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Challenges and Strategies for Educating Medical Students During the COVID-19 Pandemic: A Systematic Review

COVID-19 Pandemisi Sırasında Tıp Öğrencilerini Eğitmenin Zorlukları ve Stratejileri: Sistematik Bir İnceleme

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ABSTRACT

During the coronavirus disease-2019 (COVID-19) pandemic, medical student education faced many challenges as these students became involved in the treatment of disease. Therefore, the purpose of this study was to systematically review the challenges and strategies for medical student education during the COVID-19 pandemic. This study is a systematic review. To find the necessary documents and collect the information, Web of Science, PubMed, Scopus, and Embase databases, websites for relevant journals, and search engines such as Google Scholar, were used from January 2019 to the end of 2022. The data were analyzed using content analysis and descriptive statistics. Of the 14,474 studies found, 82 documents were ultimately included. Most studies were conducted in the United States (18%), and the largest target population was U.S. residents (41%). A total of 228 challenges were identified and categorized into seven major themes (financial constraints and infrastructure development, international education, assessment and testing system, student health and preparation, professional ethics, faculty empowerment, and virtual education) and 14 subthemes. The most significant challenges were virtual education, student health, and financial and infrastructure constraints. Solutions were also categorized into five main areas: virtual education, infrastructure and physical environment, educational approach, faculty empowerment, and health, along with 23 subcategories. Identifying

ÖZ

Koronavirüs hastalığı- 2019 (COVID-19) pandemisi sırasında, tıp öğrencilerinin eğitimi, bu öğrencilerin hastalığın tedavisine dahil olmalarıyla birçok zorlukla karşılaştı. Bu nedenle, bu çalışmanın amacı, COVID-19 pandemisi sırasında tıp öğrencisi eğitimiyle ilgili zorlukları ve stratejileri sistematik bir şekilde incelemektir. Bu çalışma bir sistematik derlemedir. Gerekli belgeleri bulmak ve bilgileri toplamak için Web of Science, PubMed, Scopus ve Embase veritabanları, ilgili dergilere ait web siteleri ve Google Scholar gibi arama motorları kullanılarak Ocak 2019'dan 2022 yılı sonuna kadar olan dönemde araştırma yapılmıştır. Veriler içerik analizi ve tanımlayıcı istatistikler kullanılarak analiz edilmiştir. Toplamda 14.474 çalışma bulunmuş olup, bunlardan 82 belge nihai olarak dahil edilmiştir. Çalışmaların çoğu Amerika Birleşik Devletleri'nde (%18) yapılmış olup, en büyük hedef kitle ABD vatandaşlarından (%41) oluşmuştur. İki yüz yirmi sekiz zorluk belirlenmiş ve yedi ana tema (finansal kısıtlamalar ve altyapı geliştirme, uluslararası eğitim, değerlendirme ve sınav sistemi, öğrenci sağlığı ve hazırlık, profesyonel etik, fakülte güçlendirme ve sanal eğitim) ve 14 alt tema altında kategorize edilmiştir. En önemli zorluklar sanal eğitim, öğrenci sağlığı ve finansal ve altyapı kısıtlamaları olarak belirlenmiştir. Çözümler de beş ana alan altında kategorize edilmiştir: sanal eğitim, altyapı ve fiziksel çevre, eğitim yaklaşımı, fakülte güçlendirme ve sağlık, ayrıca 23 alt kategori bulunmaktadır. Bu çalışmada sunulan

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ABSTRACT

and analyzing the challenges presented in this study and the solutions offered could help policymakers and higher education managers make evidence-based decisions tailored to local conditions, and turn the COVID-19 crisis into an educational opportunity.

Keywords: COVID-19, education, students, medical sciences, challenge, solutions

ÖZ

zorlukların ve önerilen çözümlerin belirlenmesi ve analiz edilmesi, politika yapıcıların ve yükseköğretim yöneticilerinin yerel koşullara göre özelleştirilmiş kanıta dayalı kararlar almalarına yardımcı olabilir ve COVID-19 krizini bir eğitim fırsatına dönüştürebilir.

