Global Disruption: Unveiling the Educational Metamorphosis Triggered by COVID-19

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Abstract: *The COVID-19 pandemic disrupted educational systems across more than 155 nations, affecting billions of students. This unprecedented crisis has accelerated the adoption of online learning, challenging traditional teaching methods and reshaping education in a matter of days. The transition to digital platforms revealed enhanced content retention and quicker learning curves among students in online environments. This study examines the integration of adaptive learning technologies with traditional methods, demonstrating their potential to create personalised and effective educational experiences. A key concern is whether these changes will persist beyond the pandemic. To address this, the study explores the long-term viability of digital adaptations and their potential to transform educational paradigms. This research provides insights into the pandemic's impact on education and offers a roadmap for future practices. It highlights state-of-the-art technological applications that could redefine learning, ensuring education systems are better equipped to prepare for future disruptions.*

Keywords: *Open and Distance Learning, Artificial Intelligence, Education, Online Learning, COVID-19*

1. INTRODUCTION

In December 2019, the world witnessed the emergence of COVID-19, caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), with its first cases reported in China. By March 11, 2020, the World Health Organisation (WHO) officially declared COVID-19 a global pandemic, ushering in a series of unprecedented challenges worldwide. To mitigate the spread of the virus, nations enforced stringent measures such as social distancing, lockdowns, and curfews, which profoundly impacted societal structures, including education. Traditional classroom settings were abruptly rendered inaccessible, compelling educators, students, and institutions to seek alternative solutions for knowledge dissemination (Spiteri et al., 2020; Vargas-Alarcón et al., 2022).

This disruption catalysed a paradigm shift in education, transitioning from conventional in-person instruction to digital learning platforms almost overnight. Policymakers and educators rapidly adopted innovative strategies to ensure the continuity of learning (Sintema, 2020). The pandemic accelerated the integration of digital technologies such as Artificial Intelligence (AI) and Machine Learning (ML) into educational systems, enabling personalised learning, real-time progress tracking, and the creation of adaptive learning environments. These changes redefined the roles of educators and students, highlighting the potential of technology to transform education beyond crisis management (Dhawan, 2020).

This study is a conceptual paper that explores the impact of COVID-19 on higher education systems through theoretical perspectives and a synthesis of existing literature. The data for this paper were collected through peer-reviewed journal articles. The selection criteria included relevance to post-pandemic educational transformations, accessibility, and data credibility. By examining how technology-driven solutions have been leveraged, this research provides a roadmap for integrating digital learning tools and strategies into future educational practices, ensuring resilience and adaptability in the face of disruptions. Figure 1 illustrates the integration of digital tools and methodologies in modern education. It highlights key components, including virtual instructors, collaborative learning environments, and course delivery systems. Additionally, it emphasises the use of online tutorials and help tools for independent learning and data analysis methods to enhance course design,

cooperative exercises, and personalised learning experiences. These elements collectively aim to improve the adaptability and efficiency of education in a digital era.

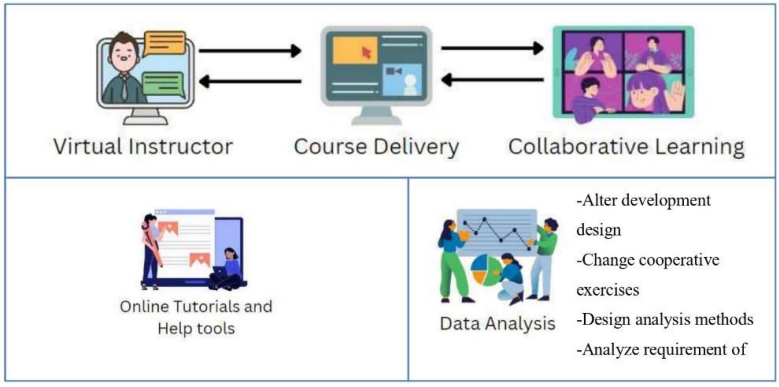

Figure 1: Online Learning Methodology

This methodology encompasses a diverse array of digital resources, interactive tools, and collaborative platforms that extend beyond physical boundaries. As we learn more about e-learning, it becomes clear that this represents a paradigm shift, promoting a more connected and technologically advanced educational experience rather than merely a departure from traditional techniques. Furthermore, the pandemic's widespread adoption of highly popular online courses and open educational resources has increased the opportunity for high-quality education by bridging the gap between various socioeconomic levels and geographic regions. E-learning, which offers students a diverse and engaging platform for knowledge acquisition, is a testament to the evolving landscape of education in a world where digital connectivity is increasingly prevalent (Aboagye et al., 2020).

