

ORIGINAL RESEARCH ARTICLE

Effects of COVID-19-related pedagogical shifts on the future of online education

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ABSTRACT

A thorough analysis of the effects of the COVID-19 pandemic on online education was necessary since the pandemic caused an unprecedented shift in the educational landscape. Adhering to the PRISMA technique, this systematic review examines 38 relevant publications to reveal the substantial changes that have taken place in the field of online education. Learning outcomes, pedagogical shifts, repercussions, obstacles, and future plans are all part of the scope. The study states that because to the pandemic, online education saw significant changes, which allowed for pedagogical breakthroughs and rapid integration of technology. Online education has seen new opportunities arise as a result of these changes, with a focus on adaptability and creativity. Online education's future and the educational experiences of subsequent generations will be greatly influenced by the insights gained by the institutions, students, and teachers that arose from the pandemic. An adaptable and dynamic educational system that welcomes new ideas, tools, and methods as ways to triumph over adversity will be the enduring effect. This extensive examination of the expansion of online education during the pandemic shows how the sector has endured as an adaptive and ever-changing educational enterprise that adapts to new circumstances. The knowledge acquired throughout this time continues to shape and improve education, making the future brighter for teachers and students in the face of changing standards and increasing technology.

Keywords: online learning; COVID-19 pandemic; pedagogical shifts; long-term implications

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1. Introduction

The epidemic of COVID-19, an unprecedented global calamity, impacted practically every aspect of human life, including schooling^[1]. In response to the disruptive impact of the epidemic, educational institutions around the world moved rapidly and frequently with little preparation to a digital and online method of instruction^[2]. Consequently, the field of education witnessed a major upheaval, resulting in the acceleration of the evolution of online learning, which had previously progressed at a slower rate^[3]. The sudden transition to online education, sometimes driven by need, was faced with an array of pedagogical challenges and resolutions^[2,4]. Educators and institutions were compelled to reassess and reconfigure their technological infrastructures, educational materials, and practises^[5]. The process of transitioning online education showcased both its advantages and disadvantages, underscoring the crucial need of adaptability and resilience when confronted with unforeseen

shocks^[4]. In order to do this, a comprehensive examination of this era of educational change should be presented. In the aftermath of the pandemic, there has been an increasing scholarly focus on comprehending the progression of online learning in light of the difficulties it has introduced, as well as evaluating the lasting pedagogical consequences of the subsequent adjustments. The aim of this study is to provide insight into several aspects of this paradigm shift, including the difficulties and successes encountered by instructors and learners, in addition to the swift integration of digital resources and pedagogical approaches^[2,3]. As the global community grapples with the lingering effects of the pandemic and mulls over the future of education, this review seeks to provide valuable insights into the advantages and disadvantages of online learning, based on the collective experiences of educators, students, and institutions^[1]. This review attempts to summarise the knowledge obtained throughout the pandemic era and provide assistance for educators, policymakers, and researchers as they navigate the changing landscape of education^[4] by assessing a vast diversity of scholarly literature and reports. Therefore, to meet the purpose of this study, this review will be guided by the following research questions:

- What are the key pedagogical shifts that occurred in online education during the COVID-19 pandemic, and how were they implemented?
- What technological tools and platforms were adopted to support pedagogical changes in online learning during the pandemic?
- What were the immediate effects of these pedagogical shifts on student engagement, learning outcomes, and overall educational experiences during the pandemic?
- What are the long-term implications of the pedagogical changes in online learning that were initiated during the COVID-19 pandemic?
- What are the challenges and limitations associated with the pedagogical shifts in online learning during the pandemic, and how have they been addressed or mitigated?
- What future agenda, insights, and recommendations to future research can be drawn from the experiences of educators, students, and institutions during the COVID-19 pandemic to inform the future of online education?

In conclusion, we study the pedagogical alterations that happened during the COVID-19 pandemic and to determine their long-term effects on the educational landscape. By doing so, we seek to contribute to a better understanding of the changing role of online learning in a post-pandemic world and its potential to shape the future of education.

Significance and importance of the research

The COVID-19 epidemic has undoubtedly brought about a significant and rapid transition in online learning modalities, hence transforming the educational environment. This study offers significant contributions to the understanding of these changes, outlining the enduring consequences for educational methodologies on an international scale. The online learning development described in this article signifies a significant paradigm change in education, which will persistently impact the future of education and instruction. Initiated as a reaction to a crisis, the incorporation of technology into education is today seen as a fundamental component of contemporary educational approaches. The results of our study have significant practical implications for academics, politicians, and establishments. These documents function as a guide for improving online learning platforms, advancing pedagogical approaches, and cultivating student participation within a digital environment. The research unearths a variety of inventive pedagogical approaches, including adaptive assessment techniques and interactive e-learning tools, which illustrate the capacity to enhance the learning experience and optimise results. Developed as a result of the pandemic's exigency, these tactics have now established fresh standards for inclusive and efficient schooling.

This study not only illuminates the present condition of online education but also provides a foundation

for further investigations and the development of policies. It draws attention to aspects that need more scrutiny, including the enduring effects of virtual learning environments on the academic achievement and welfare of students. Furthermore, our research outcomes provide significant contributions to the understanding of how policymakers and educational leaders may use technology to improve the accessibility and caliber of education. These ideas have significant importance when considering the preparation for forthcoming disruptions in education and the establishment of resilient learning systems. An essential element of our research is its emphasis on the socioeconomic ramifications associated with the transition to online education. The digital gap has been exacerbated by the epidemic, therefore further discrepancies in the availability of high-quality education. In addition to illuminating these obstacles, our study proposes frameworks for their mitigation. Demonstrating education in the period after the pandemic requires democratising access to technology and internet connection, adapting curriculum to accommodate varied learning requirements, and providing instructors with assistance in navigating the digital environment.

In summary, this investigation provides a framework for seeing and shaping the future course of education that transcends the present circumstances of the COVID-19 epidemic. This emphasises the critical nature of creative and adaptable educational methods, the value of legislative frameworks that promote effective and fair learning, and the capacity of technology to bridge gaps in education. Therefore, this study's importance extends beyond its examination of historical and contemporary developments; it also has substantial ramifications for the future of education on a global scale.