Anahtar Sözcükler: COVID-19, eğitim, öğrenciler, tıp bilimleri, zorluk, çözümler

INTRODUCTION

In late 2019, the outbreak of a new virus, namely "Coronavirus Disease 2019" (COVID-19), that caused lung infections was reported in China. The disease spread rapidly, infecting over 100 million people and affecting world health. The World Health Organization announced COVID-19 as a pandemic on March 11, 2020 (1,2). Although various organizations worldwide have taken numerous measures to respond to this crisis, people's lives worldwide have been disrupted, and many jobs and activities have been suspended. One of the critical areas upon which the fate and future of societies usually depend is the education system; in which the presentation process has changed with the coronavirus outbreak. In this regard, higher education systems worldwide have been compelled to provide online education. While the conditions have been difficult, they have inspired innovation to provide instruction in new ways. In other words, education at all levels has been dramatically affected, and residents, students, and medical educators are experiencing new conditions (3). Given that gathering in enclosed places such as a classroom causes the spread of the virus, classes have been closed, and dormitory and university welfare services have been reduced as well, university rules and regulations have been changed, student costs have increased, and hundreds of millions of students at different education levels have been affected (4,5).

The COVID-19 crisis has created unique educational challenges. Educating and evaluating students has entirely changed, and all universities and educational institutions worldwide have been implementing new educational strategies, such as virtual education. Universities and institutions have been teaching through various platforms, such as online and digital platforms. In other words, new distance learning methods have replaced traditional learning methods. Due to the novelty of this strategy, there are many weaknesses, and students are experiencing specific problems (6,7). According to statistics, more than 194 countries have been forced to change their educational systems due to the outbreak of the COVID-19 pandemic (6,7). Universities have shifted their in-person classes to online classes, blended learning environments, or social media education. This has caused irregularities in the conduct of classes, virtual and online learning has led to confusion and learner dissatisfaction, creating various challenges for students and reducing the quality of education.

A complete response to this crisis seems necessary because academic progress and education of residents and students depend on it (8,9). Identifying the challenges in higher education can be very helpful in making decisions and taking supportive and managerial measures. In other words, recognizing as many challenges and opportunities as possible during the COVID-19 pandemic is of great importance for higher education and university systems. Considering that conducting any kind of research in the field of higher education is regarded as a support for it and causes education to flourish, if there is a lack of higher education research, teaching and learning will become superficial and inefficient. Thus, the present study systematically examined educational challenges and strategies for medical students during the COVID-19 pandemic.

MATERIALS AND METHODS

This study is a systematic review conducted in 6 stages in 2022: identification of the research question, relevant studies, study selection, data charting, reporting quality assessment, and analyzing data and reporting the results. In this study, the systematic review approach taken from the book "Systematic Review to Support Evidence-Based Medicine" (10) and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (11) were used.

Identification of The Research Question

The main research question is as follows: "based on the results of previous studies, what challenges did medical students face in terms of education during the outbreak of COVID-19, and what are the main strategies to deal with these challenges?" All studies and reports related to the education of medical students during the COVID-19 pandemic, published in prestigious scientific journals in English and Persian from 2019 to the end of 2022, dealt with the challenges and solutions in the field of education. Their full texts were available and were examined. Abstracts of the articles published in conferences, seminars, and newsletters were considered exclusion criteria. Studies published in languages other than English and Persian were also excluded.

Identification of Relevant Studies

The search strategy in the present study was developed and implemented by an experienced and knowledgeable librarian who specialized in the subject area. The required data were collected by searching the Web of Science, PubMed, Scopus, and Embase databases. The search strategy was based on the following keywords: learning, education, training, "tele education", "virtual telemedicine", "e-learning", "online learning", "mobile learning", "new learning", teaching, "higher education", problem, hinder, obstacles, challenges, barrier, approach, response, answer, reaction, actions, policy, measurement. resident, student, "post graduate". COVID, "COVID-19", coronavirus, "2019 novel coronavirus", "COVID19", "2019-novel COV", "SARS-cov-2", "SARS-CoV2", "SARSCoV2", "SARSCoV-2", "severe acute respiratory syndrome coronavirus 2", "2019-ncov", "coronavirus disease 2019", "coronavirus disease-19", "2019ncov", "SARS coronavirus 2".

