



(REVIEW ARTICLE)



Reviewing online learning effectiveness during the COVID-19 pandemic: A global perspective

Idowu Sulaimon Adeniyi ^{1,*}, Nancy Mohd Al Hamad ², Ololade Elizabeth Adewusi ³, Chika Chioma Unachukwu ⁴, Blessing Osawaru ⁵, Chisom Nneamaka Onyebuchi ⁶, Samuel Ayodeji Omolawal ⁷, Aderonke Omotayo Aliu ⁷ and Isiah Oden David ⁷

¹ *Department of Sociology, Faculty of the Social Sciences, University of Ibadan, Ibadan, Oyo State, Nigeria.*

² *Bridge the Gap, Dubai UAE.*

³ *Independent Researcher UK.*

⁴ *Ministry of Education, Lagos*

⁵ *International School, Benin, Edo State, Nigeria.*

⁶ *National Examinations Council, Nigeria.*

⁷ *University of Ibadan, Ibadan, Oyo State, Nigeria.*

International Journal of Science and Research Archive, 2024, 11(01), 1676–1685

Publication history: Received on 02 January 2024; revised on 08 February 2024; accepted on 10 February 2024

Article DOI: <https://doi.org/10.30574/ijrsra.2024.11.1.0282>

Abstract

The COVID-19 pandemic has brought about unprecedented challenges to education systems worldwide, forcing a rapid shift towards online learning as a primary mode of instruction. This Review reviews the effectiveness of online learning during the pandemic from a global perspective. The study considers various factors influencing the success or challenges faced by students, educators, and institutions in transitioning to digital platforms. One key aspect under scrutiny is the technological readiness of educational institutions across different countries. Disparities in infrastructure, access to devices, and internet connectivity have played a pivotal role in shaping the online learning experience. The study investigates how these disparities have impacted the effectiveness of online education, highlighting the importance of addressing digital divides for equitable learning opportunities. Furthermore, the Review explores the role of pedagogical strategies employed in online education. With the abrupt shift to virtual classrooms, educators had to adapt their teaching methods to suit the digital environment. The review assesses the effectiveness of various instructional approaches, considering factors such as student engagement, motivation, and the ability to cater to diverse learning styles. The socio-economic implications of online learning are also examined, as the pandemic has heightened existing inequalities. The study investigates how economic disparities have influenced access to education, examining the challenges faced by vulnerable populations. It also explores potential solutions and policy implications to bridge the gap and promote inclusivity in online education. The Review delves into the psychological impact of online learning on students and educators. Isolation, screen fatigue, and the absence of face-to-face interaction have posed mental health challenges. The review considers the measures taken by educational institutions to address these concerns and enhance the overall well-being of the academic community. In conclusion, this Review provides a comprehensive overview of the global experience with online learning during the COVID-19 pandemic. By analyzing technological, pedagogical, socio-economic, and psychological dimensions, it aims to contribute valuable insights for improving the effectiveness of online education in future scenarios of crisis or as a complementary mode of learning.

Keywords: COVID-19; Pandemic, Socio-economic; Vulnerable; Learning Effectiveness

* Corresponding author: Idowu Sulaimon Adeniyi

1. Introduction

The COVID-19 pandemic has brought about unprecedented disruptions across various facets of human life, with education emerging as one of the most profoundly affected domains (Bozkurt et al.,2022). The widespread closure of schools and universities necessitated a rapid and extensive shift to online learning, fundamentally altering the landscape of education globally. This transition, driven by the imperative of ensuring continuity in learning during lockdowns and social distancing measures, has prompted a comprehensive reevaluation of online learning effectiveness. The onset of the COVID-19 pandemic in early 2020 led to a cascading series of challenges for the education sector worldwide. Almost overnight, traditional classroom-based instruction became untenable, prompting educational institutions to grapple with the abrupt cessation of in-person learning. The pandemic disrupted the conventional modes of teaching, learning, and assessment, compelling educators, students, and policymakers to navigate uncharted territory.

The impact of the pandemic on education extended beyond immediate disruptions, unveiling systemic vulnerabilities and inequalities in access to learning resources (Czerniewicz et al.,2022). The severity of these challenges necessitated swift and adaptive responses, with online learning emerging as a primary mode of education delivery during these unprecedented times. The rapid transition to online learning became a defining feature of the pandemic's impact on education. Educational institutions, compelled by the urgency to provide continued access to education, embraced digital platforms and virtual classrooms. This shift, although necessitated by crisis, brought to the forefront the potential of online learning to facilitate education in diverse circumstances.

The significance of this transition lies not only in its immediate response to the crisis but also in its potential to reshape the future of education (Bojović et al.,2020). It has prompted a reevaluation of pedagogical approaches, technological infrastructure, and the socio-economic factors influencing learning. The experiences of this global shift to online learning offer valuable insights into the adaptability of education systems and the opportunities and challenges inherent in digital education. Against this backdrop, this global perspective review seeks to comprehensively examine the effectiveness of online learning during the COVID-19 pandemic. By adopting a global lens, the review aims to capture the diverse experiences, challenges, and successes encountered by educational institutions, educators, and students across different regions.