2. Methodology

2.1. Research question and objective

This systematic literature review's major purpose is to investigate completely the evolution of online learning during the COVID-19 epidemic, with a focus on pedagogical shifts and their long-term ramifications.

2.2. Search strategy and data sources

Relevant resources were retrieved using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology. To ensure that the search was complete and comprehensive, we utilised both electronic databases and manual searches. Scopus was the most important electronic database since it contains the highest-quality research articles. PUBYEAR > 2018 AND PUBYEAR > 2023 AND (LIMIT-TO (DOCTYPE, "ar)). This analysis examined the years 2019 through 2022, with the exception of 2023, which has not yet finished. The researchers were unable to discover any relevant studies in 2019 for this review. The PRISMA structure is depicted in **Figure 1**. The purpose of the search technique was to discover papers, reports, and studies pertaining to the evolution of online learning during the COVID-19 epidemic. The search terms were constructed using a combination of keywords and Boolean operators, such as "online learning," "COVID-19," "pedagogical shifts," "distance education," and "long-term implications." The search was limited to English-language publications only.

2.3. Screening and selection process

Through the electronic database search, 154 documents were identified initially. To verify the relevancy and timeliness of the included materials, we omitted research published in 2023, which was an ongoing year at the time the search was conducted. This criterion for exclusion reduced the number of documents to 80. The remaining 80 documents were then vetted for relevance by reviewing their titles and abstracts. Articles judged extraneous to the research issue were omitted, leaving 46 papers in the final set. During the full-text evaluation of the 46 documents, their eligibility for inclusion was determined. Documents that did not explicitly address the evolution of online learning and its pedagogical consequences during the COVID-19 epidemic were omitted. The final collection of papers contained 38 sources. Illustration of inclusion and exclusion articles in

Figure 1.

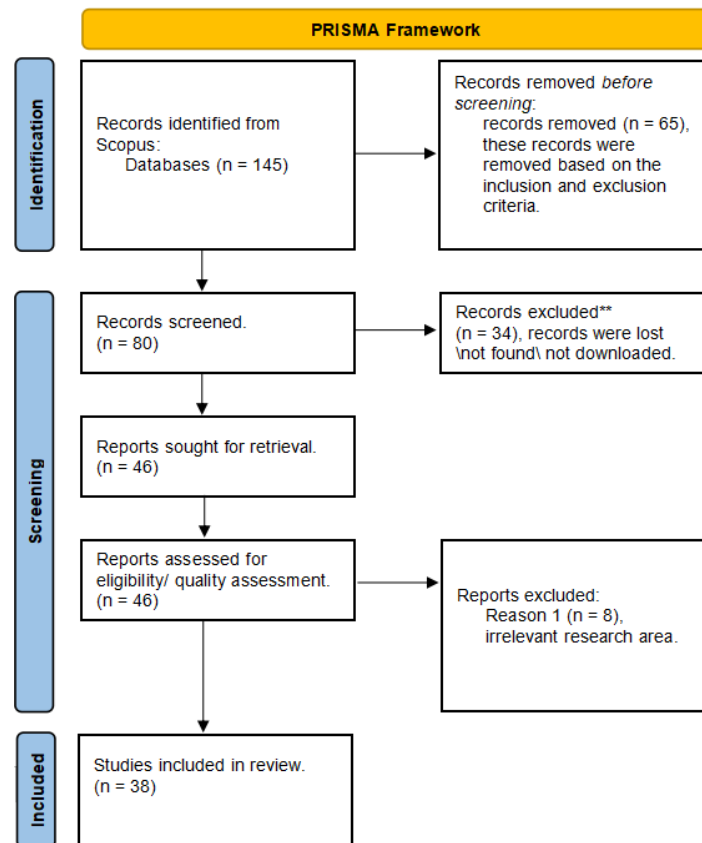


Figure 1. PRISMA framework.

2.4. Data extraction and analysis

Data from the 36 included documents will be extracted and analyzed systematically. Information related to pedagogical shifts, changes in educational strategies, and long-term implications of online learning during the COVID-19 pandemic will be extracted. This data will be organized and synthesized to provide insights into the trends and findings in the field.

2.5. Quality assessment

Manual quality and rigour evaluations of the included documents ensured that only relevant research papers met the criteria for inclusion in this review. The purpose of this evaluation was to ascertain the dependability of the results and detect any possible predispositions in the scholarly work.

2.6. Data synthesis and reporting

In a structured narrative framework, the findings of this systematic review will be synthesised and presented. The present synthesis offered an all-encompassing examination of the progression of online education during the COVID-19 epidemic, as well as the enduring pedagogical consequences that ensued. The results were presented in tables, figures, and text, as deemed suitable.

3. Results

3.1. The key pedagogical shifts that occurred during the pandemic

The online education sector saw a significant paradigm change as a result of the COVID-19 epidemic, which sparked a sequence of crucial pedagogical adjustments. This literature review examines the principal discoveries derived from a wide range of academic publications, elucidating the complex transformations that

transpired during this unparalleled era of upheaval. A succession of significant pedagogical changes marked a fundamental revolution in the domain of online education in response to the COVID-19 epidemic, as supported by the vast corpus of literature. The incorporation of several pedagogical approaches is a recurring motif in these investigations, as shown by Olsen et al.^[6], Maya et al.^[7]. The educational environment underwent a significant transformation with the implementation of blended learning strategies, which include the blending of online and offline learning modalities^[6,7]. As a result of the pandemic's abrupt shift to online/distance teaching practises as shown by DeCoito et al.^[8], and Bampton et al.^[9] instructors were compelled to confront unanticipated obstacles in online learning. In response to the crisis, hybrid models of teaching and learning surfaced with the objective of offering an equitable approach that used both in-person and online learning settings, Andreou et al.^[10]. Furthermore, the concept of Small Private Online Courses (SPOCs) gained prominence, denoting a concentrated effort to personalize and optimize remote education^[11]. The emergence of Emergency Remote Teaching (ERT), as illustrated by Mankki et al.^[12], and Motala et al.^[13] highlights the expedient adaptation of traditional teaching paradigms to the online sphere. These pedagogical shifts were driven by a myriad of factors and influenced the trajectory of online education during the pandemic, underscoring the need for agile and adaptable educational strategies, Yan et al.^[14]. Social media platforms also played a pivotal role in the transformation of online education, enabling enhanced communication and collaborative learning. **Figure 2** illustrates the key pedagogical shifts during COVID-19 pandemic.