In the aftermath of the COVID-19 pandemic's impact on online teaching and training, this research highlights several challenges, including communication barriers, inadequate home study environments, equity concerns, and achieving educational excellence in postsecondary education. It presents the cutting-edge concept of digital equity audits, which methodically identify and address inequalities in students' access to technology and digital resources. It highlights shortcomings in online learning, including issues with virtual classrooms,

teachers' limited access to online training, and a lack of expertise in internet-based instruction. The report also identifies creative ways to boost student motivation and engagement, such as incorporating gamification into online learning environments.

This paper also examines the impact of the COVID-19 pandemic on global educational practices, highlighting both challenges and opportunities for academic and digital growth during the pandemic. Amid the complex web of difficulties, the study also suggests a path forward for making headway under the particular conditions created by the COVID-19 pandemic. A common framework for emergency remote teaching will be developed as part of this roadmap, which can be customised to fit different educational environments and guarantee readiness for unforeseen events in the future. This investigation reveals the complexities of educational constraints while also offering a forward-looking perspective that highlights the possibility of learning progress and improvement despite the obstacles faced (Lizcano et al., 2019). Adaptive learning technologies, which employ algorithms to tailor each student's educational experience and better meet their unique learning needs, were a revolutionary technique used during this shift. A paradigm shift was brought about by the transition from traditional in-person instruction to digital platforms, creating an incredibly dynamic learning environment. Despite the initial learning curve, instructors and students found themselves fully engaged in an exceptionally fruitful learning environment.

2. TRANSFORMATION OF EDUCATION: ONLINE PLATFORMS

In response to the COVID-19 pandemic, governments enforced social distancing orders and shutdowns, resulting in the closure of international educational institutions. In reaction to this significant shift in the educational landscape, educators transformed their pedagogical approaches by incorporating an extensive array of digital resources into their lessons. The solution to this unanticipated worldwide catastrophe was online learning, virtual classrooms, and continuous training, which addressed issues faced by both teachers and students. The quick creation and implementation of virtual labs and simulation tools, which preserved the integrity of experiential learning while enabling science and engineering students to perform experiments and practical tasks

remotely, was another novel feature. This transformation of education led to the implementation of emergency training methods, made possible by several online platforms, which require institutions and teachers to be flexible and adaptable (Pokhrel & Chhetri, 2021).

Additionally, a creative way to enhance openness and confidence in digital education is to utilise blockchain technology to manage and verify student credentials and academic records securely. This study explains how educators have responded to pressing issues while also showcasing their inventiveness and resiliency in the face of adversity. Online learning environments like BYJU are providing their courses for free due to high demand. The company's Chief Operating Officer, Mrinal Mohit, reports that the availability of free live classes has resulted in a 200% increase in prospective users of the BYJU Think and Learning application. In addition to increasing their user base, this calculated move provided the platform with valuable data about learning preferences and habits, which enabled them to improve and optimise their tailored learning algorithms. Tencent Education has seen an increase in use concurrently with the Chinese government's directive in mid-February 2022 for a quarter of a billion holistic learners to continue their education online (Rizvi & Nabi, 2021).

Having grown its membership to over 730,000 students, roughly 81% of all prekindergarten students, the Tencent Prekindergarten Virtual Academy in Wuhan has become a significant online academic movement. Tencent implemented AI-driven teaching assistants to handle this unprecedented increase, providing students with immediate help and feedback while maintaining a high level of instruction. This phenomenon not only highlights the flexibility of educational platforms but also underscores the importance of adapting to changes in educational requirements and trends worldwide (Baxter et al., 2022). Additionally, these platforms leveraged cutting-edge data analytics to rapidly identify learning gaps and implement targeted interventions, ultimately enhancing educational outcomes throughout the crisis. Many organisations are expanding their capacities to become all-inclusive centres for learners and teachers. Lark, which was initially created to manage rapid expansion for the Singapore-based firm ByteDance, is a great example. Lark currently offers a range of services, including nearly infinite meeting time, automated translation, real-time co-editing of research projects, and intelligent scheduling coordination, to educators and students. It created a creative integration when they included an AI-driven engagement

tracker that tracks student involvement and provides teachers with feedback, thereby improving the interactive nature of online instruction. Lark increased its technological capabilities and worldwide server capacity in response to the increasing demand, guaranteeing dependable connectivity, which is especially important in times of crisis. Alibaba DingTalk, a platform for remote learning, is also expected to experience a similar upsurge. The CEO of DingTalk, Chen Hang, disclosed their response as they broke the record for the fastest capacity expansion by successfully deploying over 100,000 additional cloud servers in just two hours, utilising Alibaba Cloud. DingTalk unveiled a real-time classroom analytics dashboard to further assist instructors (Xiao et al., 2023). This dashboard empowers teachers with dynamic control over their teaching by providing them with data on student performance and engagement. The enrollment procedure for online courses is illustrated in Figure 2.