The purpose of this review extends beyond evaluating the immediate impact of online learning; it aims to distill lessons learned, identify best practices, and provide insights for the future of education. By exploring technological readiness, pedagogical approaches, socio-economic factors, and psychological well-being, this review seeks to contribute to the ongoing discourse on the transformation of education in a digitally connected world. The scope of this review encompasses an in-depth analysis of the global landscape, considering the varying degrees of preparedness, disparities in access, and the innovative solutions that emerged during the pandemic. By examining the multifaceted dimensions of online learning effectiveness, this review aims to inform educators, policymakers, and stakeholders about the challenges and opportunities inherent in the evolving landscape of education in the wake of the COVID-19 pandemic.

2. Technological Infrastructure

The COVID-19 pandemic triggered an unprecedented reliance on technology for education, prompting a global examination of technological infrastructure and its impact on online learning effectiveness. This comprehensive review delves into the global variations in technological readiness, focusing on access to devices and digital resources, as well as disparities in internet connectivity. Additionally, it explores the impact of technological infrastructure on online learning experiences, highlighting success stories in overcoming challenges and identifying common issues faced by students and institutions worldwide (Treve, 2021). The digital divide, characterized by discrepancies in access to technology, became a prominent concern as education shifted online. Globally, there were significant variations in students' access to devices such as laptops, tablets, and smartphones, influencing their ability to participate in virtual classrooms effectively.

In economically developed regions, where personal devices are more prevalent, the transition to online learning was smoother (Alsoud, and Harasis, 2021). However, in less affluent areas, students faced challenges due to the lack of personal devices, hindering their engagement with digital learning materials. Furthermore, disparities extended to the availability of digital resources. While some students had access to a plethora of online educational materials, others faced limitations, impacting the depth and breadth of their learning experiences. The examination of these global variations shed light on the inequities in access to essential technological tools for education.

Internet connectivity emerged as a critical factor influencing the effectiveness of online learning (Maheshwari, 2021.). Disparities in broadband access, network reliability, and the cost of internet services became evident on a global scale. While urban areas often boasted robust internet infrastructure, rural and underserved regions faced challenges in securing stable and affordable connections. The impact of these disparities was particularly pronounced during synchronous online classes, where real-time interaction required a consistent and high-speed internet connection. Students in areas with limited connectivity struggled to attend live sessions, leading to a digital divide in participation and engagement (Azionya and Nhedzi, 2021).

Despite the challenges posed by global variations in technological readiness, success stories emerged as educators and institutions implemented innovative solutions to overcome these hurdles. In several regions, educational institutions collaborated with governments and private entities to distribute devices to students in need. These initiatives aimed to bridge the gap in access to personal devices, ensuring that all students could participate in online learning. Recognizing the prevalence of smartphones in diverse regions, some institutions successfully implemented mobile learning platforms. These platforms delivered educational content and facilitated interactions through mobile devices, catering to students with limited access to traditional computing devices. While success stories highlighted resilience and adaptability, it is essential to acknowledge the common challenges faced by students and institutions during the global transition to online learning (Turnbull et al.,2021).

The most prevalent challenge was connectivity issues. Students experienced disruptions during live sessions, hindering their ability to engage fully in online classes (García et al.,2021). Institutions grappled with finding solutions to ensure equitable access to reliable internet connectivity. The sudden shift to online learning exposed technological literacy gaps among students and educators. Those accustomed to traditional learning environments faced a learning curve in navigating online platforms, digital tools, and collaborative software. Inequities in access to digital resources persisted, impacting the quality of online learning experiences. Students with limited access to online libraries, educational databases, and multimedia content faced challenges in accessing a comprehensive educational experience.

The absence of face-to-face interaction resulted in a lack of personalized support for students. The immediacy of addressing queries, providing individualized feedback, and offering guidance on complex topics was compromised in the virtual learning environment. Institutions struggled to maintain high levels of student engagement and motivation in the absence of in-person interactions. Creating interactive and participatory online learning experiences became a shared challenge globally.

In conclusion, the global examination of technological infrastructure during the COVID-19 pandemic underscores the pivotal role of technology in shaping online learning effectiveness (Sato et al.,2023). Disparities in access to devices, digital resources, and internet connectivity have illuminated the digital divide, revealing the urgent need for comprehensive solutions. Success stories in overcoming technological challenges showcase the resilience and adaptability of educational institutions, while the identification of common challenges emphasizes the ongoing efforts required to enhance online learning experiences globally. As education continues to evolve, addressing these technological disparities will be paramount in ensuring equitable access to quality education for students around the world.

3. Pedagogical Approaches

The shift to online learning during the COVID-19 pandemic prompted a global exploration of pedagogical approaches as educators adapted to the challenges of virtual classrooms (Hickling et al.,2021). This comprehensive review examines the adaptation of teaching methods to the online environment, the exploration of innovative instructional strategies, and the analysis of challenges and solutions in virtual classrooms. Additionally, it assesses student engagement and motivation, evaluates diverse learning styles in the online context, and identifies effective pedagogical practices for a more nuanced understanding of online learning effectiveness. sudden transition to online learning compelled educators worldwide to explore innovative instructional strategies. This involved a departure from traditional teaching methods to embrace digital tools and technologies that facilitate effective virtual instruction. Video conferencing platforms, interactive learning management systems, and multimedia resources became integral components of the online teaching toolkit (Devi et al.,2020).