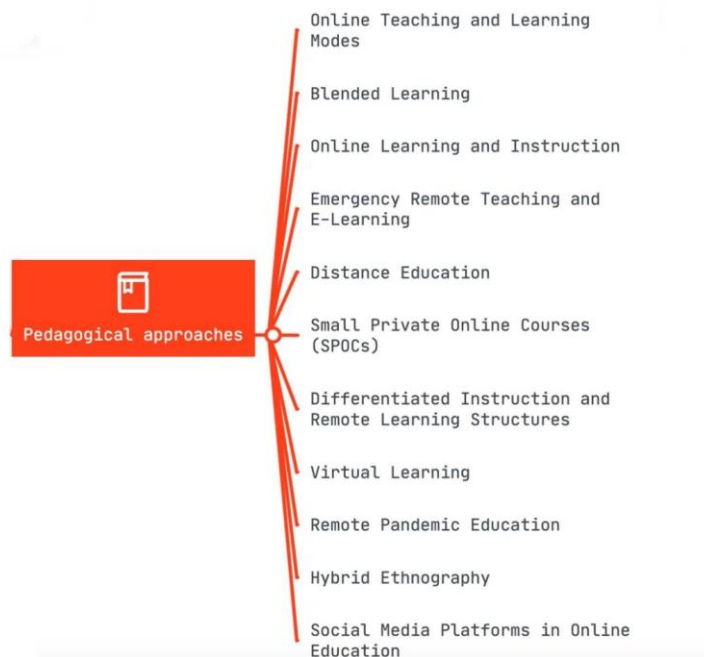


Figure 2. The key pedagogical shifts during COVID-19 pandemic.

This multifaceted exploration into the pedagogical shifts brought forth by the pandemic underscores the dynamic nature of online education and the ongoing quest for effective and sustainable instructional models in the digital age. **Table 1** illustrates thematic clusters of teaching mode in the content and subject matter of the articles.

The aforementioned categories are thematic clusters that are established on the basis of the articles' shared content and topic matter. By categorising and summarising the research on the pedagogical alterations that have occurred in online education as a result of the COVID-19 epidemic, these theme categories may be informative. As shown by the vast array of research, the pedagogical alterations that were identified in online education during the COVID-19 epidemic represent a dynamic reaction to a changing educational environment. These alterations highlight the need for flexibility, ingenuity, and ongoing investigation into

efficacious pedagogical frameworks in the age of digitalization. The thorough examination of these pedagogical changes yields significant knowledge about the continuously developing characteristics of online education, which will surely shape forthcoming methodologies in this domain.

Table 1. Thematic clusters of pedagogical shifts in the content and subject matter of the articles.

Thematic clusters of pedagogical shifts	The content and subject matter of the articles
Online teaching and learning modes	Online and offline learning modes, and online teaching
Blended learning	Blended learning
Online learning and instruction	Online learning
Emergency remote teaching and e-learning	Hybrid models of teaching and learning and (ERT)
Distance education	Online/distance teaching, distance learning
Small Private Online Courses (SPOCS)	SPOCs
Differentiated instruction and remote learning structures	DRI, Remote learning structures
Virtual learning	Virtual learning, a virtual writing center
Remote pandemic education	Remote pandemic education, remote teaching
Hybrid ethnography	Hybrid ethnography
Social media platforms in online education	Social media platforms

3.2. The technological tools and platforms were adopted during the pandemic

The education industry faced a substantial challenge in the form of the COVID-19 pandemic, which necessitated an urgent transition from traditional learning approaches to an online and remote setting. An important component of this paradigm shift was the use of diverse technological tools and platforms to bolster and supplement educational adjustments. This research analyses a wide range of information and concepts obtained from several scholarly sources in order to examine the technical and tool-related setting in which educators operated in order to provide uninterrupted instruction throughout this unprecedented catastrophe.

An enormous revolution in the use of technology tools and platforms to assist pedagogical adjustments in the domain of online education was initiated with the development of the COVID-19 pandemic. The studies provide a thorough examination of the many digital tools and platforms that academic institutions and instructors rapidly used in order to maintain uninterrupted education. The breadth of technical adaptations include well-known Learning Management Systems (LMS), including Brightspace and Canvas^[8] as well as ubiquitous video conferencing tools, like Microsoft Teams and Zoom^[9] The implementation of informal online learning communities^[14], webinars, virtual instructional environments^[7,10], and creative writing pedagogy in the digital classroom^[15] are all instances of the inventive strategies educators have employed to promote interaction and engagement in remote settings. In addition, the integration of various communication platforms such as WhatsApp, email, chat, phone, and video calls, significantly enhanced the efficiency of educator-student correspondence. The incorporation of multimedia elements, including but not limited to YouTube, PowerPoint, online games, annotations, websites, and diverse apps, contributed to the dynamism of the online instructional process. The use of many technical tools, including as Smart TV, Facebook, Twitter, Pinterest, and Instagram, in addition to mobile applications, video lessons, Kahoot, Edmodo, and Web 2.0 tools, underscores the wide range of technology resources utilised to enhance online pedagogy. The pivot towards Virtual Happy Hours (VHH), speaks to the inventive means through which educators strove to maintain social connectivity and engagement. **Figure 3** illustrates the technological tools used during COVID-19.

