & Xinyun, 2023). Additionally, AI enhances decision-making for teachers using algorithms that provide real-time data on classroom activities, allowing immediate responses to students' needs (Patricia & Joan, 2024). Overall, AI is reshaping education, particularly in open and distance learning context, by automating tasks, personalizing learning experiences, and offering intelligent support, thus increasing students' access to educational opportunities. In broader context, AI impacts ODFE in the following ways:

Intelligent Tutoring Systems (ITS): ITS are becoming more common in distance education because they can offer students real-time feedback, answer questions, and provide guidance on difficult topics. These systems adapt to individual student needs, creating personalized learning experiences by

analyzing data on students' progress and performance (Ismail, Muhterem, Hanni, & Sanna, 2022).

Personalized Learning: AI-powered platforms can analyze student data, including learning styles, progress, and preferences, to customize educational content. This personalized approach ensures students receive instruction suited to their needs, leading to better learning outcomes.

Automated Grading: AI can handle time-consuming tasks like grading and assessments, allowing teachers to focus on providing meaningful feedback. AI tools can also analyze student performance to identify areas of difficulty and offer targeted support.

Accessibility and Inclusivity: AI can make education more accessible for students with disabilities by providing tools like real-time captioning, lecture transcription, and alternative text for images, ensuring all students have equal opportunities to succeed.AI enables access to learning materials through cloud platforms, allowing students to study from anywhere with internet access (Magdalena, Klaudia, & Magdalena, 2023).

Gamification: Gamification, an AI-driven approach, enhances distance education by using data and reasoning techniques in games to improve skills. This interactive approach encourages student participation and collaboration, leading to better results (Magdalena, Klaudia, & Magdalena, 2023).

Immediate Feedback: Feedback is a crucial part of the learning process. AI provides quick and objective feedback, helping students identify areas for improvement and offering opportunities for correction (Anderson et al., 2021). In conclusion, AI has become an essential part of education, transforming traditional methods. Students now use digital tools instead of paper, write through touch or voice, and enjoy personalized learning experiences. AI has also improved research by providing access to reliable sources and protecting researchers' rights, creating a secure environment for distance education. Despite these benefits, there are concerns about AI's use in education, especially for children. UNICEF highlights issues like bias, data protection violations, and the risk of worsening the digital divide.

Impediments to Effective Artificial Intelligence Application in ODFE

Despite the critical role of AI in ODFE, several concerns should not be ignored. Concerns such as privacy and security of student data are paramount, as AIsystems rely on substantial amounts of student information. Ethical and responsible AI usage is also a concern that is affecting ODFE Moreover, reduced in-person interaction between students and teachers can hinder the education process, as interaction is crucial for measuring learner satisfaction and learning outcomes (Yunusa & Umar, 2021). Interaction helps AI systems identify and address specific student needs (Kyoungwon et al., 2021). Over-reliance on AI for academic tasks can reduce human interaction and personaliz ed attention.

Other impediments include insufficient knowledge and training in technologic al techniques and automated learning basics, which can hinder interaction and content delivery. Weak infrastructure, such as inadequate technical support an d limited Internet availability, can also obstruct AI's effectiveness in distance education (Ismail et al., 2022). Additionally, AI systems' collection and proces sing of data make privacy protection crucial, as weak data quality can lead to i naccuracies (Abdulaziz et al., 2023). Ethical concerns such as privacy, reduced independence, and the risk of bias and plagiarism must also be addressed (Pat ricia & Joan, 2024). In a broader sense, the impedments to ODFE as succintly captured by Jegede (2024) include but not limited to geographical, economic, social, political, physical, emotional or psychological.