To identify and include other published articles, in addition to searching the databases, we also manually searched some relevant journals in the field, such as Medical Education, Medical Education Online, BMC Medical Education, and the International Journal of Medical Education, as well as the Google Scholar search engine. The aforementioned keywords were also used in the Google Scholar search engine. Having excluded poorly-related articles and selected the main ones, the researchers carried out reference checks, citation checks, and reviewed gray literature to increase the assurance of identifying and reviewing the selected articles.

Study Selection

After collecting all the relevant articles, duplicate ones were excluded from the study, and two researchers performed the initial screening based on the titles and abstracts. The items that did not correspond to the study's aim were also excluded. Once the articles that did not meet the inclusion criteria were removed, the full texts of all the articles meeting the inclusion criteria were reviewed. In the next step, researchers extracted the results of the reviewed articles, and finally, the full texts were assessed in terms of eligibility. The Endnote X5 resource management software was used to organize the articles, review the titles and abstracts, and identify duplicates. The PRISMA 2020 flowchart (12) was also used to report the results of the selection and screening process.

Data Charting

The data were extracted using a researcher-made form in the Microsoft Word Office 2016 software. The data extraction was performed by two independent researchers, who were experienced and knowledgeable in data extraction, and were responsible for independently extracting the data. These investigators (E.S. and Z.Z) also independently assessed relevant full-text articles for eligibility based on the predefined criteria. Any disagreements between the investigators were resolved through discussion with the third and fourth investigators (M.H. and K.K.). The data on the influencing factors reported in each study were extracted and entered into the data extraction table. The information extracted from the studies included: bibliographic characteristics such as researcher's name, research year, and journal name; a summary of the methodology of each research; research data collection tool; the study population of each research; and the most important findings and results of each study.

Quality Appraisal

The quality of the papers was examined independently by two of the researchers using the STROBE standard checklist (strengthening the reporting of observational studies in epidemiology) designed explicitly for cross-sectional studies (13). The STROBE checklist consisted of 6 general sections under the following headings: Title and abstract, introduction, methods, results, discussion, and other information. Some areas were subdivided into different subcategories, for a total of 22 sections. The scoring was conducted based on the importance of each section for the present study. The minimum acceptable scores were set at 30 and 15, respectively. Finally, the articles that achieved a minimum score of 15 points were included in the research, and their data were reviewed. Three articles that scored less than 15 were removed at this stage.

Content-Analysis and Reporting the Results

After extracting the information using the data charting form, the extracted data were manually analyzed, summarized, and reported using the content analysis method. Content analysis is a method for identifying, analyzing, and reporting the patterns (themes) within the text and is widely used in qualitative data analysis (14-16). The data were coded by two researchers independently. The data analysis and coding steps were as follows: familiarity with the texts of articles (immersion in the results), identification and extraction of primary areas (identification and extraction of the articles more related to primary areas), placement of the articles in specified areas, reviewing and completing the results of each area using the results of the articles on the areas. Ensuring the reliability of the areas and the results extracted in each area involved reaching an agreement between the two coders through discussion and resolution of disputes. Data were reported using descriptive statistics such as percentage and frequency. Excel 2016 was also used to draw the charts.

RESULTS

In this study, 14,408 articles were retrieved from databases such as PubMed, Scopus, Web of Science, and Embase. An additional 66 studies were retrieved from other sources such as Google Scholar and specialized websites. In total, 14,474 articles were identified Finally, 74 articles were reviewed via databases, and 8 articles were reviewed via searches of other sources, resulting in a total of 82 studies. After a careful and systematic review, the required information was entered into the extraction form (Figure 1).

Most of the studies were conducted in the United States (18%), Saudi Arabia (13%), India (11%), Italy (10%), China (8.5%), Canada (6%), United Kingdom (6%) (Figure 2).

The participants in the studies included residency (41%), general medicine (23%), dentistry (10%), and pharmacology (5%) students, as well as those studying in other fields (21%) (Figure 3). Most of the studies had been conducted on residency students in surgery, urology, radiology, neurology, ophthalmology, and orthopedics.