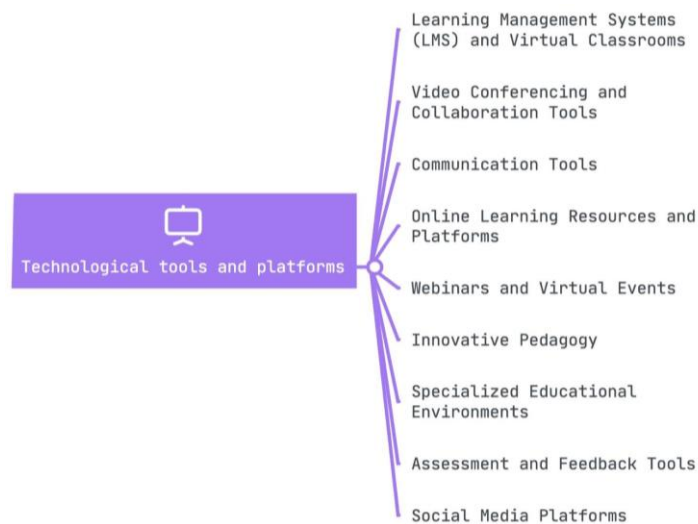


Figure 3. The technological tools used during COVID-19.

Collectively, these technological tools and platforms embody the multifaceted strategies deployed to navigate the challenges posed by the pandemic, underpinning the evolution of online learning during this transformative period. **Table 2** illustrates thematic clusters of technological tools in the content and subject matter of the articles.

Table 2. Thematic clusters of technological tools in the content and subject matter of the articles.

Thematic clusters of technological tools	The content and subject matter of the articles
Learning Management Systems (LMS) and virtual classrooms	Brightspace, Google Classroom Learning management system (LMS) Canvas, Zoom, Slack Canvas LMS and Microsoft OneNote LMS
Video conferencing and collaboration tools	Zoom and Microsoft Teams Microsoft Teams and Zoom ZOOM and Google Classroom Zoom
Communication tools	WhatsApp Email, chat, phone, and video calls Facebook Messenger/Facebook group WhatsApp group
Online learning resources and platforms	Flexible digital learning resources E-learning MOOC Google Classroom and Google Meet, Mobile and mobile apps, Video lessons, Kahoot and Edmodo, Zoom and YouTube, Web 2.0 tools, LCD, and Smart TV
Webinars and virtual events	Educational webinars VHH
Innovative pedagogy	FCM Online informal learning communities Creative writing pedagogy in the digital classroom Zoom, YouTube, PowerPoint, online games, annotations, websites, and Apps
Specialized educational environments	Dual Immersion classrooms
Assessment and feedback tools	Online assessment and LMS Qualtrics online platform
Social media platforms	Facebook, Twitter, Pinterest, and Instagram

These thematic clusters represent common themes and categories of technology tools and platforms adopted for supporting pedagogical changes in online learning during the COVID-19 pandemic. Each cluster highlights the variety of tools and platforms used to adapt to the challenges posed by remote and online education. In conclusion, the rapid adaptation to online learning spurred a remarkable diversification of technological tools and platforms, as unveiled through the extensive body of literature. The flexibility and innovation demonstrated by educators and institutions in harnessing these digital resources have not only sustained pedagogical changes during the pandemic but have also opened new horizons for the future of education. The dynamism of these technological adaptations underlines the resilience of the education sector and the enduring capacity to evolve in the face of adversity. Upon contemplation of the unparalleled difficulties presented by the epidemic, it becomes apparent that the incorporation of these technologies and platforms has not only facilitated knowledge acquisition but has also fundamentally transformed the educational domain.

3.3. The immediate effects of these pedagogical shifts during the pandemic

The pedagogical changes implemented in response to the COVID-19 epidemic have had significant and far-reaching consequences for student engagement, learning achievements, and the general quality of the educational environment. The comprehensive insights derived from an extensive collection of literature provide a nuanced perspective on these consequences. For both students and instructors, the abrupt shift to online and remote learning, which included both synchronous and asynchronous components as shown by Olsen et al.^[6], was a paradigm shift. According to Maya et al.^[7], offline learning had distinct advantages, such as strengthened social relationships and more enriching learning experiences. Furthermore, this transition resulted in enhanced technical competency and higher self-efficacy among educators as shown by DeCoito et al.^[8], which enabled them to confidently adopt online teaching. Although there was widespread recognition of the difficulties and exertion necessary to quickly adjust to this novel instructional approach as illustrated by Bampton et al.^[9], the lasting advantages of using technology became apparent, impacting the self-confidence of educators in the short and long run as claimed by Andreou et al.^[10].

Furthermore, concerning student involvement, resource availability, and academic achievement, the implementation of novel pedagogical methods, like the flipped classroom as claimed by Li et al.^[11], had favourable results. The ideas and expertise acquired during the emergency period of remote teaching highlighted the criticality of using this arduous experience to enhance education as shown in Mankki et al.^[12]. Academic staff also acknowledged significant advantages obtained from Emergency Remote Teaching (ERT), which broadened educational prospects during times of adversity as shown by Motala et al.^[13].

Pedagogical decisions were enriched through the integration of information technology and informal learning, which was regarded as a method to improve learning Yan et al.^[14]. Additionally, community building, open communication, critical reflection, and the alignment of assignments with learning objectives contributed to this enhancement Vigna et al.^[15]. The instructors shown exceptional fortitude and flexibility in surmounting the obstacles presented by the sudden transition to online training as shown by Nepangue and Ibanez^[16] and Kannan et al.^[17].

Nevertheless, the adoption of ERT was not devoid of obstacles, as emphasized in Wang et al.^[18]; online teaching anxiety was produced by student complaints, inactive online participation, and the pressure of testing and grading at the beginning of the semester. It became apparent that small group and individual sessions were crucial for fostering meaningful discourse and gaining an understanding of students' experiences by Tackie^[19]. Overall, the immediate effects of the pedagogical modifications that were adopted as a result of the pandemic were multifaceted and varied, including student involvement, academic performance, and the overall educational experience. The most often cited learning outcomes during the epidemic are shown in **Figure 4**.



Figure 4. The most mentioned learning outcomes during the pandemic.