Conclusion

AI is revolutionizing open, distance, and flexible education. By personalizing l earning experiences, providing intelligent tutoring, automating tasks, and impr oving accessibility, AI can foster effective, inclusive and equitable education g lobally. As technology advances, it is crucial to enhance rather than replace th e human element of education.AI has alreadyplayed a significant role in advan cing distance education,offering personalized experience tailored to learners' n eeds and expanding learning opportunities via the Internet and virtual classroo ms. To sustain progress, countries must strengthen technical infrastructure, inc rease Internet accessibility, and implement training programs for educators an d learners in AI technologies (Ismaila et al., 2024).

Suggestions and Future Direction

As artificial intelligence (AI) continues to shape the landscape of open, distance, and flexible education (ODFE), it is essential to address existing challenges while exploring opportunities for improvement. Ensuring ethical AI adoption, strengthening infrastructure, and enhancing human-AI interaction will be critical in fostering an inclusive and effective learning environment. The following suggestions provide actionable strategies to mitigate impediments and maximize the potential of AI in ODFE. This includes:

i. Developing robust data protection policies and encryption protocols to safeguard student data.

ii. Implementing AI-driven cybersecurity measures to detect and prevent data breaches.

iii. Educating and mobilising students and educators on ethical data usage and privacy rights.

iv. Designing AI systems that complement, rather than replace, teacher-student interactions.

v. Integrating AI tools that facilitate virtual discussions, mentorship, and real-time feedback.

vi. The use of AI to personalize learning paths while maintaining opportunities for direct human engagement. Implementing targeted training programs for educators to improve AI literacy and integration skills.

vii. Developing AI-driven learning modules to assist teachers in mastering AI-enhanced pedagogy.

viii. Encouraging interdisciplinary collaboration to bridge the gap between AI developers and education practitioners, and

ix. Investing in digital infrastructure, including affordable internet access and reliable technical support.

Reference

Abdulaziz , A., Abdel Magid , H., & Khalifa N. , A.-K. (2023). Re-thinking data strategy and integration for artificial intelligence: Concepts, opportunities, and challenges. Applied sciences,12(13),pp.1-33. doi:https://doi.org/10.3390/app13127082.

Ahmad, A. A., Yunusa, A. A., Salisu, M.A.(2023) Building a resilient future: Analyzing the role of AI in the post-pandemic education for sustainable development in Nigeria. *International Journal of Topical Educational Issues,* Vol.6 (1) December, 2023. pp 235- 240

Albuquerque, E. M. (2019). Capitalismo pós-www: Uma discussão introdutória sobre uma nova fase na economia global [Post-www capitalism: An introductory discussion on a new phase in the global economy]. Cadernos de Desenvolvimento, 14(24), 131-154.

Amara , A., Meena, J., Deborah, R., & Ayse , A. (2021). Artificial intelligence (ai)- enabled remote learning teaching using pedagogical conversational agents and learning analytics, in: Intelligent systems and learning *Data Analytics in Online Education Intelligent Data-Centric Systems.* US: Elsevier Science. doi:https://doi.org/10.1016/B978-0-12-823410-5.

Anderson , P., Arthur , B., Ruan , C., Fred, F., Yi-Shan, T., Dragan, G., & Rafael , F. (2021). Automatic feedback in online learning environments: A systematic literature review. Computers and Education: Artificial Intelligence, 2, pp. 1-17. doi:https://doi.org/10.1016/j.caeai.2021.100027.

Bessen, J. (2020). Automation and jobs: When technology boosts employment. Economic Policy, 34(100), 589-626. https://doi.org/10.1093/epolic/eiaa001.

Bozkurt, A. & Zawacki-Richter, O. (2021). Trends and Patterns in Distance Education (2014– 2019): A synthesis of scholarly publications and a visualization of the intellectual landscape. *International Review of Research in Open and Distributed Learning*, 22(2), 19–45. https://doi.org/10.19173/irrodl.v22i2.5381.

Changling, P., Xuanyu, Z., & Shuai , L. (2022). An Introduction to Artificial Intelligence and Machine Learning for Online Education . Mobile Networks and Applications, 27, pp. 1147–1150. doi:https://doi.org/10.1007/s11036-022-01953-3.

