

Review Paper

The Role of New Information Technology in the Epidemic of COVID-19: A Systematic Review



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ABSTRACT

Background: Given the changes caused by COVID-19, modern information technology has gained a higher position, fostering the realistic comprehension of technology, developing an interdisciplinary program, and endorsing scientific and technological activities within the educational environment. Considering the advancement of information technologies after COVID-19, this study was conducted to explore the role of new information technology in shaping education during the pandemic.

Materials and Methods: In this systematic review, all relevant studies were searched in Medline/PubMed, Scopus, Web of Science, ProQuest, Iran Medex, Magiran, and Scientific Information Database (SID) databases from 2019 to 2022. The analysis was conducted using a thematic analysis approach.

Results: Of the 1966 search results, 15 articles were included in this systematic review. These comprised 9 journal articles, 5 conference studies, and 1 thesis study. Data were extracted under two main categories—education and knowledge management—and four subcategories: Learning, performance quality, infrastructure, and planning.

Conclusion: Developing positive and creative skills in using new technologies is a complex process, which, through joint planning in multidisciplinary teams, can enhance technology-driven education. However, using new information technologies requires more support for educational leadership.

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Introduction

CCOVID-19 is an acute respiratory infectious disease recognized as a global pandemic with high transmission [1, 2]. Since the outbreak of the COVID-19 epidemic, various strategies have been proposed to control it. These strategies include isolating suspected individuals, closely monitoring contacts, collecting epidemiological and clinical patient data, and developing diagnostic and treatment methods [3, 4].

Digital health technology emerges as a pivotal tool in facilitating pandemic strategy and response, offering unique advantages that are challenging to replicate through conventional means [5]. Countries like South Korea have integrated digital technology into coordinated control processes, including surveillance, testing, contact tracing, and strict quarantine [6]. Telemedicine and e-health platforms allow digital interaction between patients and medical staff [7] without physical contact, reducing the time required to provide clinical services and preventing further infection [8, 9]. This action will help reduce the use of resources such as personal protective equipment and increase access to healthcare while reducing the risk of direct person-to-person transmission of COVID-19 [8, 10].

Health information technologies are necessary to improve the quality of care and reduce costs, especially in managing chronic diseases and COVID-19 [11, 12]. Information technology can be used for better management and control of COVID-19 in areas such as prevention, screening, diagnosis, treatment, and follow-up of patients. Most health service providers and patients seek to understand the potential of digital technologies to reduce face-to-face visits and observe social distance [13]. Technologies such as telemedicine have been used to address COVID-19 emergencies and disease management [14, 15].

Applying information and communication technology (ICT) for digital healthcare delivery can limit physical human interaction. Also, ICT supports the delivery of optimal care while reducing the risk of direct human-to-human exposure [6].

Telehealth could become a critical need for the general population, healthcare providers, and patients with COVID-19, especially when people are in quarantine. The pandemic crisis of COVID-19 has created unprecedented challenges for educational systems and the global

higher education sector [16]. Following the epidemics, changes have occurred to the environment and society, including the healthcare system, the education system, universities, the industry, and the general public. In this context, living conditions have changed due to information technology, creating both advantages and disadvantages. The research team's investigations showed that no comprehensive and complete study has been done that systematically evaluates the role of information technology in education or collects and analyzes the measures taken in different countries. Therefore, this comprehensive review was conducted to identify and explain the roles of information technology, especially in education, during the COVID-19 epidemic.

Materials and Methods

This systematic review included all studies conducted from 2019 and January 2022, wherein new information technology served as either one of the essential dependent or independent variables in the study's objectives. Also, studies exploring education based on new information technologies during the COVID-19 pandemic with an experimental or simulation approach were included. The thematic analysis method (the primary codes, the subcategories, and the final categories) was used to analyze the findings. The articles were analyzed using MAXQ DA software, version 18.

Search strategy

The search strategy was based on electronic and manual methods, employing keywords such as 'technology information,' 'COVID-19,' 'epidemic,' and 'modern.' Electronic databases were queried, including [Medline \(PubMed\)](#), [Scopus](#), [Web of Science](#), [ProQuest](#), [Google Scholar](#), [Iran Medex](#), [Magiran](#), and [Scientific Information Database \(SID\)](#). All relevant national and international congresses were examined, too.

Sample search strategy

The sample search keywords coupled with operators were as follows: ALL (epidemic) OR TITLE-ABS ("modern informational") OR TITLE-ABS (COVID-19) OR AND (TITLE-ABS (epidemic) OR ALL (telemedicine) OR ALL (informational) OR TITLE-ABS ("modern informational") OR ALL COVID-19) OR ALL ("informational technology") OR ALL ("modern technology") OR ALL ("technology") OR TITLE-ABS ("modern telemedicine") OR ALL ("epidemic technology") OR ALL ("COVID-19 informational") OR ALL ("informational telemedicine") OR ALL ("education

technology”) OR ALL (education) OR ALL (“education telemedicine”) OR ALL (“telemedicine COVID-19”) OR ALL (“epidemic telemedicine”) OR ALL (health) OR AND (PUBYEAR<2022 AND PUBYEAR>2019).