Educational challenges during the COVID-19 pandemic were categorized into seven main themes (financing and infrastructural development, rules and regulations, international education, assessment and testing system, student health and preparedness, professional ethics, faculty empowerment, and virtual education) and 14 subthemes (Table 1).

Examining the 82 studies obtained from database searches provided us with 228 educational challenges during the COVID-19 pandemic, as shown in Figure 4, based on their frequency. Three of the most common challenges included virtual education, student health challenges, and financial and infrastructural education constraints during COVID-19.

The solutions provided for education during the COVID-19 pandemic were classified into five main areas: virtual education, infrastructural and physical, educational approach, faculty empowerment, and the health area and 23 subcategories (Figure 5).

Table 1. Educational challenges of medical students during the COVID-19 pandemic

Main theme	Subtheme	Challenges
Financial constraints and infrastructures	Financial	• Financial constraints on Internet access, hardware shortage (17-19)
		• Financial restrictions on buying laptops or smartphones (20-22)
	Infrastructural and physical	• Unawareness of the security of e-learning programs in terms of privacy and data protection (23,24)
		• Operating system instability and inefficient ability of online education (25-27)
		• Lack of advanced electronic systems in low-income countries (28,29) problems of fourth-generation internet connection and unstable internet connection (30,31)
		• Audio-visual problems (32)
International Education	Disruptions in the international education process	• Return of exchange students to their home countries and interruption of their educational activities (33)
Assessment and testing system	Evaluation	• Lack of objective evaluation of education (34)
		• Lack of supervision of students in online education (27)
		• Difficulties of online evaluation and problems of understanding unique dynamics of online education (35,36)
Students' health and preparedness	Mental and spiritual	• Creating stress due to the risk of transmitting COVID-19 to their families (19,25,33,37,38)
		• Increased student stress due to COVID-19 infection
		• The negative impact of the epidemics on mental health (39-41)
		• Impact on students' social life (16,17,30)
		• Negative effect on students' intellectual ability (30)
		• Negative impact on their ability and confidence to be a good doctor in the future (16,42,43)
	Interest	• Students' preference for in-person education over e-learning (44,45)
		• Dissatisfaction with online education (46-48)
		• Indifference and lack of motivation to study (49-51)
Professional ethics	Ethics in education	• Prioritizing the care of patients and vulnerable people over monitoring the education of medical students (50,52,53)
	Ethics in hospital	• Reduced interaction between hospital staff and residents (54)
		• Decreased social communications (55,56)
		• Negative effect on the quality of medical care due to lack of communication with patients (57,58)
Faculty empowerment	Specialized training	• Lack of formal training of faculty members for online assessment, such as conducting and marking online exams (35)
		• Lack of knowledge and expertise of professors in online education (59-61)
	Soft skills	• Psychological aspects of telecommunications, the language of instruction, distance learning provision, and methodological problems (62)
		• An imbalance between the life and work of female teachers working at home (35,63)
Virtual education	Planning	• No guarantee of the efficiency of online education and university lectures (27,64)
		• Problems with scheduling and over-running of seminars/lectures (32,65)
	Implementation	• Lack of specific quantitative standards for measuring the quality of educational processes in online education (27)
		• Lack of knowledge and understanding of virtual education (30)
		• Insufficient communication by educational institutions and educational leadership (33)
		• Learning limitations in the laboratory or clinical skills (66-70).
	Learning	• Lack of focus when learning due to lack of direct communication (71-73)
		• Students' negative attitude towards e-learning (74,75).
		• Harder learning in e-learning (31,76)
		• Students' unpreparedness for e-learning (77,78)
		• Lack of time management in virtual education (19,36,79)
		• Lack of technical skills required to work with electronic applications (23,80)
		• Lack of direct interaction between students (55,81)
		• Lack of direct interaction between students and instructors (82,83)
	Rules	• Lack of guidelines published by the medical and dental council for online medical education (35,84)
		• Increased delay in starting educational courses (39,85)
		• Interruption of student research activities (86)
		• Delays in the graduate programs of students (87)
		• Delays in examinations and licensing of residents (88-90).