Eberhard, B., Podio, M., Alonso, A. P., Radovica, E., Avotina, L., Peiseniece, L., Sendon, M. C.,Lozano, A. G., & Solé-Pla, J. (2017). Smart work: The transformation of the labour market due to the four- th industrial revolution (I4.0). *International Journal of Business and Economics Science Applied Research,* 10(3), 47-66.

Ediloja. Wogu, I. A. P., Misra, S., Assibong, P. A., Olu-Owolabi, E. F., Maskeliunas, R., & Damasevicius, R. (2019). Artificial intelligence, smart classrooms, and online education in the 21st century: Im- plications for human development. *Journal of Cases on Information Technology,* 21(3), 66-79. https://doi.org/10.4018/JCIT.2019070105. *Educational Technology in Higher Education*, 18(54), pp. 23–44. doi:https://doi.org/10.1186/s41239-021- 00292-9.

Ertel, W. (2018). Introduction to artificial intelligence. Springer. Domínguez Figaredo, D. (2020). Data-driven educational algorithms pedagogical framing. RIED -Revista Iberoamericana de Educación a Distancia, 23(2), 65–84. https://doi.org/10.5944/ried.23.2.26470.

Gázquez, J. L. R., Delgado, M. V. B., Gras, J. J. O., Lova, J. G., Gómez, M. V. G., & Zbiec, M. (2021). Lack of skills, knowledge and competences in higher education about Industry 4.0 in the manufacturing sector. RIED - Revista Iberoamericana deEducaciónaDistancia,24(1),285-313. https://doi.org/10.5944/ried.24.1.27548.

Gleason, N. W. (2018). Higher education in the era of the fourth industrial revolution. Palgrave Mac-millan.

Goel, A. K., & Polepeddi, L. (2016). Jill Watson: A virtual teaching assistant for online education. https://smartech.gatech.edu/handle/1853/59104.

Gulnora, J., Farida , A., & Sayidolim , I. (2022). The state-of-the-art applications of artificial intelligence in distance education: a

systematic mapping study. The 6th International Conference on Future Networks & Distributed Systems. Uzbekistan: ACM. doi:https://doi.org/10.1145/3584202.3584292.

Huawei Technologies Co., L. (2022). A General Introduction to Artificial Intelligence, in: Artificial Intelligence Technology Springer Singapore. doi:https://doi.org/10.1007/9 981-19- 2879-6_1.

Ismail, C., Muhterem, D., Hanni , M., & Sanna , J. (2022). The promises and challenges of artificial intelligence for teachers: A systematic review of research. *TechTrends,* 66, pp. 616– 630. doi:https://doi.org/10.1007/s11528-022-00715-y.

Ismaila Temitayo Sanusi , Friday Joseph Agbo , Alexander Oluwaseun Dada , Abdullahi Abubakar Yunusa , Kehinde D. Aruleba , George Obaido , Olayemi Olawumi , Solomon Sunday Oyelere Centre for Multidisciplinary Research and Innovation (2024), Stakeholders' insights on artifificial intelligence education: Perspectives of teachers, students, and policymakers, Computers and Education Open (2024), doi: https://doi.org/10.1016/j.caeo.2024.100212

Jegede, O. (2024) An inclusive digital learnoing ecosystem in open, distance and e- Learning. Invited Keynote Address presented at the 2nd Annual Conference of Open, Distance and e-Learning Association of Nigeria (ODeLAN). Ahmadu Bello University Distance Learning Centre, 21-24 April 2024

Kaufman, D. (2020). Inteligência artificial: Repensando a mediação [artificial intelligen- ce: Rethinking mediation]. Brazilian Journal of Development, 6(9), 66742-66760. https://doi.org/10.34117/bjdv6n9-264

Kim, J., Merrill Jr., K., Xu, K., & Sellnow, D. D. (2020). My teacher is a machine: Understanding stu- dents' perceptions of ai teaching assistants in online education. *Journal of Human-Computer Interaction*, 36(20), 1902-1911. https://doi.org/10.1080/10447318.2020.1801227.