The search involved an initial screening based on the titles and abstracts, followed by a thorough review of the full text. The relevant information was extracted using the PRISMA (preferred reporting items for systematic reviews and meta-analyses) flowchart (Figure 1). Among the 2432 studies identified with the search terms and syntax in the databases, the full text of 55 articles was examined based on the inclusion and exclusion criteria. Finally, 15 articles focusing on modern information technology during the COVID-19 epidemic were included in this study. The findings of these studies were extracted and analyzed with a thematic approach. From the total

number of studies searched after removing duplicates, 1910 studies were excluded due to a lack of inclusion criteria. These studies are categorized into seven categories. Among these, 1100 studies were related to epidemic diseases other than the COVID-19 pandemic, 510 studies focused on the quarantine of patients with COVID-19, and 150 studies delved into simulation-based training during the COVID-19 pandemic. An additional 150 studies on the promotion of virtual education were also excluded from the present study (Figure 1).

Quality control

In this study, all identified studies were imported to EndNote™ Thomson Reuters research software, version 8 and duplicate references were removed. Then, two authors independently performed a preliminary screening of the original articles. First, they checked the titles

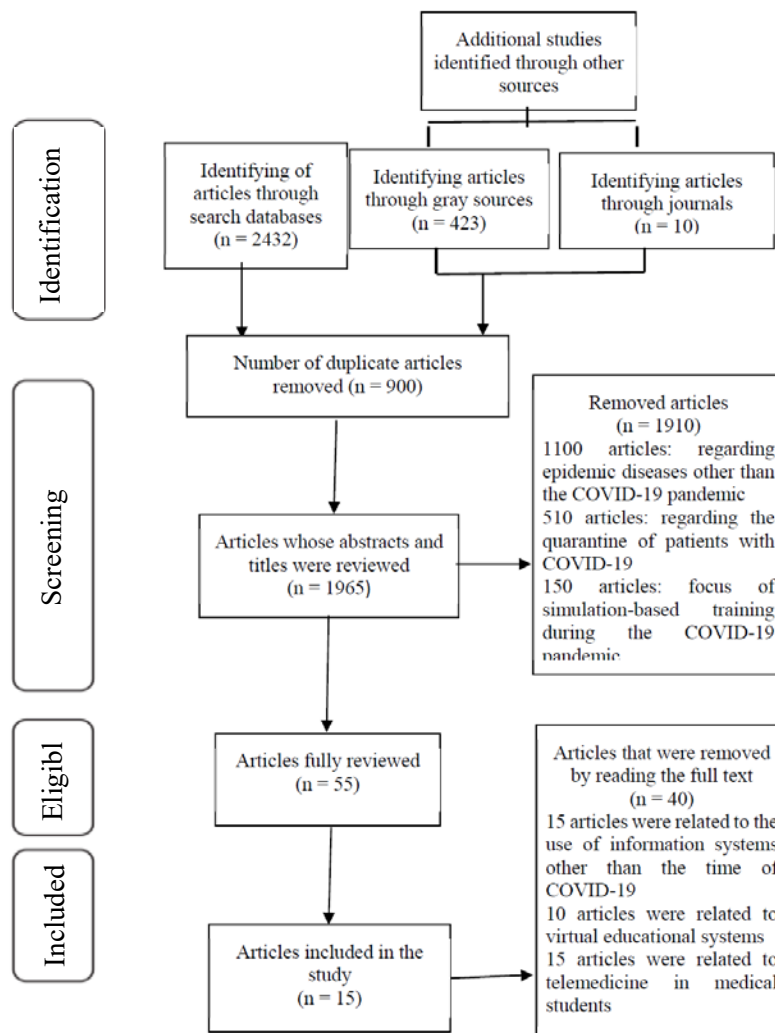


Figure 1. Characteristics of articles extracted based on systematic review

and abstracts, and then the selected articles were divided into two groups: Relevant and irrelevant. Articles deemed irrelevant by both were excluded from the study. Each author then reviewed the full text of the remaining articles and prepared a list of their included articles. Then, the two lists were compared, and the discrepancies between the two lists were discussed. In the event of disagreement, a third party was consulted to make the final decision regarding the article. The study details enlisted in this systematic review included the name of the author (s), year of publication, and study type (journal articles, conference, thesis) (Table 1). Then, the role of modern information technology during the COVID-19 pandemic was elucidated according to the blueprint of the researcher-made analysis. Two authors evaluated the articles separately using the quality evaluation checklist [33]. All the studies included in this systematic review were reviewed independently based on the checklist questions.

Results

According to the PRISMA checklist of this study, among the 2432 studies found with the search terms and syntax in the databases, the full texts of 55 articles were examined because the titles and abstracts met the inclusion and exclusion criteria. Finally, 15 articles on the role of modern information technology during the COVID-19 epidemic were included in this study. The findings and results of these studies were extracted and analyzed with a thematic approach.