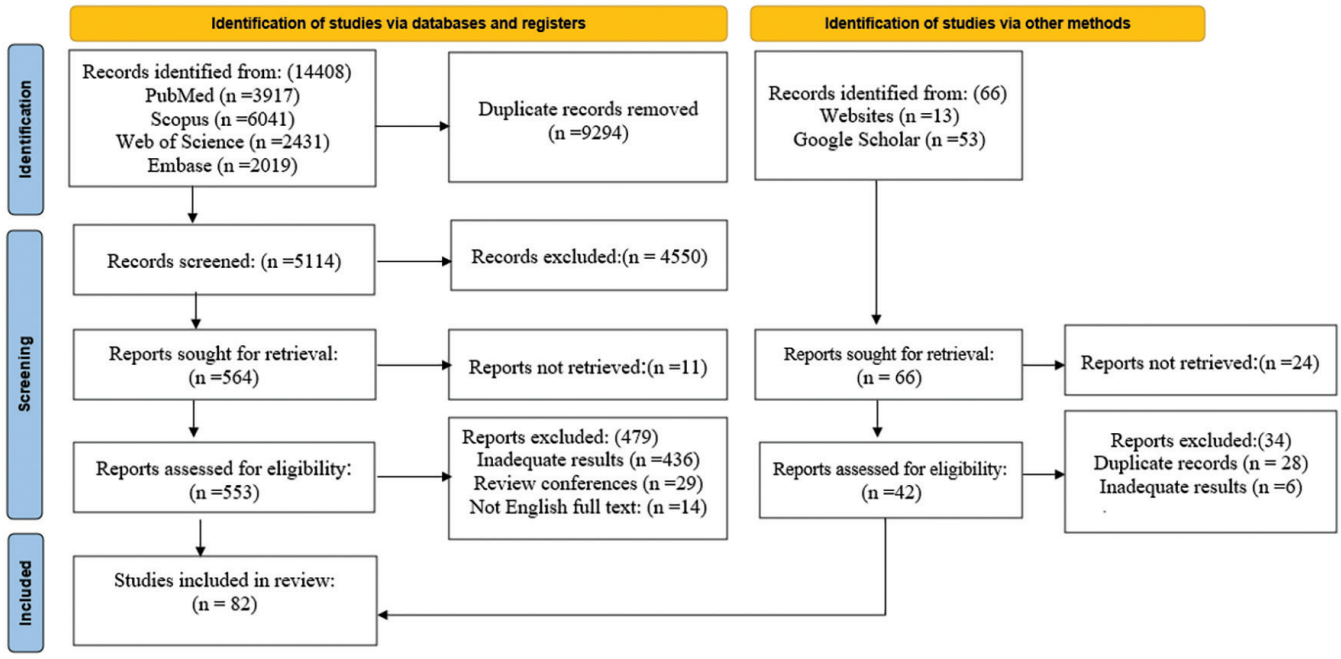

Figure 1. Screening process and selection of articles on challenges and strategies for educating medical students during the COVID-19 by countries

COVID 19: coronavirus disease-2019

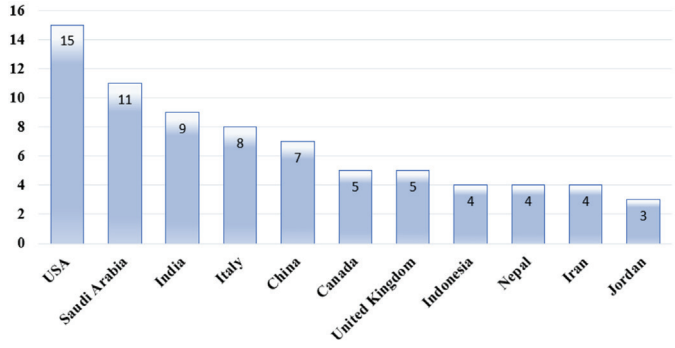

Figure 2. Frequency distribution of the articles on challenges and strategies for educating medical students during the COVID-19 by countries