Innovative strategies encompassed the development of engaging multimedia content, such as recorded lectures, interactive simulations, and virtual labs (Dustman et al.,2021). Gamification, collaborative online projects, and real-world applications of concepts emerged as effective means to capture students' attention and enhance comprehension in the digital space. The exploration of innovative instructional strategies also involved leveraging social media and online communities to create collaborative learning environments. Educators utilized platforms such as discussion

forums, group chats, and collaborative documents to foster communication and interaction among students in the absence of face-to-face interactions (Yuan and Wu, 2020.).

The shift to virtual classrooms brought forth a range of challenges that necessitated innovative solutions (Rizvi and Nabi, 2021). One significant challenge was maintaining student engagement and participation in the absence of physical presence. Educators faced the task of adapting their teaching methods to sustain interest and motivation. Technical issues, including connectivity problems and platform-related challenges, posed obstacles to smooth virtual instruction. Addressing these challenges required a combination of technical support, clear communication strategies, and contingency plans to minimize disruptions. Another challenge was the potential for increased distractions in the home environment. Educators explored strategies to create structured and interactive online sessions, incorporating breaks, varied activities, and participatory elements to keep students actively engaged throughout virtual classes.

The online learning environment accentuates the importance of recognizing and accommodating diverse learning styles (Papaioannou et al.,2023). Students exhibit varying preferences for how they absorb, process, and retain information, and educators must adapt their pedagogical approaches accordingly. Visual learners may benefit from multimedia presentations, infographics, and diagrams, while auditory learners may prefer recorded lectures or podcasts. Kinesthetic learners might require interactive simulations, virtual labs, or hands-on activities even in a digital space. Recognizing these diverse learning styles allows educators to tailor their instructional strategies to cater to the varied needs of students. Additionally, understanding cultural differences is crucial in a global online learning context. Culturally sensitive pedagogy ensures that instructional content is inclusive and resonates with students from diverse backgrounds, fostering a more equitable and engaging learning experience (Cook-Sather, 2020).

Effective pedagogical practices in the online environment go beyond the transposition of traditional methods to digital platforms (Aroles and Küpers, 2022; Adeleke et al., 2019). Educators worldwide identified practices that enhance student engagement, motivation, and overall learning outcomes in virtual classrooms. Incorporating active learning strategies, such as discussions, group projects, and collaborative assignments, fosters student engagement. These activities promote interaction, critical thinking, and knowledge application, creating a dynamic online learning environment.

Providing timely and constructive feedback is essential for student motivation and improvement (Fong et al.,2021; Ilugbusi et al., 2020). Educators implemented digital tools for efficient feedback on assignments, assessments, and participation, fostering a continuous feedback loop that guides students in their learning journey. Recognizing the challenges students faced during the pandemic, educators adopted flexible assessment methods. This involved diversified evaluation techniques, such as open-book exams, project-based assessments, and alternative forms of testing that assessed understanding rather than rote memorization. Leveraging technology for active participation and interaction is crucial for effective online pedagogy. Educators explored the integration of polling tools, interactive quizzes, and virtual breakout rooms to maintain a dynamic and participatory online classroom (Naik and Govindu, 2022).

In conclusion, the global perspective on pedagogical approaches during the COVID-19 pandemic highlights the dynamic and adaptive nature of education in the digital age (Bento et al.,2021). The exploration of innovative instructional strategies and the analysis of challenges and solutions in virtual classrooms underscore the resilience and creativity of educators. The assessment of student engagement, motivation, and diverse learning styles emphasizes the importance of tailoring pedagogical practices to meet the unique needs of students in the online context (Alamri et al.,2021; Vincent et al., 2021). As education continues to evolve, the lessons learned from this period of adaptation will contribute to the ongoing refinement of pedagogical approaches, ensuring a more inclusive, engaging, and effective online learning experience for students worldwide (Almusharraf and Khahro, 2020).

4. Socio-Economic Factors

The COVID-19 pandemic has not only unveiled the vulnerabilities of education systems but has also magnified the socio-economic disparities that impact online learning effectiveness on a global scale. This comprehensive review explores the socio-economic factors influencing online learning, examining the economic impact on access to education, inequalities in educational opportunities, and the policies and interventions implemented globally to address these gaps (Baumann and Cabassa, 2020).

The economic impact of the pandemic (Reimers, 2022; Abrahams et al., 2023) has been profound, and its ripple effects have significantly influenced access to education. As societies grapple with economic downturns, families face financial constraints that directly impact their ability to afford essential tools for online learning, such as devices and reliable

internet connectivity. Students from lower-income households are disproportionately affected, facing barriers to entry into the digital realm of education. The lack of resources, compounded by the sudden shift to online learning, exacerbates existing educational inequalities. The inability to access technology and online resources places these students at a disadvantage, hindering their ability to participate fully in virtual classrooms (Contreras et al.,2021).

Socio-economic disparities extend beyond technological access and permeate various facets of educational opportunities (Helsper, 2021.). Students from affluent backgrounds may have access to private tutors, dedicated study spaces, and a conducive home environment, providing them with an advantage in the virtual learning landscape. On the contrary, students from economically disadvantaged backgrounds may lack these resources, contributing to a widening educational gap. In addition, the pandemic-induced economic challenges may force some students to prioritize work over education, further limiting their ability to fully engage in online learning. This dynamic exacerbates existing disparities, potentially perpetuating cycles of inequality and limiting social mobility (Brown, and James, 2020).