Of the total number of studies searched after removing duplicates, 1910 articles were excluded due to a lack of inclusion criteria. These studies were categorized into 7 groups: 1100 Articles were about epidemics other than COVID-19, 510 articles focused on the quarantine of patients with COVID-19, 150 articles were about simulation-based training during the COVID-19 pandemic, and 150 studies about the promotion of virtual education (Figure 1). Next, 55 articles entered the quality assessment stage. The full text of these studies was reviewed based on the critical appraisal skills program (CASP) checklist [33], and 40 articles were excluded due to the lack of factors related to the purpose of this systematic review—the role of modern information technology in COVID-19. In addition, among 55 articles reviewed in full text, only three studies used a qualitative method, and these three studies were excluded during the screening stage due to non-compliance with the inclusion criteria. Therefore, all 15 articles were conducted quantitatively, and no qualitative research was included in this systematic review.

Among the studies included, 9 studies are journal articles, 5 conference studies, and 1 thesis. The majority of them were descriptive cross-sectional articles (Table 1).

Based on the findings of this research study, modern information technology's role during the COVID-19 pandemic has been divided into two main categories and four subcategories (Table 2).

The articles revealed two main categories—education and knowledge management—and four subcategories: Learning, quality performance, infrastructure, and planning.

Education: Life in the time of epidemic

Apart from the devastating health consequences, the COVID-19 crisis has immediate economic and social impacts on the lives and studies of higher education students. Hence, researchers are eager to investigate its effects on their daily lives, including teaching and learning, social communication, and how students cope emotionally with situations in different parts of the world [32, 33].

Learning

Due to the COVID-19 pandemic in the middle of the spring 2020 semester, many universities were forced to switch from face-to-face classroom instruction to distance learning. Many institutions use the Zoom application as their learning platform. The results showed that students had a negative attitude towards using Zoom, perceiving it as harmfully influencing their learning experience and motivation to learn [34].

During the COVID-19 pandemic, Zoom was the choice of many government agencies, universities, non-profit organizations, and individuals. Zoom was founded by Eric Yuan in 2011. It is a web-based video conferencing tool that provides high-quality audio, video, and screen sharing, perfect for virtual conferences, lectures, meetings, webinars, and more. Educators could use its various features to create interactive learning environments. Additionally, Zoom sessions can be recorded and made available for future reference. Some studies have explicitly focused on the use of Zoom in the classroom [4, 15].

They investigated the non-uniformity of the concerns arising from teaching and learning using video conferencing with the quality experienced in a traditional classroom environment. The results showed that the teaching and learning of remote students are of lower quality than those of students in the conventional classroom. Kan-

Table 1. Characteristics of articles extracted based on systematic review

Authors	Year	Country	Study Type	Findings
Zagos et al. [17]	2022	Greece	Descriptive	A lack of digital equipment and underdeveloped technological infrastructure causes educational inequalities.
Conrad et al. [18]	2022	Canada	Descriptive	Online learning environments during the COVID-19 pandemic, effective online implementation in future quality
Abelgas et al. [19]	2022	The Philippines	Qualitative	Challenges: 1) Unstable internet connection, 2) Inadequacy of technological means and 3) An unfavorable educational environment at home.
Chandrasiri et al. [20]	2022	Sri Lanka	Thematic	People’s positive perception towards online learning Online learning, an efficient learning strategy
Balahadiya et al. [21]	2022	The Philippines	Descriptive	Online learning as a measure during the COVID-19 pandemic
Rice et al. [22]	2022	Mexico	Descriptive	Using technologies, evaluating and modifying digital educational materials, and managing the tension between wanting independence to choose new technologies during the COVID-19 pandemic
Cameron et al. [23]	2021	New Zealand	Qualitative	Using virtual reality systems during the COVID-19 pandemic
Wayne et al. [24]	2020	China	Descriptive	Improving the quality of medical education during the COVID-19 pandemic.
Saide et al. [25]	2020	Taiwan	Systematic	Effective knowledge transfer of the teaching-learning process in the context of the coronavirus crisis by maximizing information technology tools and knowledge management approach.
Nguyen et al. [26]	2020	Vietnam	Descriptive	Increasing the effectiveness of online education during the COVID-19 pandemic.
Serhan et al. [27]	2020	America	Qualitative	The quality of learning and motivation to learn flexibility are the main advantages of using educational software
Xie et al. [28]	2020	America	Qualitative	Online education promotes educational justice and innovation through artificial intelligence and mobile education
Li et al. [29]	2020	China	Descriptive	Continued efforts towards organizational simulation and online learning
Bojović et al. [30]	2020	Serbia	Descriptive	Using business intelligence, data warehousing, predictive analytics, data science, and artificial intelligence to manage this data efficiently
Yan et al. [31]	2020	Hong Kong	Thematic	Information technology resources rich insights for hospitals in the COVID-19 pandemic.

darelli’s study showed that students had a negative attitude toward video conferencing in the classroom. However, the use of virtual Zoom training leads to an increase in student satisfaction and a reduction in the workload of instructors by 25% [4, 18].