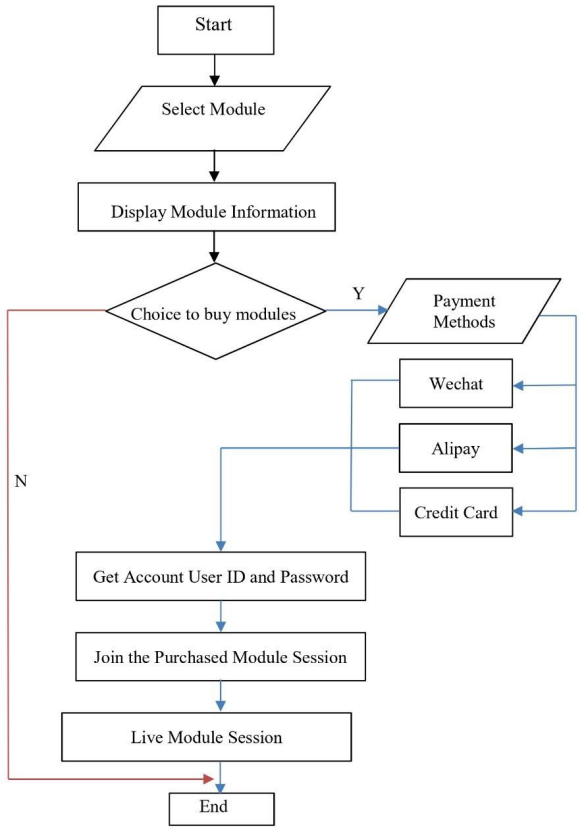

Figure 2: The Flowchart of Online Learning Enrollment

This proactive strategy not only demonstrates adaptability but also emphasises how important technology is in quickly scaling up educational resources to satisfy previously unheard-of demand. Both platforms have also included virtual counselling services and mental health tools, recognising the importance of supporting teachers' and students' well-being during these challenging times. Innovative collaborations are being formed among several public schools. The goal of this partnership is to provide public school broadcasts on various networks, appealing to a wide age range and offering multiple digital alternatives. The incorporation of interactive elements into broadcasts, which enable students to participate in real-time surveys and quizzes, is a unique characteristic of this collaboration that enhances interaction and engagement. Prominent media organisations, such as the BBC, are also supporting virtual education, as evidenced by programs like Bitesize Daily. It was introduced on April 20 and offers 14 weeks of course material coaching to youth in the UK (Anthony et al., 2020). Athletes such as Sergio Aguero of Manchester City promote it. The curriculum incorporates augmented reality features into lectures to provide a rich educational environment that bridges the gap between virtual and physical learning settings. The preparation of educators and learners throughout this shift to new educational paradigms must be appropriately assessed and supported. Teachers now have access to a cutting-edge training program that focuses on building resilience and digital pedagogical skills, preparing them for the shift to online learning. While students with a growth mindset quickly adapt to the latest teaching techniques, individuals with a fixed mindset may find it challenging to adjust (Adipat et al., 2021).

AI-powered technologies are revolutionising education by enabling personalised learning pathways that cater to individual student needs, offering tailored instruction to accommodate diverse learning paces and styles. Tools such as adaptive learning platforms, intelligent tutoring systems, and recommendation engines dynamically adjust content and pace based on a student's performance and interests. This shift underscores that education cannot rely on a one-size-fits-all approach; instead, diverse strategies must be employed to address the varying needs of learners across different themes and grade levels (Udeogalanya, 2022). Moreover, online learning has significantly enhanced accessibility for individuals with physical limitations by minimising mobility barriers. Advanced technologies such as speech recognition software, eye-tracking systems, and text-to-speech converters are being integrated into virtual platforms to create inclusive learning environments (Basilaia

& Kvavadze, 2020). These approaches are not only helpful for gaining information but also for developing essential skills such as critical thinking, problem-solving, and self-directed learning. In addition, facilitated peer-to-peer interactions in virtual environments have been demonstrated in recent research to significantly improve communication and cooperation skills within the flipped classroom paradigm. The technology environment that facilitates remote learning is extensive and varied. Smooth virtual communications are made possible by popular video conferencing technologies like Google Hangouts Meet, Cisco, Slack, Zoom, and WebEx. Such innovations not only empower students with disabilities but also cultivate essential digital skills in a rapidly evolving educational landscape.