Various regions and institutions have implemented policies and interventions to mitigate socio-economic gaps in online learning (Anlimachie and Avoada,2020; Adaga et al., 2024). Case studies provide valuable insights into successful initiatives that have addressed economic disparities effectively. Some regions have initiated device distribution programs, providing students with laptops or tablets to facilitate online learning. These programs aim to bridge the digital divide by ensuring that all students have equal access to the necessary technology. Recognizing the importance of reliable internet connectivity, certain areas have implemented initiatives to provide subsidized or free internet access to economically disadvantaged households. This ensures that students can participate in online classes without facing barriers related to connectivity (Kamble et al.,2021).

Successful partnerships between educational institutions and tech companies have resulted in discounted or subsidized devices and software licenses (Ozalp et al.,2022; Abrahams et al., 2024). These collaborations have made technology more accessible to a broader range of students, irrespective of their socio-economic backgrounds. Based on the analysis of successful initiatives, several recommendations emerge for fostering inclusivity in online learning and addressing socio-economic gaps (Cerna et al.,2021). Institutions and governments can provide targeted financial assistance to students from economically disadvantaged backgrounds. This assistance can be in the form of grants, scholarships, or subsidies for educational resources, ensuring that financial constraints do not impede access to quality online education. Implementing flexible learning models accommodates students with work or familial responsibilities. Institutions can offer asynchronous learning options, allowing students to access educational content at times that suit their schedules. This flexibility supports those who may need to balance employment with their academic pursuits (Kelly et al.,2022). Establishing community engagement programs that involve local communities in supporting education can be instrumental. These programs may include mentorship initiatives, community-led learning centers, or collaborations with local businesses to provide resources for students.

Institutions can advocate for policy changes at the governmental level to address systemic issues contributing to socio-economic disparities (Hariram et al.,2023). This may involve lobbying for increased funding for education, infrastructure development, and policies that promote economic equality. In conclusion, the socio-economic factors influencing online learning effectiveness during the COVID-19 pandemic demand a nuanced and strategic approach. The examination of economic impacts on access to education and inequalities in educational opportunities underscores the urgency of addressing these disparities. The analysis of policies and interventions, including case studies of successful initiatives, provides a blueprint for fostering inclusivity in online education. By implementing targeted financial assistance, flexible learning models, community engagement programs, and advocating for policy changes, stakeholders can work towards creating a more equitable online learning environment that transcends socio-economic barriers and ensures educational opportunities for all (Bandyopadhyay et al.,2021).

5. Psychological Well-being

A The COVID-19 pandemic triggered an unprecedented surge in online learning, ushering in a new era in education (Namboodiri, 2022). As institutions worldwide adapted to virtual platforms, a critical aspect that emerged for scrutiny was the psychological well-being of students and educators. This comprehensive review explores the psychological impact of online learning during the pandemic, examining both the challenges faced and the support measures implemented by institutions globally. The shift to online learning brought about a sense of isolation for many students and educators. Traditional classrooms foster social interaction, collaboration, and a sense of community. In contrast, virtual education can lead to feelings of isolation, detachment, and a lack of the social dynamics inherent in face-to-face learning environments (Jeffery and Bauer, 2020; Ezeigweneme et al., 2024).

Students, especially those accustomed to the camaraderie of campus life, may find the absence of physical interaction with peers challenging (Nunn, 2021). The loss of informal socializing, group projects, and extracurricular activities can impact not only academic engagement but also the overall well-being of students. Additionally, educators may experience a sense of disconnection from their students, missing the interpersonal aspects of teaching that contribute to job satisfaction. The prolonged use of screens for virtual classes, meetings, and assignments has led to a phenomenon known as "screen fatigue." This involves increased mental exhaustion, eye strain, and decreased attention spans. Students and educators alike grappled with the challenges of staying engaged during extensive periods of screen time, contributing to heightened stress and mental fatigue.

Mental health considerations became paramount as individuals navigated the demands of online learning (Dinella, 2023; Orieno et al., 2024). The blurred boundaries between home and academic life, coupled with the pressures of adapting to new technologies and learning formats, took a toll on the mental well-being of both students and educators. The heightened anxiety, stress, and burnout experienced during the pandemic underscored the need for proactive measures to support psychological health in the online learning environment. Recognizing the psychological impact of online learning, institutions responded by implementing a range of support measures. Mental health resources and counseling services were expanded to address the specific challenges posed by virtual education. Many universities and schools increased access to virtual counseling sessions, providing a platform for students and educators to discuss their concerns, stressors, and coping mechanisms (Majrashi et al., 2021; Ohenhen et al., 2024).

The availability of mental health resources became integral to institutional support systems. Institutions partnered with mental health professionals to offer webinars, Online platforms, often supplemented with chat and email support, became lifelines for workshops, and resources focused on stress management, resilience building, and strategies to navigate the psychological challenges associated with online learning (Caligiuri et al., 2021). Individuals seeking guidance on mental health issues exacerbated by the virtual learning environment. Beyond mental health resources, institutions implemented a variety of strategies to enhance overall well-being in the online learning environment. Recognizing the importance of maintaining a healthy work-life balance, some institutions encouraged flexible schedules, allowing students and educators to manage their time effectively (Bell et al., 2021; Okoro et al., 2024).