Murillo et al. (2018) found that instructors and students value using Zoom. Due to the COVID-19 pandemic, Agarwal and Kaushik (2020) replaced face-to-face classes with 40-minute Zoom lectures. Then, they investigated the satisfaction levels of Ghanaian international students with online learning in higher education institutions in China. The results of this study showed that students were satisfied with their online learning experience, considering online courses to be effective [15, 35].

Performance quality

Technology can take pressure off our daily tasks. The most important advantage of online education for students in the current situation is the ability to study in the safe place of their home [10]. Adapting students to distance education under the pressure of the consequences of the pandemic crisis cannot be effective in countries where the vast majority of students lack access to the Internet due to technical, educational, financial, or organizational issues [19]. The COVID-19 epidemic caused a kind of digital disparity. On the one hand, the middle class works comfortably with access to technology at home. On the other hand, students from disadvantaged communities (often ethnic minorities) cannot access

Table 2. Investigating the role of new information technology during the COVID-19 pandemic based on a systematic review

Class	Subclass	Primary codes
Education	Learning	<ul style="list-style-type: none"> Access to information Equality and justice-innovation-efficiency Increasing the independence of students and the possibility of choosing a suitable learning model according to learning methods Attitude about technology The degree of inclusive attention Online learning technology and, subsequently, attitudes toward technology Online multimedia learning limits cognitive overload more than learning capacity Removing information overload in online learning Increasing the level of understanding of online learning Using online learning tools in teaching-learning activity Learning using artificial intelligence technologies in the teaching process Examining the need to learn anywhere and everywhere in the time of COVID-19 Ability to access instructions from anywhere and in any time zone Convenience of education through online learning Online learning as a practical and flexible method Increasing technological and logistic resources
	Performance quality	<ul style="list-style-type: none"> Teaching and more participation in the process of acquiring knowledge A temporary solution to substitute teaching in times of crisis The ability to study in the safety of their home Responsive distance learning Using online learning technology positively Maintain interaction between people Clinical skills training Application of information, creation of knowledge, and decision-making to flourish talents and broaden learners Facilitating the development, access, and improvement of educational quality Increasing growth and skill in implementing learning based on a virtual environment Availability of facilities to use the virtual environment Inadequacy of technological equipment Unfavorable learning environment at home Unstable internet connection
Knowledge management	Infrastructure	<ul style="list-style-type: none"> Influencing virtual technologies in everyday life Flexibility of students in using digital infrastructure Technology as part of formal education Cognitive overload affecting the results of online learning A suitable space for online learning Learning management system platform Support for sustaining the use of digital technologies and online resources Using smart phones in online learning Continuous monitoring of digital resources and infrastructure Eliminating logistics costs completely
	Planning	<ul style="list-style-type: none"> Educational design suitable for online learning Integrating information technology and education in interdisciplinary programs Development of human resource training programs in the field of educational technology. Free online training software, including internet access Standardizing digital and technological competencies in the virtual environment

such technologies in limited homes. Thus, while for the former, their safe house conditions led to a low-risk situation of COVID-19, for the latter, it increased insecurity and risk. Moreover, an essential issue in online learning is practicality. Laboratory studies cannot be done with distance learning [21]. Online learning may be ineffective because of 1) The too many and varied required media, 2) Unequal facilities for students, and 3) Lack of

awareness among teachers, students, and parents about the use of technology [10, 11].

According to reports, information technology has continued to be used in Indonesia. The fear of adverse effects caused by technology is the main reason teachers reject this technology [9]. There may also be challenges to using modern information technology because of 1) Unstable internet connection, 2) Inadequacy of techno-

logical devices, and 3) Unfavorable educational environment at home [6]. Technological and logistical resources and people's preparation are key to the success of online learning. Students' most significant challenge was online learning participation [36]. Factors such as teacher training, attitude, technical competence, time limits, pedagogy, and methodology are among the significant distance education elements for evaluating the assurance of quality learning [34].

Knowledge management

Today, the knowledge transfer system between teachers and students has become challenging, and many are still designing and identifying the best approach and solution to deal with this crisis. Therefore, the knowledge transfer is critical in the COVID-19 pandemic [13].

An educational model with intelligent solutions can help students in crisis overcome situations such as fear of loss, stress, and violence and learn tolerance, risk reduction, and life skills. The role of teachers in an online environment is challenging because instructors must engage students in various cognitive tasks such as answering questions, thinking, reasoning, analyzing information, and practicing and retrieving information [30]. It seems that knowledge management can help different approaches to face the pandemic crisis in the framework of the teaching-learning process [8].

Infrastructure

Emergency distance education is a temporary solution, an alternative model for teaching in times of crisis. March (1991) argued that the organization should simultaneously create two innovations (exploratory and exploitative). Combining these two theories, this study presents two new terms, knowledge discovery and exploitation, to enhance the online teaching-learning scenario (activities for knowledge sharing) [15].

A socio-technical perspective integrating the social/knowledge (exploration of knowledge-exploitation) and technical aspects (use of information technology tools for the online teaching-learning process) is crucial for transferring knowledge during the COVID-19 pandemic. Centers providing education must simultaneously develop a strategy to discover new knowledge and maximize their existing knowledge resources, managing the transfer of knowledge between instructors, which becomes competitive and complex [31].