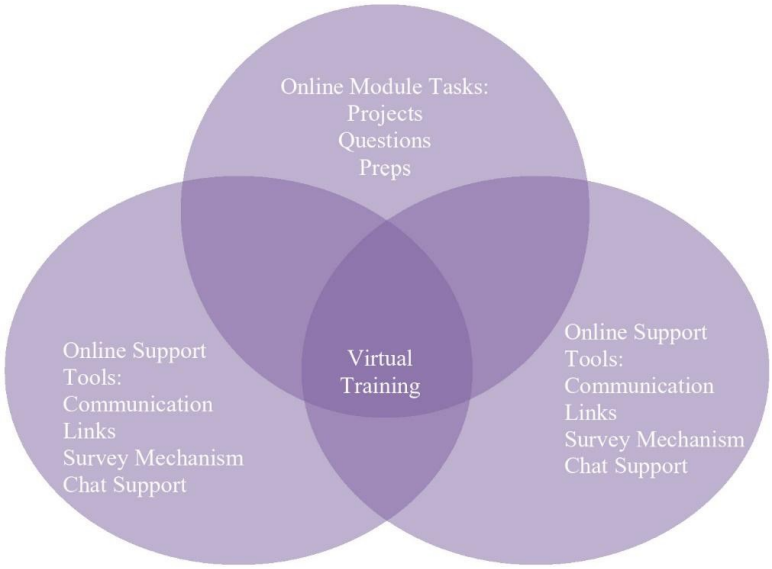

Figure 3: The Virtual Learning Environment

As illustrated in Figure 3, the growing adoption of such technologies emphasises the need for flexibility and adaptability in shaping the future of education. Virtual classrooms are becoming increasingly inclusive and accessible due to recent platform innovations, such as AI-driven real-time transcription and translation services. Furthermore, learning management systems that are cloud-based and adaptable, like Elias, Moodle, BigBlueButton, and Skype, provide instructors and students with an extensive toolbox.

These systems incorporate innovative features, including AI-powered analytics that monitor student performance and engagement, providing teachers with valuable insights to inform their teaching strategies. Furthermore, the incorporation of virtual and augmented reality (VR/AR) capabilities into these platforms is transforming experiential learning by enabling students to participate in previously unthinkable immersive simulations and virtual field excursions. These platforms not only enhance accessibility as technology advances, but they also help students acquire critical skills in an ever-evolving educational environment.

3. UNVEILING OBSTACLES: CHALLENGES IN ONLINE TRAINING AND LEARNING

Handling the wide world of online training and education presents more difficulties than just connecting to and using resources. With numerous alternatives available, students and teachers often struggle to select the most valuable and relevant resources. The process can be enhanced by recent advancements in artificial intelligence and machine learning algorithms, which provide customised suggestions for educational materials and tools tailored to each user's unique learning preferences and needs. Moreover, the fluid nature of digital platforms may lead to challenges in adapting to new interfaces and developing new technologies. To address this, the adoption of adaptable user interfaces that change according to patterns of human interaction can significantly enhance the user experience by providing simple navigation and valuable features. A multidimensional strategy is necessary to address these issues, including user-friendly interface designs, comprehensive training programs, and ongoing support systems to enhance the overall quality of the online learning environment. Cutting-edge training programs with gamification components have demonstrated potential in raising retention and engagement,

improving the efficacy and enjoyment of the learning process. Understanding and addressing these challenges is essential to creating an online learning environment that is both more efficient and more accessible as the digital world develops. Furthermore, the implementation of resilient feedback mechanisms that enable users to promptly express concerns and propose enhancements might result in the ongoing improvement of virtual learning environments.

3.1 CHALLENGES TACKLED BY INSTRUCTORS IN THE REALM OF ONLINE TEACHING

Most tutors faced a challenging learning curve in the rapid transition to online learning while trying to stay current with the latest developments. When transferring traditional in-person courses to virtual classrooms, teachers found it easier to use pre-made teaching materials rather than starting from scratch. However, as teachers adjusted their classes to account for technical complexities, problems surfaced. Some cutting-edge platforms have addressed these issues by introducing AI-driven lesson planning tools that can automatically convert paper lesson plans into interactive online formats, significantly reducing the technical burden on teachers (Worthington & Levasseur, 2015). The requirements of online instruction proved too much for the instruments that had worked effectively for them in traditional settings, underscoring the necessity for more technological expertise in the rapidly changing field of digital education. Specialised training programs in digital pedagogy and the integration of new technology into teaching methods have been developed in response to this. These programs, which offer certificates and micro-credentials, provide teachers with specialised skills to enhance their ability to teach online. This dynamic movement highlights the importance of educators being adaptable and underscores the need for ongoing professional development to navigate the complexities of online education effectively. Additionally, peer-to-peer learning and the exchange of best practices among educators are facilitated by collaborative platforms that are emerging. This promotes the development of a supportive community and ongoing advancements in digital teaching approaches (Rapanta et al., 2020). With the shift from conventional teaching techniques that heavily relied on PowerPoint presentations, educators are facing the challenge of providing students with insufficient slideshows to understand the material independently. The requirement for internet services to maintain connectivity may pose additional difficulties, especially when handling potentially slow broadband connections, as shown in Figure 4.