Wellness initiatives, such as mindfulness sessions, virtual fitness classes, and wellness challenges, were introduced to promote physical and mental health. These initiatives aimed to counteract the sedentary nature of online learning and provide opportunities for individuals to engage in activities that contribute to their well-being. Moreover, institutions explored creative ways to foster a sense of community in the virtual realm. Virtual clubs, social events, and networking opportunities were organized to recreate the social fabric of traditional campuses. These initiatives not only addressed feelings of isolation but also contributed to a more holistic educational experience that considers the overall well-being of the academic community.

In conclusion, the psychological well-being of individuals engaged in online learning during the COVID-19 pandemic has been a critical facet of the global educational landscape (Pluim and Hunter, 2022). The exploration of the psychological impact, encompassing the challenges of isolation, screen fatigue, and mental health considerations, has underscored the importance of proactive measures. Institutions worldwide have responded by implementing support measures, including mental health resources, counseling services, and strategies to enhance overall well-being in the online learning environment. As education continues to evolve in the digital age, prioritizing the mental health and well-being of students and educators remains essential for fostering a positive and sustainable learning experience.

6. Comparative Analysis

The COVID-19 pandemic forced an unprecedented shift to online learning globally, necessitating a comparative analysis of its effectiveness across diverse cultural and socio-economic contexts. This examination is crucial to understand the nuances influencing the success or challenges of online education worldwide.

The cross-cultural analysis delves into how different societies adapted to online learning, taking into account cultural nuances, educational traditions, and societal expectations. Cultural factors play a significant role in shaping learning preferences, communication styles, and attitudes toward technology. Understanding these dynamics aids in tailoring online education approaches to align with diverse cultural contexts. For instance, collectivist cultures may value collaborative learning strategies, while individualistic cultures might prefer self-directed approaches. Additionally, language barriers and varying levels of technological literacy impact the cross-cultural effectiveness of online education. Countries with a strong digital infrastructure and widespread technology adoption may find online learning more seamless, while others may face challenges related to access and connectivity.

Despite the diversity in cultural contexts, a comparative analysis reveals commonalities and differences in the global experiences of online learning during the pandemic (Cranfield et al., 2021; Mouchou et al., 2021). Many regions faced similar technological challenges, such as the need for reliable internet access, access to devices, and digital literacy. Educators worldwide had to adapt pedagogical strategies to the virtual environment, incorporating online resources and interactive tools. Regardless of cultural context, socio-economic factors influenced students' ability to access online education, highlighting disparities in educational opportunities. Cultures exhibit unique learning preferences and styles, influencing the effectiveness of online education. Some may thrive in collaborative online environments, while others may prefer individualized approaches.

Varied governmental responses to the pandemic impacted the implementation and success of online learning. Countries with proactive measures and supportive policies may have experienced smoother transitions. Disparities in digital infrastructure influenced the extent to which online learning was embraced. Technologically advanced regions may have found it easier to integrate online education seamlessly. The insights garnered from the comparative analysis provide a foundation for improving online education in diverse cultural and socio-economic contexts. Recognizing cultural diversity, educators can tailor online learning approaches to align with the preferences and learning styles of specific regions. This may involve incorporating culturally relevant content, collaborative projects, or adapting assessment methods.

Policymakers must prioritize addressing socio-economic disparities to ensure equitable access to online education. Initiatives such as subsidizing devices, improving internet infrastructure, and providing financial assistance can bridge the digital divide. Offering training and professional development opportunities for educators in diverse cultural contexts is crucial. This ensures that they are equipped to navigate cultural nuances and effectively engage students from different backgrounds. Establishing platforms for global collaboration and knowledge exchange allows educators, policymakers, and researchers to share successful practices and learn from each other. This collaborative approach fosters a collective understanding of effective online learning strategies. Recognizing the psychological impact of online learning, institutions should implement support structures that consider cultural attitudes towards mental health. This may involve culturally sensitive counseling services and well-being programs.

In conclusion, the comparative analysis of online learning effectiveness during the COVID-19 pandemic from a global perspective provides valuable insights for shaping the future of education. By understanding the cultural and socio-economic factors influencing online learning, stakeholders can develop targeted strategies that enhance accessibility, inclusivity, and effectiveness across diverse contexts. The shared experiences and lessons learned from this analysis pave the way for a more adaptive and equitable approach to education in an increasingly digital world (An, 2023).

7. Conclusion

In conclusion, the global perspective review of online learning effectiveness during the COVID-19 pandemic has yielded significant insights into various dimensions of this transformative educational shift.

The examination of technological infrastructure revealed a wide spectrum of readiness across different regions, with disparities in access to devices and internet connectivity significantly impacting the online learning experience. Pedagogical approaches demonstrated remarkable adaptability, with educators embracing innovative strategies to enhance engagement and motivation. Socio-economic factors played a pivotal role, highlighting the need for targeted policies to address inequalities in access to education. The psychological well-being of students and educators emerged as a critical consideration, emphasizing the importance of support measures and mental health resources.