Consequently, the results underscore the need to provide time and space for educators and students to effectively learn and utilize digital technologies and creating a flexible and inclusive educational landscape that extends beyond the immediate crisis. **Table 3** illustrates thematic clusters of learning outcomes in the content and subject matter of the articles.

Table 3. Thematic clusters of learning outcomes in the content and subject matter of the articles.

Thematic clusters of learning outcomes	The content and subject matter of the articles
Enhanced digital proficiency	Educators and students developed improved technical proficiency and digital literacy, enabling them to navigate online learning environments with confidence
Improved self-efficacy	Teachers experienced an increase in self-efficacy in online teaching, leading to a more positive perspective on technology integration, both immediately and in the long term
Positive impact on student engagement	Innovative pedagogical models, such as the flipped classroom, positively impacted student engagement, access to resources, and academic performance
Adaptability and resilience	Educators demonstrated remarkable adaptability and resilience in overcoming the challenges posed by the rapid transition to online instruction
Social connection and independence	Offline learning and online sessions provided students with opportunities for social connections and increased independence, helping them adjust to the rapidly changing educational landscape
Innovation and adaptation	Instructors and educational institutions embraced innovation and adaptation, finding solutions to the challenges posed by the sudden shift to online learning
Long-term implications	The knowledge and insights gained during emergency remote teaching have enduring benefits and suggest long-term implications for the improvement of education

These thematic clusters reflect the most common learning outcomes observed as a result of the pedagogical shifts during the COVID-19 pandemic, highlighting the positive impact on both educators and students.

3.4. The long-term implications during the pandemic

The pedagogical changes instigated during the COVID-19 pandemic have left a lasting imprint on the landscape of online learning, with far-reaching implications for education in the long term. The insights drawn from the wealth of articles reveal multifaceted outcomes that warrant consideration as shown by Alzahrani et al.^[20]. The sudden shift to online learning exposed challenges related to the absence of face-to-face connections on campus, creating barriers to requesting help as claimed by Olsen et al.^[6]. Students faced difficulties acclimating to the transition from offline to online learning, underscoring the need for incremental development of online pedagogical designs Maya et al.^[7] and Kannan et al.^[17]. Integration of technology into the instructional environment, while vital, was found to be a complex endeavor, necessitating a careful balance between online information and competence requirements DeCoito et al.^[8] and Bampton et al.^[9]. Long-term considerations highlight the importance of cultivating the hard-earned knowledge gained during emergency

remote teaching as mentioned in Motala et al.^[13]. The evolving nature of education, encompassing distance learning, varied delivery methods, and blended learning Vigna et al.^[15], presents opportunities for reevaluating pedagogical strategies and technology integration. Junior faculty may find mentorship and professional development instrumental in alleviating teaching anxiety as highlighted by Wang et al.^[18]. **Figure 5** illustrates the learning implications of online learning during the pandemic.



Figure 5. Learning implications of online learning during the pandemic.

In sum, the pedagogical changes during the pandemic have spurred a rapid digital competency growth, prompting a reevaluation of technology integration, online pedagogy, and lifelong learning models. As the education landscape evolves, it is imperative to harness the enduring benefits of these changes and address the associated challenges, fostering innovation and adaptability for the future of online learning. The insights gained from this transformative period pave the way for informed decisions and strategic planning in education, ensuring a dynamic and resilient approach to pedagogy in the long term. Thematic analysis of the implications in online learning during the pandemic, based on the provided results, reveals a range of interconnected themes that address both the challenges and opportunities associated with the pedagogical changes is presented in **Table 4**.

Overall, the thematic analysis reveals a complex interplay of challenges, adaptation, and opportunities associated with the pedagogical changes in online learning during the pandemic. These themes provide valuable insights for shaping the future of education and understanding the enduring implications of the transformative period.

Table 4. Thematic clusters of learning implications in the content and subject matter of the articles.

Thematic clusters of learning implications	The content and subject matter of the articles
Technological integration and skills development	The difficulties associated with the incorporation of technology into educational settings are highlighted, which also emphasise the need for instructors to improve their technological proficiency. The ramifications are substantial regarding conventional and online educational environments.
Student transition and acclimatization	Numerous scholarly shed lights on the difficulties that students have when they make the shift from traditional to digital learning. The need for students to gradually adapt to novel educational approaches and technologies is apparent, underscoring the value of gradual advancements in online pedagogical frameworks.

Table 4. (Continued).

Thematic clusters of learning implications	The content and subject matter of the articles
Pedagogical adaptation and development	Scholarly articles emphasise the criticality of modifying and advancing pedagogy to address the changing requirements of pupils. Coordination, careful preparation, and instructional coherence are all essential components of effective online education.
Faculty training and mentorship	The value of mentoring and professional development for junior teachers and educators is discussed in several works, including. Particularly in the context of online learning, these programmes attempt to decrease teaching anxiety and improve teaching effectiveness.
Technology-enhanced learning and inclusivity	The use of mixed synchronous and asynchronous learning, the implementation of secure and well-known platforms, and the investigation of emerging technologies, as elaborated which provide prospective prospects for augmenting education and learning. This issue pertains to the notion of enhancing the design of online materials to maintain students' interest.
Rapid digital competency growth	The pandemic instigated an exponential increase in kids' and instructors' digital proficiency. The consequences of this advancement are extensive and transcend the present emergency, influencing future methodologies in the field of instruction.
Long-term impact and sustainability	Scholarly underscore the criticality of investigating alternative modalities and assessing the viability of mixed techniques within the realm of education. Vigilant deliberation is necessary on the enduring consequences of the alterations brought about by the epidemic.
Support systems and monitoring	Several scholarly expound upon the significance of monitoring and support systems for educators and students alike. These technologies are essential for effectively addressing the obstacles presented by distance learning.
Professional exchange and collaboration	The potential for professional cooperation and exchange to solve difficulties and uncover novel solutions is shown via the interchange of teaching experiences and ideas among nursing academic staff.
Social media and lifelong learning	Some scholars emphasise the restricted use of social media, they do underscore its capacity for facilitating sharing and attracting followers. Furthermore, it is underscored that academics and subject coordinators must serve as models of lifelong learning.