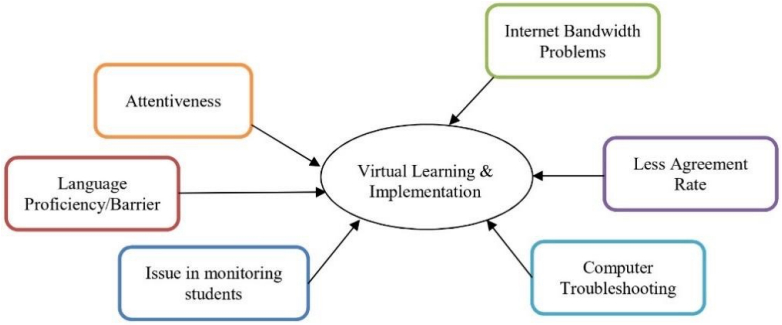

Figure 4: Challenges in Online Training and Learning

This dilemma calls for the investigation of novel tools and development techniques to produce comprehensive educational resources. To close this gap, creative solutions are being created, such as interactive e-books and multimedia-rich content platforms, which will enable students to have more engaging and self-paced learning experiences (Cullinan et al., 2021). It is possible that previously available technology tools, such as computers and the internet, were offered by educational institutions for use in instruction and learning. However, these days, teachers have to rely on their home resources, which might not always be efficient or easily accessible. This change raises several problems, one of which is that teachers' personal computers may not have the most recent upgrades installed to support new features and handle large file sizes related to course materials. Virtual Desktop Infrastructures (VDI) and cloud-based solutions are becoming essential tools to address these issues, allowing educators to access powerful computer resources and updated software without requiring expensive gear at home. Effective online education depends critically on instructors being able to adapt to this new environment and having access to updated technology. Additionally, organisations are starting to implement digital literacy initiatives and provide remote technical assistance to help teachers overcome technological difficulties and enhance their ability to deliver high-quality instruction remotely.

This is especially evident when households simultaneously engage in online activities for both work and leisure. Faculty personnel may encounter restrictions regarding resources necessary for creating courses, communicating with students, and exchanging knowledge, such as cloud-based solutions, video

conferencing software, and screen recording apps. Due to access limitations and brief trial periods, educators should be cautious of free services and demo software, as many credible tools require membership payments. To improve the quality of online education without increasing expenses, some universities are now exploring partnerships with digital businesses to offer staff and students free or heavily discounted access to premium learning resources (Mody & Gontjes, 2022). To ensure the uninterrupted operation of online education in the event of unforeseen circumstances, educators must make a long-term commitment to training and become proficient in Information and Communication Technologies (ICT). In addition, novel approaches such as mesh network technology are being explored to enhance connectivity in regions with inadequate internet infrastructure, ensuring that every student can engage efficiently in online learning (Tadesse & Muluye, 2020). Teachers must contend with the challenges that come with connectivity and access, while also preparing for the ongoing need to adapt to new digital tools and resources as technology continues to evolve. Furthermore, efforts are being made to integrate artificial intelligence into educational platforms to provide personalised learning experiences. This would enable more effective catering to the individual needs of students and promote an inclusive learning environment.

Some academic staff members have started using Zoom, but only for the 40-minute free trial version. When courses were ending just before the scheduled lecture periods, this constraint became apparent. Furthermore, the fact that Zoom broadcasts require high-speed internet presents a challenge for students who might not have access to such connectivity. Real-time education introduces an additional level of complexity, as some students may behave or speak in ways that contradict social etiquette conventions. This puts further strain on teachers, who are already juggling other responsibilities outside of the classroom. Innovative approaches, such as asynchronous learning models, where students view recorded lectures at their convenience, are being used to mitigate these difficulties. This method provides students in different time zones or with varied timetables with flexibility, while also reducing the strain on real-time internet connectivity (Basar et al., 2021). The changing online tool landscape and the requirement for inclusive and respectful online conduct become critical components to address for an efficient and fair learning environment as educators navigate the challenges of virtual education. To help educators manage conduct in online classrooms, preserve social etiquette, and lessen the additional load on teachers, new software advancements in AI-driven

moderation tools are also being launched. These technologies offer a more regulated and polite virtual learning environment by automatically identifying and responding to unwanted conduct.

3.2 CHALLENGES TACKLED BY INSTRUCTORS IN THE REALM OF ONLINE TEACHING

Educational systems need to acknowledge that students from low-income families and those residing in rural areas often face challenges in accessing reliable online and multimedia resources, such as virtual meetings and other digital tools. This highlights the importance of teachers considering the diverse technological aptitudes and internet access levels of their students when they enrol in an online course. To address these issues and close the digital divide, creative projects such as mobile learning systems are being implemented. By utilising widely available smartphones, mobile learning eliminates the need for expensive computer equipment and traditional internet connectivity, offering interactive learning experiences and instructional content (Edelhauser & Lupu-Dima, 2021). Because they lack access to reliable technology or the internet, some students struggle to participate in online learning, highlighting socioeconomic differences both within and across countries. According to the International Student Assessment Program (ISAP), only 34% of Indonesian students have access to a computer for educational purposes, compared to 95% in nations like Austria, Switzerland, and Norway. This highlights the nation's significant digital divide. On the other hand, new developments in satellite internet technology hold the potential to transform rural internet access altogether, providing high-speed connectivity to marginalised groups and levelling the playing field for students everywhere (Goudeau et al., 2021). Addressing these gaps is crucial for creating inclusive and equitable learning environments internationally, as education continues to shift online.