The findings underscore the necessity for a nuanced and adaptive approach to future educational strategies and policies. Addressing technological disparities requires concerted efforts to bridge the digital divide, ensuring equitable access to resources. Pedagogical practices should continue to evolve, incorporating lessons learned during the pandemic to create engaging and effective online learning environments. Policymakers must prioritize initiatives that mitigate socio-economic barriers, promoting inclusivity and equal opportunities for all learners. Furthermore, institutions should integrate comprehensive support structures to safeguard the psychological well-being of the academic community.

The global nature of the review emphasizes the need for collaborative efforts to enhance online learning effectiveness. As we navigate the post-pandemic educational landscape, sharing best practices and innovative solutions across borders becomes paramount. Collaborative research initiatives, international partnerships, and knowledge exchange platforms can facilitate the dissemination of successful strategies. Additionally, the call to action extends to policymakers, urging them to work collectively to establish global standards and frameworks that promote accessibility, quality, and inclusivity in online education. In moving forward, a collective commitment to ongoing assessment,

collaboration, and the implementation of informed policies will contribute to a more resilient and effective global education system, capable of addressing current challenges and those that may arise in the future.

Compliance with ethical standards

Disclosure of conflict of interest

The author has no conflict of interest in this research.

Reference

- [1] Abrahams, T. O., Ewuga, S. K., Kaggwa, S., Uwaoma, P. U., Hassan, A. O. and Dawodu, S. O., 2023. Review of strategic alignment: Accounting and cybersecurity for data confidentiality and financial security.
- [2] Abrahams, T. O., Ewuga, S. K., Kaggwa, S., Uwaoma, P. U., Hassan, A. O. and Dawodu, S. O., 2024. MASTERING COMPLIANCE: A Comprehensive Review Of Regulatory Frameworks In Accounting And Cybersecurity. *Computer Science & IT Research Journal*, 5(1), pp. 120-140.
- [3] Adaga, E. M., Egieya, Z. E., Ewuga, S. K., Abdul, A. A. and Abrahams, T. O., 2024. Philosophy In Business Analytics: A Review Of Sustainable And Ethical Approaches. *International Journal of Management & Entrepreneurship Research*, 6(1), pp. 69-86.
- [4] Adeleke, O. K., Segun, I. B. and Olaoye, A. I. C., 2019. Impact of internal control on fraud prevention in deposit money banks in Nigeria. *Nigerian Studies in Economics and Management Sciences*, 2(1), pp. 42-51.
- [5] Alamri, H., Lowell, V., Watson, W. and Watson, S. L., 2020. Using personalized learning as an instructional approach to motivate learners in online higher education: Learner self-determination and intrinsic motivation. *Journal of Research on Technology in Education*, 52(3), pp. 322-352.
- [6] Almusharraf, N. and Khahro, S., 2020. Students satisfaction with online learning experiences during the COVID-19 pandemic. *International Journal of Emerging Technologies in Learning (ijET)*, 15(21), pp. 246-267.
- [7] Alsoud, A. R. and Harasis, A. A., 2021. The impact of COVID-19 pandemic on student's e-learning experience in Jordan. *Journal of Theoretical and Applied Electronic Commerce Research*, 16(5), pp. 1404-1414.
- [8] An, N., 2023. Toward Learning Societies for Digital Aging. *arXiv preprint arXiv:2305. 01137*.
- [9] Anlimachie, M. A. and Avoada, C., 2020. Socio-economic impact of closing the rural-urban gap in pre-tertiary education in Ghana: context and strategies. *International Journal of Educational Development*, 77, p. 102236.
- [10] Aroles, J. and Küpers, W., 2022. Towards an integral pedagogy in the age of 'digital Gestell': Moving between embodied co-presence and telepresence in learning and teaching practices. *Management Learning*, 53(5), pp. 757-775.
- [11] Azionya, C. M. and Nhedzi, A., 2021. The digital divide and higher education challenge with emergency online learning: Analysis of tweets in the wake of the COVID-19 lockdown. *Turkish Online Journal of Distance Education*, 22(4), pp. 164-182.
- [12] Bandyopadhyay, S., Bardhan, A., Dey, P. and Bhattacharyya, S., 2021. *Bridging the education divide using social technologies*. Springer.
- [13] Baumann, A. A. and Cabassa, L. J., 2020. Reframing implementation science to address inequities in healthcare delivery. *BMC health services research*, 20, pp. 1-9.
- [14] Bell, D. J., Self, M. M., Davis III, C., Conway, F., Washburn, J. J. and Crepeau-Hobson, F., 2020. Health service psychology education and training in the time of COVID-19: Challenges and opportunities. *American Psychologist*, 75(7), p. 919.
- [15] Bento, F., Giglio Bottino, A., Cerchiareto Pereira, F., Forastieri de Almeida, J. and Gomes Rodrigues, F., 2021. Resilience in higher education: a complex perspective to lecturers' adaptive processes in response to the COVID-19 pandemic. *Education Sciences*, 11(9), p. 492.
- [16] Bojović, Ž., Bojović, P. D., Vujošević, D. and Šuh, J., 2020. Education in times of crisis: Rapid transition to distance learning. *Computer Applications in Engineering Education*, 28(6), pp. 1467-1489.
- [17] Bozkurt, A., Karakaya, K., Turk, M., Karakaya, Ö. and Castellanos-Reyes, D., 2022. The impact of COVID-19 on education: a meta-narrative review. *TechTrends*, 66(5), pp. 883-896.