3.5. The challenges and limitations during the pandemic

The challenges and limitations associated with the pedagogical shifts in online learning during the pandemic have been a subject of great concern and adaptation. As highlighted in the literature, several key challenges have emerged. Adaptability, interaction, self-regulation, and emotional learning posed significant challenges in the context of blended learning Oslen et al.^[6]. Fear of illness, social distancing, and mask-wearing difficulties added unexpected obstacles to the educational landscape Maya et al.^[7]. Teachers encountered various problems, affecting their attitudes toward online teaching, and highlighting the gap between expectations and support DeCoito et al.^[8]. The transition to online learning was time-consuming and required significant upskilling, primarily relying on technology Bampton et al.^[9]. Virtual instructors faced difficulties in maintaining instructional effectiveness when compared to hybrid or in-person teachers Andreou et al.^[10]. The integration of Small Private Online Courses (SPOCs) required educators to align pedagogical tools and online content effectively, ensuring students' comprehension of complex subjects Li et al.^[11]. The cost of increasing ICT technology and providing devices and data packages to students and staff was found to be unsustainable Motala et al.^[13]. Student participation was hindered by a lack of digital skills, affecting their engagement in online activities Yan et al.^[14]. However, these challenges prompted various adaptations and strategies. The literature highlights that the pandemic accelerated the acceptance of online learning as a permanent feature of education, reflecting advancements in technology, a demand for flexibility, and institutions grappling with uncertainty Vigna et al.^[15]. Teachers developed empathy for students facing economic and geographic challenges, leading to the creation of genuine assessments and accessible resources Nepangue et al.^[16]. There was a newfound intimacy between teachers and certain students, particularly regarding mental health support, but its impact on learning outcomes remained unclear Tackie et al.^[19]. **Figure 6** illustrates the challenges and limitations during the pandemic.

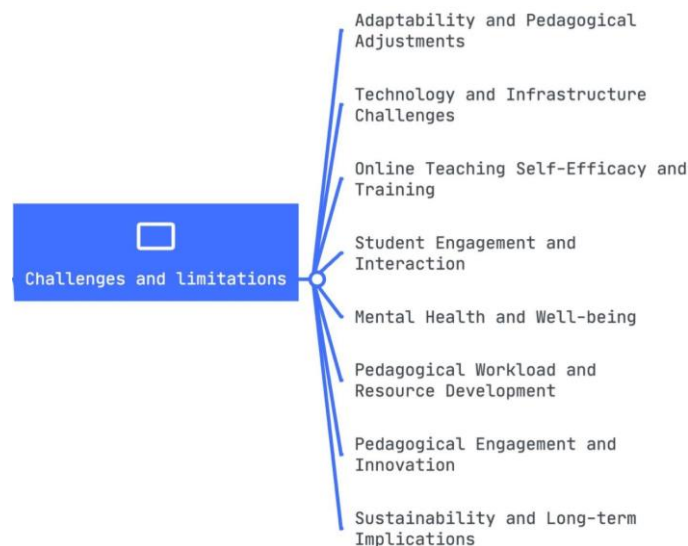


Figure 6. The challenges and limitations during the pandemic.

Table 5. Thematic clusters of the challenges and limitations in the content and subject matter of the articles.

Thematic clusters of challenges and limitations	The content and subject matter of the articles
Adaptability and pedagogical adjustments	Challenges of blended learning. Difficulty in integrating SPOCs with existing teaching methods. Uncertainty and doubt about learning results during the initial implementation of online teaching. Educators adjusting to changing physical and social settings. Alteration of teaching techniques and strategies for digital education.
Technology and infrastructure challenges	Challenges arising from poor internet connectivity, frequent power outages, and information and communication technology (ICT) incompetence. Uneven distribution of materials, technical resources, and social resources across different educational levels and situations. Technology limitations affecting student involvement.
Online teaching self-efficacy and training	Need to boost higher education lecturers' online teaching self-efficacy. The requirement for teachers to adapt to virtual teaching without adequate training and support. Teacher educators providing realistic learning opportunities for pre-service teachers without in-school experiences.
Student engagement and interaction	Challenges related to student involvement in online activities and interaction with instructors. The difficulty of students in accessing material and collaborating in online learning environments. Challenges in maintaining social connection, especially for medical students and health professionals.
Mental health and well-being	The psychological and emotional drain experienced by students and educators due to the abrupt switch to digital education. The importance of mental health and the newfound intimacy between teachers and certain students.
Pedagogical workload and resource development	Increased workloads for teachers as they created and curated digital materials and connected with students outside of class. The ongoing effort required for resource development and content curation.
Pedagogical engagement and innovation	Encouragement for educators to innovate and develop empathy for students facing economic and geographic challenges. Alteration of teaching techniques to establish inclusive digital education. Promotion of active learning strategies such as cooperative learning and peer teaching.
Sustainability and long-term implications	The unsustainability of increasing information and communication technology (ICT) and providing devices and data packages. The potential long-term implications of online learning as a permanent educational tool. The institutional adoption of online learning in pedagogy beyond the pandemic.

In conclusion, the challenges and limitations brought about by the pedagogical shifts during the pandemic have been significant. However, educators, institutions, and students have been actively addressing and mitigating these issues through a range of strategies and adaptations. The pandemic accelerated the integration of online learning as a long-term educational tool, reflecting a shift in the education landscape that has prompted innovative solutions and approaches. The thematic analysis of the challenges and limitations of online learning during COVID-19, based on the provided articles, reveals several clusters of common themes. These thematic clusters encompass the various obstacles encountered in the transition to online learning are

illustrated in **Table 5**.

In summary, the complexities and constraints of online education within the COVID-19 pandemic need a comprehensive strategy for alleviation. The difficulties at hand are multifaceted, including technological and infrastructural concerns, educational adaptations, as well as the welfare of both students and instructors. Achieving these obstacles necessitates an integration of instructional innovation, support, and training in order to guarantee the efficacy of online learning.