In the United States, a clear difference exists between wealthy and less wealthy households: only 25% of children from less affluent homes report having access to a computer at age 15, whereas almost all 15-year-olds from wealthier families report having one. Although several educational institutions, such as those in New South Wales, Australia, have provided pupils in need with technical equipment, worries about the ongoing epidemic potentially widening the technology divide still exist. Creative strategies are being explored to alleviate this problem, such as community-driven technology sharing initiatives, in

which wealthy households donate gently used equipment to underprivileged pupils, guaranteeing fair access to educational materials (Nufus et al., 2023). In the past, comprehension was improved for students in physical classrooms by keeping eye contact with teachers, reading their body language, and analysing their attitude. Furthermore, students' learning experiences have been greatly aided by the confidence they gained from knowing that teachers were always ready to explain any confusing topics. Fostering a fair and equitable education system becomes increasingly dependent on bridging technology gaps and maintaining the fundamental elements of conventional learning as educational dynamics continue to evolve.

However, educators were forced to choose between synchronous learning and real-time remote learning due to several technological obstacles, including issues with internet speeds, connectivity, and other problems. As an alternative, students can participate in asynchronous lectures, where they view a previously recorded lecture sent to them via email. The disadvantage is that the session may not meet the intended standards of excellence if it is the instructor's first attempt at conducting one. Among the many additional challenges that instructors face, one of the most notable is the quality of the streaming audio in online session recordings. The pursuit of efficient synchronous and asynchronous learning techniques becomes increasingly crucial as the educational landscape evolves into new modalities, necessitating ongoing improvement and technological breakthroughs to ensure the best possible virtual learning environment.

Thus, the primary obstacles related to e-learning are financial limitations, flexibility, accessibility, learning approaches, the significance of lifelong learning, and curriculum design (Godber & Atkins, 2021). Innovative approaches to address these issues are being developed, such as personalised adaptive learning algorithms and gamified learning platforms, to accommodate a range of learning preferences and styles and promote more successful and engaging online learning (Bhamani et al., 2020). For students taking online courses, personality development and participation in outdoor extracurricular activities are becoming increasingly important, underscoring the need for a comprehensive education that extends beyond traditional academic disciplines. In response to concerns about parental guidance, joint efforts between academic institutions and community organisations are being undertaken to provide resources and support for parents and students, ensuring a supportive learning environment even in homes where one or both parents work.

To overcome these obstacles, physical workstations must be designed that take into account the various aspects affecting successful online education and accommodate a range of learning styles. Emerging innovations in e-learning, such as peer-to-peer learning networks and virtual mentoring programs, are transforming the landscape of online education, fostering social engagement and collaboration among students in virtual settings (King et al., 2022). To build a strong and welcoming online learning environment that fosters intellectual, emotional, and social growth in the digital age, a comprehensive strategy that incorporates both technological and socioemotional factors is essential.

4. IMPLICATIONS ARISING FROM ONLINE LEARNING AND EVALUATION

As online learners experience reduced contact time and encounter fewer interactions with instructors to address challenges in knowledge acquisition, it is anticipated that the quality of students' academic performance will diminish in both 12-month assessments and class examinations. The traditional method of conducting proctored assessments was deemed impractical during the COVID-19 outbreak due to the risk of infection transmission. This led to the adoption of online examinations, introducing a significant amount of trial and error, ambiguity and heightened frustration stemming from misunderstandings among instructors, students, and guardians (Murphy & Wyness, 2020). As the educational landscape grapples with these shifts, the repercussions on assessment methodologies and student performance underscore the need for innovative and effective strategies in the realm of online learning. Various strategies are employed to conduct online tests, taking into consideration the comfort level, expertise threshold and synchronisation of both teachers and students. Due to the extensive student population, standardised methods for detecting violations have yet to be universally implemented across many institutions and schools. Interestingly, amidst the disruptions caused by the lockdown and the shift to online learning, some students have experienced unexpected benefits. For instance, in Norway, a decision was made for every Grade 10 learner to receive a high school diploma (Maurin & McNally, 2008). Similarly, a French study highlighted that the 1968 youth demonstrations' choice to deviate from traditional examination procedures had a significant and lasting impact on the affected cohorts in terms of their labour supply (Ali & Dmour, 2021). These nuanced approaches and unanticipated outcomes underscore

the complexity and varied repercussions of online testing methodologies. If you have more than one paragraph, please insert a line space between the paragraphs. Do not insert any spaces before and after the paragraph. Please insert a line spacing after each paragraph, before the next section.