Knowledge discovery involves pursuing new knowledge innovation, information solutions, and opportunities, while knowledge exploitation involves maximizing existing knowledge, data, and information. The primary role of information technology in knowledge management is the rapid flow of shared knowledge through the interaction and online communication of communities. The transfer speed depends on the participants' readiness, especially the training providers, to accept the new learning methods and tools [6].

The process of transitioning to a distance learning model involves five stages: a) Preparation, b) Planning, c) Implementation, d) Operation, and e) Evaluation. Research on online learning during the COVID-19 pandemic shows how factors such as attitudes about technology [19], degree of inclusive attention [18], and effective course design [25] positively affect online learning outcomes.

Planning

Online education includes distance learning, combined learning, online courses, rotating classrooms, and mobile classrooms. Choosing the best type of training depends on the needs and limitations of each learner. Teachers and coaches can adapt their teaching styles and methods to the needs of their students. Online education is an approach that allows students to adjust their daily lives and work schedules to advance their education, maximize resources and productivity, and access courses and related materials anytime and anywhere, using various methods and offering degree programs from around the world. The other benefits of online education comprise equity in access to education, significant innovation in education, and greater efficiency in teaching and learning. Online education can use data-driven learning strategies, various free online learning tools, and the knowledge capital of a community of learners to enhance education through innovation. Online education provides flexibility to meet student needs and can continue without disruption, even during the COVID-19 pandemic. Online education is an emerging trend and will become integral to post-pandemic education. During the coronavirus crisis, online and related learning tools comprised the first and most suitable tools for teaching-learning activities. Today's devices are rapidly changing information technology tools, and its many features of knowledge management for online education-learning have maximized knowledge transfer in times of crisis, such as COVID-19 [13, 31, 36].

The e-learning process requires appropriate devices, such as hardware and software. Purchasing appliances (telephone, computer, laptop, internet access, etc.) becomes an additional burden in such stressful conditions. Instead of providing knowledge and educational content and training the workforce under rigid programs, training centers should teach learners skills such as applying information, creating knowledge, making decisions to develop talents, and expanding learning. In this context, education can be seen as a technological process. Further, technological products can be packaged and transferred, and as a practical process, absorbing the achievements of other technical fields [10, 22].

Quality assurance approaches should be adopted, ongoing efforts should be based on institutional support collaboration, and experiences should be shared between institutions to help understand better and prepare for the spread of the COVID-19 disease [9].

To address the educational concerns of individuals in online learning, management should adopt a policy that provides ongoing training and supervision for faculty members. It is advisable to monitor students who cannot attend class, take feedback from students and teachers in their classes, and use coping mechanisms in online learning. Educational institutions should create appropriate and compelling content, set up an effective and efficient delivery system, and provide digital literacy training to current faculty to improve learning outcomes [12].

Discussion

This study has been prepared to examine the role of new information technologies, especially education, during the COVID-19 pandemic. Based on the findings of the present study, education is one of the practical components of using modern information technology during COVID-19. Undoubtedly, outcomes-based education leads to much innovation, flexibility, and experimentation in anatomy, teaching-learning, clinical skills, assessing students' well-being, and coaching or mentoring for advancements in medical education. The domains stretched from curriculum focusing on infection control to epidemic modeling, population and public health, telemedicine, and health equity.

To better manage and reduce the spread of the coronavirus, hospitals can improve the efficiency of their medical system by replacing part of physical treatments with digital technologies [37]. Accordingly, doctors can provide medical care remotely using new technologies such as telemedicine and virtual services [38, 39]. These

virtual care services offer a variety of non-distributive functions and enable the physician to provide quality medical care services during the COVID-19 pandemic. Such services may include reviewing patient medication records, health education, healthcare management, and remote medication review [24, 40, 41]. Therefore, telemedicine and virtual care can be integrated as an approach to maximize the efficiency of healthcare delivery in the healthcare system [42].

Tang et al. (2021) listed six principles of high-impact educational practice for online education: Proper connection between online instructional design and student learning, effective delivery of online instructional information, adequate support by instructors and teaching assistants, timely feedback, tutoring, and email guidance after class, high-quality engagement to improve the breadth and depth of student learning, and contingency planning for unexpected events in online training platforms [36]. Higher education, hoping for continued academic growth, has taken a different path, effectively stopping the traditional face-to-face teaching-learning approach and moving towards alternatives to online education systems [6]. The study of Zagkos et al. (2022) pointed out that replacing mobile learning is inevitable and allows learning anytime and anywhere [17].

The evolving landscape necessitates curriculum and strategy adaptations. In some cases, online classes cause concern about what students experience with this new learning method [17]. Whitelaw et al. noted that the COVID-19 pandemic has affected the learning processes of more than 1.5 billion students worldwide. Additionally, online learning has become the norm as populations worldwide try to minimize the pandemic's impact on their lives [6]. Also, quality was another practical component in using new educational technology during the COVID-19 pandemic, significantly affecting learners' performance and satisfaction. Therefore, it can be said that the role of educators in preparing for online learning is the key to success and increasing the quality of education.