3.6. Future agenda, insights, and recommendations to future research during the pandemic to inform the future of online education

As a result of the COVID-19 epidemic, institutions, students, and educators have gained invaluable knowledge and suggestions that will continue to influence the future of online education. It is imperative that we incorporate these results into our future endeavours in order to improve the quality and efficacy of online education. Several significant domains arise from the research:

To begin with, it is apparent that pupils held the perception that online education was substandard in comparison to conventional face-to-face teaching, notwithstanding the accessibility of adaptable digital learning resources, Oslen et al.^[6]. To rectify this view, further investigations need to centre on comprehending the perspectives and encounters of educators, as well as the way they influence the learning styles of pupils, Maya et al.^[7]. Instructors must have access to effective professional development and assistance to change their attitudes and adjust to online teaching, DeCoito et al.^[8]. By using the insights gained from both traditional face-to-face instruction and remote learning throughout the epidemic, educational results may be further optimized, Bampton et al.^[9]. Hence, it is imperative that next research investigate the enduring ramifications of the COVID-19 epidemic on the self-efficacy of educators, Andreou et al.^[10]. It is essential to delve further into the implementation of novel pedagogical continuity tactics in online learning, Motala et al.^[13] and include the advantages of informal learning on student learning outcomes and agency, Yan et al.^[14] into forthcoming pedagogical approaches. Further research is required to determine how to construct an effective pedagogy for creative writing in the digital classroom, considering the post-pandemic era, Vigna et al.^[15].

Faculty preparation and training are crucial for enhancing the quality of online instruction; faculty should be provided with problem-solving toolkits and practical exercises to aid in their instruction, Wang et al.^[18]. It is advisable to investigate integrated technology solutions that improve reflective practises, such as the TEEL platform, as educational institutions broaden their provision of online education, Kannan et al.^[17]. Additionally, it is crucial to consider the educators' inclination to embrace crisis adaptations and modify established protocols in the aftermath of the epidemic as shown by Alzahrani et al.^[20], and Virumbrales et al.^[21], and Wackenhut et al.^[22]. Institutions should prioritise the appropriate selection and use of Learning Management Systems (LMS) to provide affordances for blended learning, Attard et al.^[23]. As a result of the transition to online education, future research should seek to comprehend the concerns, needs, and experiences of university teachers, Tulaskar et al.^[24]. These investigations need to differentiate between generic characteristics of online education and phenomena associated with the epidemic, Blonder et al.^[25]. Diverse technical, pedagogical, and administrative strategies have been proposed to promote the development of online assessment; they should be included progressively into educational practices, Ghanbari and Nowroozi^[26]. The expansion of distant education alternatives, particularly in domains such as craft and associated sciences, presents auspicious prospects for study as shown by Kouhia et al.^[27] and Kang et al.^[28]. To foster student motivation and proficient online learning, it is essential to investigate novel approaches, Eady et al.^[29]. This entails the development of online ecological initiatives that prioritise community benefit and long-term sustainability as claimed by Gibson^[30]. It is the duty of institutions of higher education to promote e-pedagogy and effectively handle educational crises, Shrestha et al.^[31]. The findings suggest that while these adjustments presented challenges, they also presented opportunities for improvements and developments in teaching methodologies, thus

presenting a chance to achieve pedagogical goals as shown in Cranfield et al.^[32], and Gomes et al.^[33]. These changes have effects that go beyond the time of the epidemic. They have led to a reevaluation of teaching methods and a recognition of how important it is to use technology in classrooms and teach digital literacy, Solsona-Puig et al.^[34]. The dynamic interaction among various teaching techniques, social learning, and autonomy underscored the progressive character of education, Binks et al.^[35]. Adaptations like virtual community development and collaborative learning have been explored to engage students more effectively as shown by Elliot and Makara^[36]. The proliferation of digital environments prompted both students and educators to embrace online learning, which fostered self-reliance and simplified adaptations to rapid transformations, Idris et al.^[37]. While the challenges of online learning were evident, innovative approaches, such as blended synchronous and asynchronous learning, safe and familiar platforms, and the adoption of new technologies, may enhance learning and education in the future as shown in Alimyar and Lakshmi^[38], and Aguilar et al.^[39]. Furthermore, the shift to online assessment, though initially challenging, prompted instructors to adapt and refine pedagogical approaches, Lie et al.^[40]. The experiences of academics and topic coordinators in modeling lifelong learning offer valuable insights into the evolving educational landscape as claimed by Green et al.^[41], and Harwood and Koyama^[42], and Ng et al.^[43].

The findings and suggestions for further study in the field of online learning are shown in **Figure 7**.



Figure 7. The insights and recommendations for future research in online learning.

In conclusion, the future of online education is shaped by the insights and recommendations derived from the experiences of educators, students, and institutions during the COVID-19 pandemic. By addressing the challenges identified and incorporating innovative practices and technological solutions, the field of online education can continue to evolve and provide high-quality learning experiences for students.

The insights and recommendations for future research on the future of online education, drawn from the experiences of educators, students, and institutions during the COVID-19 pandemic, can be clustered into several thematic categories are illustrated in **Table 6**.

Table 6. Thematic clusters of insights and recommendations for future research in the content and subject matter of the articles.