Online exam platforms present both advantages and drawbacks. The benefits include increased efficiency, reduced time, cost savings and a decrease in paperwork. However, a notable drawback is the heightened susceptibility to cheating, which requires a careful approach in designing evaluations to address this issue. It is essential to create assessments that cannot be easily solved by referencing textbooks or online sources. While essay questions can be incorporated, they present challenges in terms of grading, as they require meticulous evaluation by examiners. The challenge becomes more pronounced when dealing with practical curriculum components that necessitate face-to-face interactions, such as laboratories, demonstrations, and workshops. These hands-on experiences are crucial for learners and their absence poses a significant obstacle to qualification. As educational assessments continue to evolve, finding the right balance between the advantages and challenges of online exam platforms becomes imperative for ensuring fair and effective evaluation processes. Online evaluation methods have evolved to cater to the digital landscape. Educationalists are leveraging a variety of valuation tools, including online quizzes, interactive projects and virtual exams. This transfer has prompted a reassessment of traditional grading procedures, with a growing emphasis on assessing not just memorisation but also critical thinking, problem-solving, and digital literacy. Teachers are adapting to the need for clear and timely communication, providing detailed feedback to students through digital channels (Sapriati et al., 2023).

Learners may sometimes resort to using equipment for in-house experiments or accessing virtual laboratories, but this necessitates careful planning and preparation, making it challenging to accomplish within tight deadlines. Withholding specific coursework from students is feasible, especially if it is not essential for their major and does not adversely impact their ability to pass. However, in cases where practical experience is integral to their specialisation, a mechanism should be in place for learners to complete such work once the crisis has abated and conditions are conducive. This flexible method of approaching practical learning emphasises the need to provide students with opportunities to gain essential real-world expertise in their chosen disciplines,

while acknowledging the limitations imposed by unanticipated events. The challenges of maintaining a sense of community in online learning environments are faced by both educators and learners. Videoconferencing technologies and platforms for collaboration have become indispensable for promoting contact and engagement. While access to and customised educational opportunities are two advantages of online learning, there are drawbacks as well, such as the requirement for fair access to technological advances and the potential for an increase in academic fraud. Currently, ongoing collaboration between educators and learners is essential to address these implications and refine the online learning and evaluation landscape for a more effective and inclusive educational experience (Braßler & Schultze, 2021).

4.1 IMPLICATIONS ON OPPORTUNITIES AND THE EFFICIENCY OF ONLINE LEARNING

Given the concerns raised by some individuals who anticipate unfavourable user experiences and a hindrance to sustainable development due to the abrupt transition to web-based learning without sufficient preparation, training, and readiness, there is an opposing belief that a novel hybrid instructional approach could emerge, offering substantial advantages. Wang Tao, Vice President of Tencent Cloud and Tencent Education, envisions a continued acceleration of information technology integration in educational settings. He predicts that distance learning will evolve into an integral component of learning environments, emphasising the ongoing transformation and potential long-term benefits in education (Braßler & Schultze, 2021). As the educational landscape adapts, these differing perspectives underscore the ongoing debate surrounding the future of online learning and its potential to revolutionise traditional educational paradigms.

Several universities have successfully undergone transformative measures. For example, Zhejiang University swiftly implemented DingTalk ZJU, enabling a seamless transition to providing over 5,000 classes online within just two weeks. Notably, Imperial College London introduced a highly popular program on Coursera in 2020 focused on coronavirus research (Blinkoff et al., 2023). This program has garnered widespread acclaim for its benefits. Dr. Amjad, a faculty member at the University of Jordan utilising Lark for instruction, attests, “It has revolutionised my teaching approach. Particularly during this pandemic, it allows me to engage with my students efficiently through

group chats, video conferences, polling, and content sharing" (Bailey et al., 2020). These success stories highlight the adaptability and effectiveness of innovative tools and approaches in the face of challenges, offering a glimpse into the evolving landscape of higher education, as illustrated in Figure 5. More notably than ever, the bond between teachers and parents has been strengthened, especially as parents play a more active role in supporting their children's academic and economic development during homeschooling. The global shift to digital platforms for learning and teaching, including Zoom, Google Classroom, virtual learning environments and various social and group platforms such as WhatsApp, Telegram Messenger and WeChat, represents a unique era in education (Bustamante et al., 2022). This shared experience among instructors, parents and learners creates unprecedented opportunities for collaboration, the development of innovative solutions and a shared enthusiasm for learning from one another and exploring novel approaches. In the evolving landscape of education, the integration of digital platforms not only facilitates learning but also fosters a collaborative and dynamic educational ecosystem.