Several studies showed that online learning and its acceptance were widely affected by the characteristics of all learners, important factors in online learning in developing countries. These characteristics include Internet self-efficacy, experience using computers and the Internet, anxiety with computer usability, and online learning approaches. Learners' attitudes are also influenced by the excellence and ease of use of online learning courses, the usability of online learning, and learners' level and computer skills [11, 31, 36]. Knowledge management

was another practical component in using new educational technology during the COVID-19 pandemic. It is essential to emphasize distance education and learner characteristics to identify potential barriers to learning, such as motivation, costs, learning feedback, support and services to learners, feelings of isolation, and training [43].

Zagkos et al. identified online learning and various manageable factors that could affect the results of online learning. People's ability to use technology and their motivation in the online learning environment can affect learning success [17]. Yan et al.'s study underscores that the easier students perceive online learning, the higher their satisfaction, leading to increased time spent learning and enhanced overall quality [31]. The effective transfer of knowledge from the teaching-learning process during the coronavirus crisis helps by maximizing the information of technology tools and the knowledge management approach [22]. According to the study of Kapoor et al., online learning, flexibility, effectiveness, students' knowledge acquisition, more opportunities to gain experience, cost savings, and affordability for managing centers and knowledge receivers created communication between them [8].

Conclusion

A systematic review of studies on the role of modern technology during the COVID-19 pandemic showed that most studies were conducted to learn and increase the quality of education and knowledge. The study's findings have direct outcomes for universities and health center authorities in providing a policy for helping students in online learning. Also, regarding online learning and poor connection to the Internet, higher authorities should provide the infrastructure for online education and information technology so that students and other people can adapt to online learning. After all, they are committed to providing requirements and improving the quality of learning. Through various formats (simulators, artificial intelligence), virtual reality offers a definitive support tool for patients and healthcare providers during this global health crisis. In addition, a proactive approach to providing care while reducing face-to-face contact during the COVID-19 pandemic suggests continuous webinars/seminars and ICT training for learners and holding online classes for learning. Mental awareness should be adopted.

Research limitations

One of the limitations of the current research was the limited scope of the search and the lack of a sufficient number of studies conducted in this field. A few studies have emphasized health and treatment, mostly in technical engineering. Based on the current research findings, developing educational programs and strategies, such as virtual reality and simulators in education, are suggested for future studies.

Ethical Considerations

Compliance with ethical guidelines

There were no ethical considerations to be considered in this research.

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Authors' contributions

All authors contributed equally to the preparation of this article.

Conflict of interest

The authors declared no conflict of interest.

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References

- [1] Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. *New England Journal of Medicine*. 2020; 382(8):727-33. [DOI:10.1056/NEJMoa2001017] [PMID]
- [2] Moslehi S, Dehghani A, Masoumi G, Barghi Shirazi F. Vulnerability management of the elderly during COVID-19 pandemic: A systematic review. *Health in Emergencies and Disasters Quarterly*. 2023; 8(2):77-86. [DOI:10.32598/hdq.8.2.310.3]