COVID 19: coronavirus disease-2019

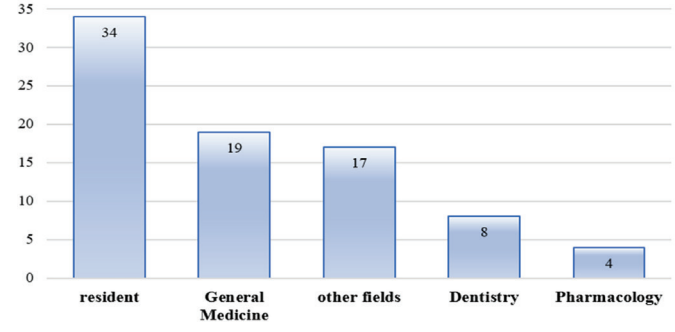

Figure 3. Frequency distribution of the participants in the study of challenges and strategies for educating medical students during COVID-19 by discipline

COVID 19: coronavirus disease-2019

DISCUSSION

Examining the 82 studies obtained from database searches resulted in classifying educational challenges during COVID-19 into seven main themes (financial constraints and infrastructural development, international education, assessment, and testing system, student preparedness and health, professional ethics, faculty empowerment and virtual education) and 14 subthemes. The solutions provided by the studies were also categorized into five areas: virtual education, infrastructure, physical areas, educational approach, faculty empowerment, and health.

Identifying the challenges was the first step in turning them into opportunities. Most of the difficulties expressed in the studies were under the category of virtual education, and in this study, they were classified into four subcategories: planning, implementation, learning, and education rules. One of the most critical challenges in virtual education mentioned in most studies was the limitation of learning practical or clinical skills. A study conducted in Southeast Asia by Wittayanakorn et al. (91) in 2020 showed that neurosurgery residents were more concerned about a significant reduction in their surgeries, potentially leading to both a loss of existing skills and a lack of opportunities to acquire new ones. They were worried about their future because they were not confident in the assessment of their competence in neurosurgery if they were allowed to graduate from the educational course or take a national board exam (91). Development areas, such as online education modules or virtual boot camps for neurosurgery residents simulated in laboratories, enabled the students to develop practical skills (91). The current situation requires the use and promotion of these educational innovations. virtual patients (for training clinical examinations, diagnostic skills, and communication skills) virtual reality simulators (for touch training, surgical skills, and resuscitation training) have

shown that they can be as effective as real patients for educational purposes (29).

Other challenges of virtual education included the negative impact on the quality of medical care due to the lack of communication with patients, planning problems and over-running of seminars and lectures, and the lack of guidelines published by the medical and dental council for online medical education (32,84). Success in virtual education depends on the faculty members' attitudes and interactive teaching styles, as well as the students' experience and attitude towards technology. To increase the quality of education, choosing the appropriate method for distance education is essential. Problem-based learning approaches can ensure the understanding of important concepts and be based on critical thinking. Furthermore, faculty members can create clinical films to enhance the learning experience (92). Careful planning of online education, regular feedback in online classes, and effective time management are critical in establishing the rules of virtual education classes (18,93). Residents and other students should be encouraged to use online resources to facilitate learning. For specialist assistants, in particular, distance education through educational videos or online webinars can be integrated into academic programs. The university can positively impact students' learning through online discussions (21).

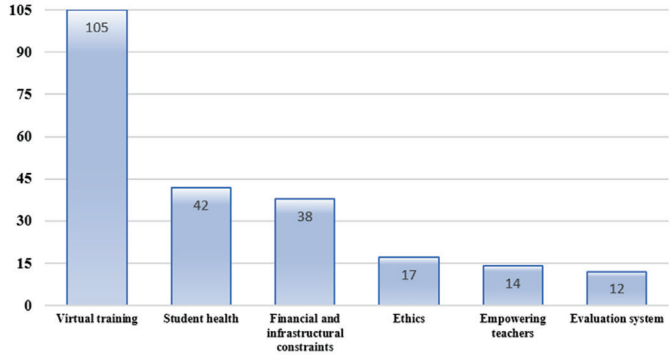

Figure 4. Frequency of the most recurring educational challenges for medical students during the COVID-19 pandemic

COVID 19: coronavirus disease-2019

Financial and infrastructural constraints are other significant education challenges during COVID-19. Hardware and software facilities (infrastructures) play an essential role in the education system (94). According to the present study's findings, access to the fourth-generation Internet, unstable Internet connections, operating system instability, financial restrictions on access to laptops and smartphones, and lack of awareness about the security of e-learning programs could be considered infrastructural problems of virtual education. In another study, Idris and Osman. (95) attributed the