- [18] Brown, P. and James, D., 2020. Educational expansion, poverty reduction and social mobility: Reframing the debate. *International Journal of Educational Research*, 100, p. 101537.
- [19] Caligiuri, P., De Cieri, H., Minbaeva, D., Verbeke, A. and Zimmermann, A., 2020. International HRM insights for navigating the COVID-19 pandemic: Implications for future research and practice. *Journal of international business studies*, 51, pp. 697-713.
- [20] Cerna, L., Mezzanotte, C., Rutigliano, A., Brussino, O., Santiago, P., Borgonovi, F. and Guthrie, C., 2021. Promoting inclusive education for diverse societies: A conceptual framework.
- [21] Contreras, C. P., Picazo, D., Cordero-Hidalgo, A. and Chaparro-Medina, P. M., 2021. Challenges of virtual education during the COVID-19 pandemic: Experiences of Mexican university professors and students. *International Journal of Learning, Teaching and Educational Research*, 20(3), pp. 188-204.
- [22] Cook-Sather, A., 2020. Respecting voices: How the co-creation of teaching and learning can support academic staff, underrepresented students, and equitable practices. *Higher Education*, 79(5), pp. 885-901.
- [23] Cranfield, D. J., Tick, A., Venter, I. M., Blignaut, R. J. and Renaud, K., 2021. Higher education students' perceptions of online learning during COVID-19—A comparative study. *Education Sciences*, 11(8), p. 403.
- [24] Czerniewicz, L., Agherdien, N., Badenhorst, J., Belluigi, D., Chambers, T., Chili, M., De Villiers, M., Felix, A., Gachago, D., Gokhale, C. and Ivala, E., 2020. A wake-up call: Equity, inequality and Covid-19 emergency remote teaching and learning. *Postdigital science and education*, 2(3), pp. 946-967.
- [25] Devi, K. S. and Aparna, M., 2020. Moodle—An effective learning management system for 21st century learners. *Alochana Chakra Journal*, 9(6), pp. 4474-4485.
- [26] Dinella, L. M., Fulcher, M. and Weisgram, E. S., 2023. Understanding women's work, children and families during the COVID-19 global pandemic: using science to support women around the globe. *Journal of Social Issues*, 79(3), pp. 847-860.
- [27] Dustman, W. A., King-Keller, S. and Marquez, R. J., 2021. Development of gamified, interactive, low-cost, flexible virtual microbiology labs that promote higher-order thinking during pandemic instruction. *Journal of microbiology & biology education*, 22(1), pp. 10-1128.
- [28] Ezeigweneme, C. A., Umoh, A. A., Ilojiyanya, V. I. and Adegbite, A. O., 2024. Review Of Telecommunication Regulation And Policy: Comparative Analysis USA AND AFRICA. *Computer Science & IT Research Journal*, 5(1), pp. 81-99.
- [29] Fong, C. J., Schallert, D. L., Williams, K. M., Williamson, Z. H., Lin, S., Kim, Y. W. and Chen, L. H., 2021. Making feedback constructive: the interplay of undergraduates' motivation with perceptions of feedback specificity and friendliness. *Educational Psychology*, 41(10), pp. 1241-1259.
- [30] García-Morales, V. J., Garrido-Moreno, A. and Martín-Rojas, R., 2021. The transformation of higher education after the COVID disruption: Emerging challenges in an online learning scenario. *Frontiers in psychology*, 12, p. 616059.
- [31] Hariram, N. P., Mekha, K. B., Suganthan, V. and Sudhakar, K., 2023. Sustainalism: An Integrated Socio-Economic-Environmental Model to Address Sustainable Development and Sustainability. *Sustainability*, 15(13), p. 10682.
- [32] Helsper, E., 2021. The digital disconnect: The social causes and consequences of digital inequalities. *The Digital Disconnect*, pp. 1-232.
- [33] Hickling, S., Bhatti, A., Arena, G., Kite, J., Denny, J., Spencer, N. L. and Bowles, D. C., 2021. Adapting to teaching during a pandemic: Pedagogical adjustments for the next semester of teaching during COVID-19 and future online learning. *Pedagogy in Health Promotion*, 7(2), pp. 95-102.
- [34] ILUGBUSI, S., AKINDEJOYE, J. A., AJALA, R. B. and OGUNDELE, A., 2020. Financial liberalization and economic growth in Nigeria (1986-2018). *International Journal of Innovative Science and Research Technology*, 5(4), pp. 1-9.
- [35] Jeffery, K. A. and Bauer, C. F., 2020. Students' responses to emergency remote online teaching reveal critical factors for all teaching. *Journal of Chemical Education*, 97(9), pp. 2472-2485.
- [36] Kamble, A., Gauba, R., Desai, S. and Golhar, D., 2021. Learners' perception of the transition to instructor-led online learning environments: Facilitators and barriers during the COVID-19 pandemic. *International Review of Research in Open and Distributed Learning*, 22(1), pp. 199-215.
- [37] Kelly, C. M., Rofcanin, Y., Las Heras, M., Ogbonnaya, C., Marescaux, E. and Bosch, M. J., 2020. Seeking an "i-deal" balance: Schedule-flexibility i-deals as mediating mechanisms between supervisor emotional support and employee work and home performance. *Journal of Vocational Behavior*, 118, p. 103369.