- [3] Hellewell J, Abbott S, Gimma A, Bosse NI, Jarvis CI, Russell TW, et al. Feasibility of controlling COVID-19 outbreaks by isolation of cases and contacts. *Lancet Glob Health*. 2020; 8(4):e488-96. [DOI:10.1016/S2214-109X(20)30074-7] [PMID]
- [4] Adhikari SP, Meng S, Wu YJ, Mao YP, Ye RX, Wang QZ, et al. Epidemiology, causes, clinical manifestation and diagnosis, prevention and control of coronavirus disease (COVID-19) during the early outbreak period: A scoping review. *Infectious Diseases of Poverty*. 2020; 9(1):29. [DOI:10.1186/s40249-020-00646-x] [PMID]
- [5] Ferretti L, Wymant C, Kendall M, Zhao L, Nurtay A, Abeler-Dörner L, et al. Quantifying SARS-CoV-2 transmission suggests epidemic control with digital contact tracing. *Science*. 2020; 368(6491):eabb6936. [DOI:10.1126/science.abb6936] [PMID]
- [6] Whitelaw S, Mamas MA, Topol E, Van Spall HG. Applications of digital technology in COVID-19 pandemic planning and response. *The Lancet Digital Health*. 2020; 2(8):e435-40. [DOI:10.1016/S2589-7500(20)30142-4] [PMID]
- [7] Bokolo AJ. Exploring the adoption of telemedicine and virtual software for care of outpatients during and after COVID-19 pandemic. *Irish Journal of Medical Science*. 2021; 190(1):1-10. [DOI:10.1007/s11845-020-02299-z] [PMID]
- [8] Kapoor A, Guha S, Das MK, Goswami KC, Yadav R. Digital healthcare: The only solution for better healthcare during COVID-19 pandemic? *Indian Heart Journal*. 2020; 72(2):61-4. [DOI:10.1016/j.ihj.2020.04.001] [PMID]
- [9] Torous J, Myrick KJ, Rauseo-Ricupero N, Firth J. Digital mental health and COVID-19: Using technology today to accelerate the curve on access and quality tomorrow. *JMIR Mental Health*. 2020; 7(3):e18848. [PMID]
- [10] Pecchia L, Piaggio D, Maccaro A, Formisano C, Iadanza E. The inadequacy of regulatory frameworks in time of crisis and in low-resource settings: Personal protective equipment and COVID-19. *Health and Technology*. 2020; 10(6):1375-83. [DOI:10.1007/s12553-020-00429-2] [PMID]
- [11] Reeves JJ, Hollandsworth HM, Torriani FJ, Taplitz R, Ables S, Tai-Seale M, et al. Rapid response to COVID-19: Health informatics support for outbreak management in an academic health system. *Journal of the American Medical Informatics Association*. 2020; 27(6):853-9. [DOI:10.1093/jamia/ocaa037] [PMID]
- [12] Khangura S, Konnyu K, Cushman R, Grimshaw J, Moher D. Evidence summaries: The evolution of a rapid review approach. *Systematic Reviews*. 2012; 1:10. [DOI:10.1186/2046-4053-1-10] [PMID]
- [13] Wind T, Rijkeboer M, Andersson G, Riper H. The COVID-19 pandemic: The 'black swan' for mental health care and a turning point for e-health. *Internet Interventions*. 2020; 20:100317. [DOI:10.1016/j.invent.2020.100317] [PMID]
- [14] Zhai Y, Wang Y, Zhang M, Gittel JH, Jiang SH, Chen B, et al. From isolation to coordination: How can telemedicine help combat the COVID-19 outbreak? *medRxiv*. Preprint. 2020; 1-4. [DOI:10.1101/2020.02.20.20025957]
- [15] Murillo-Cabezas F, Vigil-Martín E, Raimondi N, Pérez-Fernández J. [COVID-19 pandemic and digital transformation in critical care units (Spanish)]. *Medicina Intensiva*. 2020; 44(7):457-8. [DOI:10.1016/j.medin.2020.04.004] [PMID]
- [16] Crawford J, Butler-Henderson K, Rudolph J, Malkawi B, Glowatz M, Burton R, et al. COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *Journal of Applied Learning & Teaching*. 2020; 3(1):1-20. [DOI:10.37074/jalt.2020.3.1.7]
- [17] Zagkos C, Kyridis A, Kamarianos I, Dragouni KE, Katsanou A, Kouroumichaki E, et al. Emergency remote teaching and learning in Greek universities during the COVID-19 pandemic: The attitudes of university students. *European Journal of Interactive Multimedia and Education*. 2022; 3(1):e02207. [DOI:10.30935/ejimed/11494]
- [18] Conrad C, Deng Q, Caron I, Shkurska O, Skerrett P, Sundararajan B. How student perceptions about online learning difficulty influenced their satisfaction during Canada's COVID-19 response. *British Journal of Educational Technology: Journal of the Council for Educational Technology*. 2022; 53(3):534-57. [DOI:10.1111/bjet.13206] [PMID]
- [19] Abelgas LJ. Junior high school students' perceptions and challenges of online learning implementation during COVID-19 pandemic. *Journal of Positive School Psychology*. 2022; 6(2):1910-8. [Link]
- [20] Chandrasiri NR, Weerakoon BS. Online learning during the COVID-19 pandemic: Perceptions of allied health sciences undergraduates. *Radiography (London, England: 1995)*. 2022; 28(2):545-9. [DOI:10.1016/j.radi.2021.11.008] [PMID]
- [21] Balahadia FF. Challenges of information technology education student's online classes during the COVID-19 pandemic in selected public colleges and universities in the Philippines. *International Journal of Computing Sciences Research*. 2022; 6:877-92. [DOI:10.25147/ijcsr.2017.001.1.79]
- [22] Rice MF. Special education teachers' use of technologies during the COVID-19 era (Spring 2020-Fall 2021). *TechTrends: For Leaders in Education & Training*. 2022; 6(2):310-26. [DOI:10.1007/s11528-022-00700-5] [PMID]
- [23] Cameron MP, Fogarty-Perry B, Piercy G. The impacts of the COVID-19 pandemic on higher education students in New Zealand. *Journal of Open, Flexible and Distance Learning*. 2022; 26(1):42-62. [DOI:10.61468/jofdl.v26i1.515]
- [24] Wayne DB, Green M, Neilson EG. Medical education in the time of COVID-19. *Science Advances*. 2020; 6(31):eabc7110. [DOI:10.1126/sciadv.abc7110] [PMID]
- [25] Saide S, Sheng ML. Knowledge exploration-exploitation and information technology: Crisis management of teaching-learning scenario in the COVID-19 outbreak. *Technology Analysis & Strategic Management*. 2021; 33(8):927-42. [DOI:10.1080/09537325.2020.1854714]
- [26] Nguyen DT, Kieuthi TC. New trends in technology application in education and capacities of universities lecturers during the Covid-19 pandemic. *International Journal of Mechanical and Production Engineering Research and Development (IJMPERD)*. 2020; 10(3):1709-14. [DOI:10.24247/ijmperdjun2020155]
- [27] Serhan D. Transitioning from face-to-face to remote learning: Students' attitudes and perceptions of using zoom during COVID-19 pandemic. *International Journal of Technology in Education and Science*. 2020; 4(4):335-42. [DOI:10.46328/ijtes.v4i4.148]