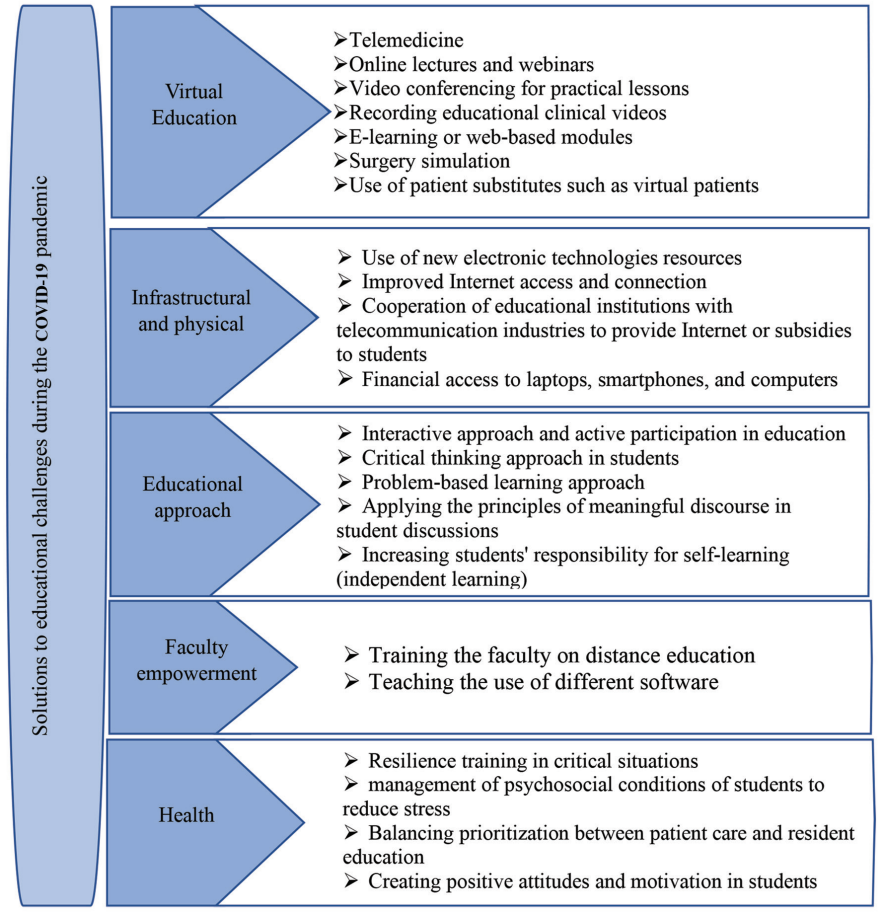

Figure 5. Strategies to deal with educational challenges of medical students during COVID-19

COVID 19: coronavirus disease-2019

barriers and opportunities for implementing virtual education in Algerian universities to a lack of infrastructure, technical skills, and motivation for the staff (95). The virtual education system requires some elements, and the absence of any of these elements will lead to a severe disruption of the launch and establishment of this new system. Telecommunication and Internet infrastructures, human resource infrastructure, and experienced experts are involved in virtual education (96). Along with the constant advancement of technology and the pervasive digitalization, it is necessary to focus on the factors that facilitate e-learning. Utilizing new electronic technology resources, improving internet access and connection, cooperation between educational institutions and telecommunication industries to provide free internet or subsidies to students, and financial access to laptops, smartphones, and computers can facilitate virtual education (20,59,91).

Another educational challenge is associated with students' health. In other words, the pandemic has negatively affected their mental, physical, social, and intellectual abilities. Students are concerned about their knowledge and self-confidence in becoming good doctors in the future (42,97). This feeling has caused great stress and anxiety in medical students. A study conducted in Egypt also reported that the lack of personal protective equipment, negative concerns about the surgical profession, and financial pressures were essential factors affecting the mental health of residents (98). Studying the quality of life among orthopedic residents in South Korea showed a decrease in their satisfaction levels due to their exposure to COVID-19 stressors and their concerns about the possibility of transmitting the disease to their families (99). Such stress levels could significantly impact the resilience and strength of future physicians to cope with critical situations such as having critically ill patients and complex surgeries. Essential resilience training has broader benefits for performance improvement and can be incorporated into the students' curricula (42). It is also essential to balance the prioritization between patient care and resident education, and create positive attitudes and motivation in the students during the pandemic in order to reduce their stress (49,51).