Kizilcec, R. F., & Halawa, S. (2022). Challenges and opportunities of ai in education. A*I & Society*, 37(2), 419-432.

LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. Nature, 521, 436-444. https://doi.org/10.1038/nature14539.

Liang, X., & Wang, X. (2023). Ethical considerations of ai in distance education. *Journal of Distance Education,* 34(2), 175-189.

Magdalena, G., Magdalena , O., & Klaudia , P. (2023). The influence of emerging technologies on distance education. *Electronics,* 12(7), pp. 1-29. doi:https://doi.org/10.3390/electronics12071550.

Melim, J. I., & Moraes, L. C. G. (2021). Projeto neoliberal, ensino remoto e pandemia: Profes- sores entre o luto e a luta [Neoliberal project, remote teaching and pandemic: Teachers between grief and struggle]. Germinal: Marxismo e Educação em Debate, 13(1),198- 225. http://dx.doi.org/10.9771/gmed.v13i1.43547.

Moumita, G., & Thirugnanam, A. (2021). Introduction to Artificial Intelligence, in: Artificial Intelligence for Information Management: A Healthcare Perspective . Springer Singapore. doi:https://doi.org/10.1007/978-981-16-0415-7_2.

Patricia , F., & Joan , T. (2024). The Future of Lifelong Learning: The Role of Artificial Intelligence and Distance Education, in: Lifelong Learning - Education for the Future World. Intechopen. doi:https://doi.org/10.5772 / intechopen.114120.

Peters, M. A., & Jandric, P. (2019). Education and technological unemployment in the fourth industrial revolution. In G. Redding, A. Drew, & S. Crump (Eds.), The Oxford handbook of higher education systems and university management (pp. 394-413). Oxford University Press.

Riedo,C. R. F. (2020). Immediate qualitative assessment of written productions in distance education [Doctoral dissertation, State University of Campinas]. https://doi.org/10.47749/T/UNICAMP.2020.1129481.

Rahman , S., Wajdi , A., Furqan , R., Ernesto , L., Arif , M., & Gyu , S. (2023). Role of artificial intelligence in online education: A systematic mapping study,. *IEEE Access,* 11, pp. 52570- 52584. doi:https://doi.org/10.1109/ACCESS.2023.3278590.

Russel, S., & Norvig, P. (2009). Artificial intelligence: A modern approach (3rd ed.). Prentice Hall.

Schwab, K. (2017). The fourth industrial revolution. Crown Business.

Sdenka Zobeida , S.-P., Kejiang , X., & Xinyun , H. (2023). Artificial intelligence and learning analytics in teacher education: A systematic review. *Education Sciences*, 12(8), pp. 1-18. doi:https://doi.org/10.3390/educsci12080569.

Seo, K., Tang, J., Roll, I., Fels, S., & Yoon, D. (2021). The impact of artificial intelligence on learner–instructor interaction in online learning. *International Journal Of Educational Technology In Higher Education*, 18, 1-23.

Utku , K. (2018). On the Intersection of Artificial Intelligence and Distance Education. IGI Global. doi:https://doi.org/10.4018/978-1-5225-5643-5.ch058.

Yu, H., Miao, C., Leung, C., & White, T. J. (2017). Towards AI-powered personalization in MOOC lear- ning. npj Science of Learning, 2(15), 1-5. https://doi.org/10.1038/s41539- 017-0016-3.

Yunusa, A. A., (2021) The effects of quality, Interaction, motivation, and user-characteristics on students' satisfaction and learning in an open and distance learning environment. Unpublished PhD. Thesis, Universiti Sains Malaysia (USM).

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic Review of Research on Artificial Intelligence Applications in Higher Education – Where Are the Educators? International Journal of Educational Technology in Higher Education, 16(39),1-33. https://doi.org/10.1186/s41239-019-0171-0.