- [38] Maheshwari, G., 2021. Factors affecting students' intentions to undertake online learning: an empirical study in Vietnam. *Education and Information Technologies*, 26(6), pp. 6629-6649.
- [39] Majrashi, A., Khalil, A., Nagshabandi, E. A. and Majrashi, A., 2021. Stressors and coping strategies among nursing students during the COVID-19 pandemic: scoping review. *Nursing Reports*, 11(2), pp. 444-459.
- [40] Mouchou, R., Laseinde, T., Jen, T. C. and Ukoba, K., 2021. Developments in the Application of Nano Materials for Photovoltaic Solar Cell Design, Based on Industry 4. 0 Integration Scheme. In *Advances in Artificial Intelligence, Software and Systems Engineering: Proceedings of the AHFE 2021 Virtual Conferences on Human Factors in Software and Systems Engineering, Artificial Intelligence and Social Computing, and Energy, July 25-29, 2021, USA* (pp. 510-521). Springer International Publishing.
- [41] Naik, V. and Govindu, A., 2022. Enriching and energizing the virtual classroom using breakout sessions: A better experience of active learning during Covid-19 pandemic. *J. Eng. Educ. Transform*, 35, pp. 129-134.
- [42] Namboodiri, S., 2022. Zoom-ing past "the new normal"? Understanding students' engagement with online learning in higher education during the covid-19 pandemic. In *Re-imagining Educational Futures in Developing Countries: Lessons from Global Health Crises* (pp. 139-158). Cham: Springer International Publishing.
- [43] Nunn, L. M., 2021. *College belonging: How first-year and first-generation students navigate campus life*. Rutgers University Press.
- [44] Ohenhen, P. E., Chidolue, O., Umoh, A. A., Ngozichukwu, B., Fafure, A. V., Ilojiana, V. I. and Ibekwe, K. I., 2024. Sustainable cooling solutions for electronics: A comprehensive review: Investigating the latest techniques and materials, their effectiveness in mechanical applications, and associated environmental benefits.
- [45] Okoro, Y. O., Ayo-Farai, O., Maduka, C. P., Okongwu, C. C. and Sodamade, O. T., 2024. THE ROLE OF TECHNOLOGY IN ENHANCING MENTAL HEALTH ADVOCACY: A SYSTEMATIC REVIEW. *International Journal of Applied Research in Social Sciences*, 6(1), pp. 37-50.
- [46] Orieno, O. H., Ndubuisi, N. L., Ilojiana, V. I., Biu, P. W. and Odonkor, B., 2024. The Future Of Autonomous Vehicles In The US Urban Landscape: A Review: Analyzing Implications For Traffic, Urban Planning, And The Environment. *Engineering Science & Technology Journal*, 5(1), pp. 43-64.
- [47] Ozalp, H., Ozcan, P., Dincol, D., Zachariadis, M. and Gawer, A., 2022. "Digital colonization" of highly regulated industries: an analysis of big tech platforms' entry into health care and education. *California management review*, 64(4), pp. 78-107.
- [48] Papaioannou, G., Volakaki, M. G., Kokolakis, S. and Vouyioukas, D., 2023. Learning spaces in higher education: a state-of-the-art review. *Trends in Higher Education*, 2(3), pp. 526-545.
- [49] Plum, G. and Hunter, S., 2022. Changing Educational Landscapes and the Importance of Mental Well-Being in Teacher Education. *Crisis and Opportunity*, p. 290.
- [50] Reimers, F. M., 2022. Learning from a pandemic. The impact of COVID-19 on education around the world. *Primary and secondary education during Covid-19: Disruptions to educational opportunity during a pandemic*, pp. 1-37.
- [51] Rizvi, Y. S. and Nabi, A., 2021. Transformation of learning from real to virtual: an exploratory-descriptive analysis of issues and challenges. *Journal of Research in Innovative Teaching & Learning*, 14(1), pp. 5-17
- [52] Sato, S. N., Condes Moreno, E., Rubio-Zarapuz, A., Dalamitros, A. A., Yañez-Sepulveda, R., Tornero-Aguilera, J. F. and Clemente-Suárez, V. J., 2023. Navigating the New Normal: Adapting Online and Distance Learning in the Post-Pandemic Era. *Education Sciences*, 14(1), p. 19.
- [53] Treve, M., 2021. What COVID-19 has introduced into education: Challenges facing higher education institutions (HEIs). *Higher Education Pedagogies*, 6(1), pp. 212-227.
- [54] Turnbull, D., Chugh, R. and Luck, J., 2021. Transitioning to E-Learning during the COVID-19 pandemic: How have Higher Education Institutions responded to the challenge?. *Education and Information Technologies*, 26(5), pp. 6401-6419.
- [55] Vincent, A. A., Segun, I. B., Loretta, N. N. and Abiola, A., 2021. Entrepreneurship, agricultural value-chain and exports in Nigeria. *United International Journal for Research and Technology*, 2(08), pp. 1-8.
- [56] Yuan, C. H. and Wu, Y. J., 2020. Mobile instant messaging or face-to-face? Group interactions in cooperative simulations. *Computers in Human Behavior*, 113, p. 106508.