Virtual education and online academic lectures have broken down space restrictions. Although they can effectively prevent crowds and the risk of infection, they may significantly reduce some students' learning efficiency due to poor self-awareness, instructors' lack of skills in online software, and lack of supervision for students (30,80). Investing in skilled human resource training is an important issue in the development of online education (100). Using experts to train the staff, students, and faculty members to benefit from this educational system can enhance user-system relationships and increase the efficiency of this system (86). Individual skills, as well as computer and Internet skills, are other important requirements that must be taken into account (101).

Reduced student-student and student-instructor (interactions and communications) were other challenges of online education. A sudden shift from a class full of friends and teachers to someone teaching on the screen can be a disappointing experience (18).

The restriction of students' interactions due to the epidemic has led to them feeling social isolation (17,56). According to the results of Freeman et al.'s study (102) and the review by Noori et al. (103), some disadvantages of online education were low control over education, inflexibility, and lack of face-to-face interactions. They showed adverse effects on effectiveness and learner satisfaction (102,103). Vonderwell (104) considered the delayed feedback from the instructors and the feelings of isolation as the disadvantages of online training courses, and believed these disadvantages resulted from not communicating with the instructor (104). Students are more satisfied with interactive online sessions than with other methods, such as webinars and lectures. Thus, classes can be divided into smaller groups for better interactions (69). In addition, the focus should be on active student participation. Expression and thinking, in terms of course content creation manifested in making course contents with the students' previous experiences and knowledge, and interpretation through analysis, integration, and evaluation of one's and others' perceptions, supports students' shared knowledge and allow them to make inferences by extending their understanding and knowledge to wider areas. Therefore, critical reflection in learning can help students develop and strengthen their metacognitive skills (82). Some limitations of this study include reviewing only English language articles and focusing on higher education.

CONCLUSION

The COVID-19 pandemic posed numerous problems to all aspects of societies, including public health. Although education during this period had challenges for students, it led to the flourishing of some capabilities, such as the integration of virtual education. Based on this article, some of the specific experiences highlighted are:

Financial constraints on Internet access, hardware shortage, and lack of advanced electronic systems in low-income countries are major challenges for students trying to access online education. Lack of direct communication, interaction between students and instructors, and supervision in online education leads to difficulties in learning and evaluation, and negative attitudes towards e-learning. The COVID-19 pandemic has had a negative impact on students' mental health, social life, and intellectual ability, creating stress and interrupting educational activities. The solutions provided for education during the pandemic include virtual education through telemedicine, online lectures, webinars, video conferencing, e-learning, and simulation. Other solutions involve improving infrastructure, providing financial access to technology, and empowering faculty through training and teaching them to use different software. Health-related solutions include resilience training and management of psychosocial conditions of students. These experiences and solutions highlight the challenges and potential solutions for education during the COVID-19 pandemic and the importance of addressing issues related to infrastructure, technology, and mental health to ensure effective and accessible online education. Therefore, identifying these challenges and providing executive solutions can help higher education managers and policymakers make evidence-based decisions and turn this threat into an educational opportunity.

Ethics

Informed Consent: Our study is a systematic review, and consent information is not typically required for such studies.

Footnotes

Authorship Contributions

Concept: K.K., S.A.A., M.H., Design: K.K., M.H., Supervision: K.K., S.A.A., M.H., Resources: Z.Z, E.S.H, Material: K.K., M.H., Z.Z., E.S.H., Data

Collection or Processing: S.A.A., Z.Z, E.S., Analysis or Interpretation: K.K., S.A.A., M.H., Literature Search: K.K., M.H., Writing: K.K., S.A.A., M.H., Z.Z, E.S., Critical Review: K.K., S.A.A., M.H., Z.Z, E.S.

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