A survey in the United States indicates that learners often retain 25–60% more knowledge when engaged in online learning compared to 8–10% in a traditional classroom setting. The flexibility of studying at one's own pace, whether through re-reading, skimming, or swiftly navigating subjects, contributes to increased retention (Hollister et al., 2022). Furthermore, e-learning requires 40–60% less time to comprehend than conventional classroom instruction, primarily because learners can access materials online (Chi, 2009). Dowson Tong, President of Smart Industries Group, emphasises the need for a coordinated effort to establish a framework that transcends merely replicating a physical classroom through video capabilities. He emphasises the importance of utilising a variety of tools, features, and awareness approaches that promote integration, personalisation, and competence (Claessens et al., 2013). These insights underscore the effectiveness and efficiency of online learning methodologies, highlighting the need for a strategic approach to enhance the overall learning experience. Recognising that children primarily rely on basic senses for learning, Mrinal Mohit from BYJU emphasises the importance of utilising technology to make education engaging and effective. Drawing from experience, Mohit notes that incorporating gamification has proven to enhance participation and foster a heightened enthusiasm for learning, particularly among young learners. This approach surpasses traditional methods, fostering a genuine fascination with the learning process (Crouch et al., 2018). The

incorporation of captivating components into education has the power to revolutionise the learning process as technology advances, drawing students' attention and commitment in fresh and creative ways.

Following the epidemic, the effectiveness of online learning in this modern era is highlighted by its capacity to provide individualised and adaptable learning experiences. From the convenience of their residences, learners can access a wide range of programs and materials, customising their education to fit their schedules and preferences. The online learning environment has been enhanced by collaborative tools, immersive technology, and AI-centred learning systems, which offer dynamic and captivating educational possibilities. The adaptability of online learning has also been instrumental in addressing various learning styles and accommodating diverse student needs. While challenges such as the digital divide and the importance of social interaction persist, the overwhelming trend in 2023 is the recognition of online learning as a resilient, scalable and effective educational model. The experiences of adapting to online education during the pandemic have spurred continued innovation, fostering a dynamic educational environment that prioritises accessibility, personalised learning and the seamless integration of technology into the fabric of modern education (Deslauriers et al., 2019).

5. CONCLUSION

The COVID-19 pandemic's aftermath has sparked a radical change in the field of education. Following extensive disruptions, the effectiveness of the conventional educational paradigm in fostering 21st-century skills has come under scrutiny. While the pandemic thrust online learning into the spotlight, revealing both advantages and challenges, numerous countries embraced this paradigm shift, expanding the use of online education. This study examines the collaborative efforts of instructors and students in exploring effective strategies amid ongoing pandemic challenges. The analysis reveals that the willingness of learners to engage in additional e-learning depends on effective teaching methodologies, time management proficiency, and the adaptability of online platforms like BYJU's, DingTalk ZJU, and others. Factors influencing less frequent e-learning include communication challenges, unreliable internet connectivity and unfavourable living conditions. Learners who view online training as a time-saving alternative and maintain focus stand to

benefit the most. Critical conclusions suggest the need to enhance teaching methods, prioritise effective communication, and create designated spaces for online learners on campuses. Educating parents about their children's virtual classroom needs is crucial, ensuring a conducive domestic learning environment. As institutions grapple with the collective lessons learned, an opportunity arises to deliver online instruction more effectively, particularly in emergencies. Advanced technologies, such as artificial intelligence-driven platforms and virtual reality tools, can further enhance the quality of online education. The vision for 2024 reflects a paradigm shift, with the widespread adoption of digital methodologies and the integration of hybrid models to enhance flexibility. While the benefits of online learning are evident, challenges persist, including issues of digital equity and the challenge of replicating social interactions online. In conclusion, post-COVID-19 online learning has become integral, shaping the future of education through the ongoing refinement of digital tools and a nuanced understanding of its benefits and challenges. The evolving landscape positions online learning as a dynamic force in education, redefining how knowledge is acquired and shared.

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8. AUTHORS' CONTRIBUTION

Mr. Abdul Basit designed the study framework, coordinated the research activities, and led the writing of the manuscript. Prof.Dr. Jasni Mohamad Zain provided strategic guidance, reviewed the methodology, and contributed to

refining the manuscript. Miss Hafiza Zoya Mojahid conducted data collection, analysis, and visualisation. Dr. Abdul Kadir Jumaat contributed to the validation of findings and ensured the alignment of the research with the study objectives. Dr. Nur'Izzati Hamdan reviewed and enhanced the statistical approaches, contributing to the interpretation of the results. All authors provided critical feedback, shaped the research direction, and approved the final manuscript version.

9. CONFLICT OF INTEREST DECLARATION

We certify that the article is the Authors' and Co-Authors' original work. The article has not received prior publication and is not under consideration for publication elsewhere. This research/manuscript has not been submitted for publication, nor has it been published in whole or in part elsewhere. We testify to the fact that all Authors have contributed significantly to the work, validity and legitimacy of the data and its interpretation for submission to IJELHE.

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