Thematic clusters of challenges and limitations	The content and subject matter of the articles
Student perceptions and learning outcomes	Students perceived online education as inferior to physical instruction, despite flexible digital learning materials. Future studies should examine how student perceptions impact their learning outcomes. The benefits of informal learning and its impact on student learning outcomes and agency should be explored.
Instructor opinions and experiences	Research should focus on understanding instructors' opinions and experiences and how they influence students' learning styles. Effective professional development and support for instructors are crucial to help them adjust to online teaching and improve their opinions.
Pedagogical strategies	Innovative pedagogical continuity strategies in online learning should be investigated for their effectiveness during and beyond the epidemic. The study emphasizes the need to explore innovative methods for motivating students to achieve their best in online learning.
Curriculum and instructional changes	Research should assess whether knowledge gained during the pandemic translates into successful instructional methods in the future. Pedagogical and technology training for instructors, like physical education instructors, should be explored to update their skills for teaching in the modern-day digital classroom. Understanding the willingness of educators to adopt post-pandemic adaptations is essential.
Technology and Learning Management Systems (LMS)	The proper selection and use of LMS to realize affordances for blended learning should be investigated. The study highlights the need for further research to improve online assessment methods and gradually integrate technology into schooling.
Resource inequities and teacher professional orientations	Future investigations should examine teacher experiences to reveal the implications of school resource inequities on teacher professional orientations.
Online education in higher education	Future studies should differentiate between general features of online education and those related to the pandemic. The study emphasizes the importance of understanding university professors' needs, issues, and experiences.
Sustainability and ecological programs	Long-term technical and sustainability training to build ecological online programs that benefit the community should be considered.
Teaching-learning elements	Regardless of the maturity of early years education in each country, the new social context impacted teacher identity and teaching-learning elements. Digital teaching and learning methods should be improved to prioritize fairness in technology-mediated programs and platforms.
Health and wellness	Quantitative research on the influence of online studies on physical and mental health through adequate metrics is recommended. The importance of internet spaces for academic and psychological assistance during ERT should be explored.
Craft and related areas	The potential for expanding remote education options in craft and related areas to foster promising research opportunities is suggested.
Institutional responsibilities	Higher education institutions should take on responsibilities in supporting e-pedagogy and managing educational crises. Universities should provide early opportunities for students to develop digital, information, and academic skills to become autonomous learners.
Medical education transformation	The study raises questions about whether COVID-19 has provided the experience, vision, and courage for medical education to change permanently.

These thematic clusters represent key areas for future research and provide valuable insights and recommendations to shape the future of online education based on the experiences of educators, students, and institutions during the COVID-19 pandemic.

4. Discussion

The objective of this study was to examine the progression of online learning amidst the COVID-19 pandemic. "A systematic review of pedagogical shifts and their long-term implications" offers an all-encompassing examination of the significant pedagogical changes that transpired in online education throughout this period. The discourse centres on several key points: pedagogical transformations, the integration of technological platforms and tools, the immediate impact on student engagement and academic achievements, the enduring consequences, obstacles and constraints, and suggestions for further research in

the realm of online education.

Preventive measures were needed in the realm of online education because to the COVID-19 epidemic. The use of blended learning strategies and hybrid models arose in reaction to the abrupt shift towards online instruction. Additionally, attention was drawn to the notions ERT and Small Private Online Courses (SPOCs). Numerous variables drove these transformations, underscoring the criticality for flexible and responsive educational approaches. Moreover, social media platforms have significantly contributed to the improvement of communication and collaborative learning. The results emphasise the ever-changing characteristics of online learning and the continuous pursuit of efficacious pedagogical approaches in the era of digitalization.

The use of electronic tools and platforms was of the utmost importance in facilitating educational adjustments throughout the epidemic. A variety of technologies were used, including learning management systems (LMS), video conferencing software, multimedia tools, social networking platforms, and others. In addition to facilitating the shift towards online learning, they also created opportunities for advancements in the field of education. The dynamism shown by these technological adjustments serves to emphasise the education sector's resiliency. The pedagogical adjustments have a wide range of direct implications on student engagement, learning results, and overall educational experiences. Although obstacles were duly recognised, the modifications offered prospects for inventive approaches and enhancements in pedagogical and educational practises. The findings underscore the criticality of adaptable educational frameworks and digital literacy that transcend the current crisis. The enduring consequences of these pedagogical transformations in online education have significantly impacted the field of education. The epidemic expedited the integration of online learning into the curriculum permanently. A reassessment of technological integration, educational approaches, and models of lifelong learning ensued as a result. In an ever-changing educational environment, it is critical to capitalise on the lasting advantages of these transformations while also confronting the corresponding obstacles.

The substantial obstacles and constraints linked to the pedagogical transitions in online education generated a multitude of adjustments and approaches. The global health crisis expedited the incorporation of online learning as a sustainable pedagogical instrument, signifying a transformation in the field of education that has stimulated the development of novel strategies and solutions. In conclusion, suggestions for further investigation in the realm of online education are presented. The aforementioned suggestions are organised into thematic clusters and encompass a range of subjects: instructor perspectives and experiences, instructor professional development, the enduring consequences of the pandemic, inventive pedagogical continuity approaches, faculty training and readiness, online assessment, student motivation, ecological online programme development, and crisis management in education. With the intention of influencing the trajectory of online education, these observations and suggestions seek to rectify obstacles, enhance pedagogical methodologies, and elevate the calibre of online learning encounters.

Educators', students', and institutions' experiences during the epidemic have yielded significant insights and suggestions that will aid in the development of online education in the future. Instructor perspectives and experiences, professional development, the enduring consequences of the pandemic, novel pedagogical continuity approaches, faculty preparation and training, online assessment, student motivation, and ecological online programmes are among the topics addressed in these recommendations. The aforementioned findings are designed to improve the future quality and efficacy of online learning.

5. Conclusion

In summary, the COVID-19 epidemic instigated an extraordinary metamorphosis within the domain of distance learning, encouraging pivotal changes in teaching methodologies and the swift integration of cutting-edge technology resources and platforms. The varied assortment of academic studies that contributed to the

multifarious results emphasise the ever-changing character of this educational environment. These changes, while they have introduced difficulties, have created fresh prospects for the development of online education, placing more emphasis on flexibility, originality, and ongoing investigation of efficacious pedagogical approaches in the age of digitalization. Upon contemplation of the insights and suggestions gleaned from the epidemic, it becomes indisputable that the experiences of institutions, students, and educators have proven to be of immeasurable value. These observations will have a significant impact on the trajectory of online education, improving the quality and efficacy of educational experiences for future generations. An education system that is dynamic and robust in the face of hardship, embracing technology and change, is the lasting legacy of the epidemic.

Author contributions

Conceptualization, HA and SA; methodology, FA; software, HA; validation, BIE, FA and SA; formal analysis, MABMA; investigation, ID; resources, HA; data curation, HA; writing—original draft preparation, HA; writing—review and editing, HA and SA; visualization, HA; supervision, HA; project administration. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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