- [28] Xie X, Siau K, Nah FF. COVID-19 pandemic-online education in the new normal and the next normal. *Journal of Information Technology Case and Application Research*. 2020; 22(3):175-87. [DOI:10.1080/15228053.2020.1824884]
- [29] Li L, Lin M, Wang X, Bao P, Li Y. Preparing and responding to 2019 novel coronavirus with simulation and technology-enhanced learning for healthcare professionals: Challenges and opportunities in China. *BMJ Simulation & Technology Enhanced Learning*. 2020; 6(4):196-8. [DOI:10.1136/bmjstel-2020-000609] [PMID]
- [30] Bojović Ž, Bojović PD, Vujošević D, Šuh J. Education in times of crisis: Rapid transition to distance learning. *Computer Applications in Engineering Education*. 2020; 28(6):1467-89. [DOI:10.1002/cae.22318]
- [31] Yan A, Zou Y, Mirchandani DA. How hospitals in mainland China responded to the outbreak of COVID-19 using information technology-enabled services: An analysis of hospital news webpages. *Journal of the American Medical Informatics Association: JAMIA*. 2020; 27(7):991-9. [DOI:10.1093/jamia/ocaa064] [PMID]
- [32] Hollander JE, Carr BG. Virtually perfect? Telemedicine for COVID-19. *New England Journal of Medicine*. 2020; 382(18):1679-81. [DOI:10.1056/NEJMp2003539] [PMID]
- [33] Larijani HA, Shirazi FB, Moslehi S. Responding to coronavirus (COVID-19) and providing reproductive health services in humanitarian settings. *Journal of Disaster and Emergency Research*. 2021; 4(1):4-6. [DOI:10.18502/jder.5638]
- [34] Soliman M, Pesyridis A, Dalaymani-Zad D, Gronfula M, Kourmpetis M. The application of virtual reality in engineering education. *Applied Sciences*. 2021; 11(6):2879. [DOI:10.3390/app11062879]
- [35] Duthheil F, Baker JS, Navel V. COVID-19 as a factor influencing air pollution? *Environmental Pollution (Barking, Essex: 1987)*. 2020; 263:114466. [DOI:10.1016/j.envpol.2020.114466] [PMID]
- [36] Tang YM, Ng GWY, Chia NH, So EHK, Wu CH, Ip WH. Application of virtual reality (VR) technology for medical practitioners in type and screen (T&S) training. *Journal of Computer Assisted Learning*. 2021; 37(2):359-69. [DOI:10.1111/jcal.12494]
- [37] Bokolo Anthony J. Use of telemedicine and virtual care for remote treatment in response to COVID-19 pandemic. *Journal of Medical Systems*. 2020; 44(7):132. [DOI:10.1007/s10916-020-01596-5] [PMID]
- [38] Rafieepour A, Masoumi G, Dehghani A. Health responses during the COVID-19 pandemic: An international strategy and experience analysis. *Health in Emergencies and Disasters Quarterly*. 2021; 6(3):147-60. [DOI:10.32598/hdq.6.3.310.1]
- [39] Elson EC, Oermann C, Duehlmeyer S, Bledsoe S. Use of telemedicine to provide clinical pharmacy services during the SARS-CoV-2 pandemic. *American Journal of Health-System Pharmacy: AJHP: Official Journal of the American Society of Health-System Pharmacists*. 2020; 77(13):1005-6. [DOI:10.1093/ajhp/zxaa112] [PMID]
- [40] Neubeck L, Hansen T, Jaarsma T, Klompstra L, Gallagher R. Delivering healthcare remotely to cardiovascular patients during COVID-19: A rapid review of the evidence. *European Journal of Cardiovascular Nursing*. 2020; 19(6):486-94. [DOI:10.1177/1474515120924530] [PMID]
- [41] Moslehi S, Barghi Shirazi F, Adibi Larijani H, Haj Ahmadi M. Challenges of providing health services to Cardiovascular patients during the COVID-19 pandemic in Iran. *Journal of Health Administration*. 2022; 24(4):95-104. [DOI:10.52547/jha.24.4.95]
- [42] Hur J, Chang MC. Usefulness of an online preliminary questionnaire under the COVID-19 pandemic. *Journal of Medical Systems*. 2020; 44(7):116. [DOI:10.1007/s10916-020-01586-7] [PMID]
- [43] Wirth W, Hartmann T, Böcking S, Vorderer P, Klimmt C, Schramm H, et al. A process model of the formation of spatial presence experiences. *Media Psychology*. 2007; 9(3):493-525. [DOI:10.1080/15213260701283079]

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