

Review Article



Massive Open Online Courses in Medical Sciences: A Narrative Review Study

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Abstract

Background: Massive Open Online Courses (MOOCs) have gradually become one of the most important topics in the field of higher health education. However, no systematic review has been conducted on this type of education in the field of health.

Methods: This study is a narrative review of published research from January 2012 to March 2023 using a precise search in five databases: Web of Science, PubMed, SID, Cochrane Library, and Magiran, as well as, Google and Google Scholar, using the keywords "MOOC," "Massive Open Online Course," "Health," and "Medic*," and their Persian equivalents. Out of the 1129 articles reviewed, 41 articles studies met the inclusion criteria. Studies that focused on MOOCs but examined areas beyond the scope of health and medical sciences were excluded from this study.

Results: There is significant evidence of a relationship between MOOC courses and their effective outcomes in the field of health. Based on the findings, six key themes emerged: online complementary education for students, educators, and physicians; health literacy promotion; job skill training; patient-centered education; general public education; prevention and treatment.

Conclusion: Today, MOOCs are at the forefront of improving the quality of healthcare, prevention, treatment, and health literacy in response to economic crises and sudden epidemics worldwide. Improving health factors, increasing health literacy, adopting healthy lifestyles, job-related training, expanding interdisciplinary collaborations, responding to sudden health crises, increasing global aging population, reducing health inequalities, increasing food insecurity, and drug abuse, decreasing in-person training during epidemics, increasing dropouts from traditional education, and recognizing the importance of health tourism require skill acquisition.

Introduction

One of the methods for acquiring knowledge in contemporary times is distance education. One of the styles of this type of education is the Massive Open Online Course (MOOC), which has changed traditional teaching methods and made learning accessible to everyone, everywhere, and at all times, leading to social justice in the distribution of remote educational resources and facilities.¹ MOOCs have gradually become one of the most important subjects in health education, appearing as a major advancement and perhaps a transformative force in the health education sector, changing lifelong learning by providing quality educational materials with free access to join the global community.²

The technological and educational revolutions of the 21st century have increased access to extensive online MOOC courses. These international online educational

courses allow people all over the world to access evidence-based quality content.³ Due to innovative teaching techniques, the flexibility of educational programs, no geographic barriers, continuous learning opportunities, the potential for large numbers of learners, free access, multiple learning spaces, interactive participation, immediate feedback, and accurate dissemination of information in emergencies, MOOCs have become very popular in healthcare in a short time.⁴⁻¹⁰

Today, the importance of MOOCs has reached a point where they are used and welcomed as a significant educational resource by major universities worldwide, and to the extent that they have been referred to as a disruptive force in global education.¹¹ In an era where economic crises and possible epidemics have affected education, and face-to-face education has become less prominent, MOOCs serve as a suitable substitute for

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addressing these challenges.¹²

In the field of health, the gap in the quality and safety of health care and preventive education has become a major international problem, especially during pandemics. Access to extensive online MOOC courses has greatly facilitated efforts to address this challenge on a global scale.¹³ Although electronic education in medicine has existed in various forms for many years, the unique idea of an online course accessible to a large number of learners simultaneously, which coincides with the transfer of healthcare systems from paper-based to electronic systems, did not exist before MOOCs.¹⁴

Even though the number of MOOCs in the field of health is rapidly growing¹⁵ and extensive online courses are increasingly providing valuable access to reliable information on healthcare and medicine through various commercial and non-commercial online platforms without time constraints, geographic barriers, or educational levels, no review study has yet been conducted on the status of MOOCs in the field of health.¹⁶ While the concept of online delivery in medicine is not new, MOOCs are still relatively unknown and quantitative for many in the healthcare community.¹⁷ Although they are currently the main focus of education research, serving as a tool for improving healthcare professions,¹⁸ no review research has yet been conducted on the importance and application of MOOCs in the field of health and medicine. Therefore, the purpose of this study is to fill the gap in the literature by conducting a quick review to inform the scientific and university communities about the current status and importance of MOOCs in health and medicine. Nevertheless, we pursue the question that, what are the factors influencing (the development of) MOOC? This study aims to summarize recent literature on MOOCs in health and medicine. However, no systematic review has been conducted on this type of education in the field of health. The present research is done with this aim.

Methods

Study design and the type of study

This study is a narrative review, there are various approaches and methods for investigating a topic. To examine the subject of this research, a narrative review method has been employed. Essentially, narrative review creates a bridge among a diverse and scattered collection of articles on a subject, with a focus on qualitative interpretation and synthesis of the state of knowledge within a selected literature set.¹⁹

Data collection and tools/instruments

The study utilized data from January 2012 to March 2023. Relevant English language keywords in the field of health and medicine, as well as MOOC-related terms and their corresponding Persian equivalents, were searched keywords “MOOC,” “Massive Open Online Course,” “Health,” and “Medic*” in reputable scientific databases

such as Web of Science, Cochrane Library, PubMed, SID, Magiran, Google, and Google Scholar.

Inclusion and exclusion criteria

The exclusion criteria of this study included Studies that focused on MOOCs but examined areas except the scope of health and medical sciences. The inclusion criteria of this article, include studies that were only examined in the health field and were included in the article between 2012 and 2023 and also, the inclusion criterion was literature that investigated MOOCs in any subdomains and thematic areas of health.

Screening

After the initial search, 1129 articles were retrieved, and after screening for eligibility based on Inclusion and exclusion criteria and reviewing titles and abstracts of unrelated articles, 41 articles were subjected to final scrutiny. Then, studies were summarized conceptually and by findings, and the full text of selected articles was interpreted. Studies that dealt with MOOCs but examined domains beyond the realm of health and medical sciences or generally referred to the health sector were excluded from the study, and the inclusion criterion was literary works that explored MOOCs in any subdomains and thematic areas of health (Figure 1).

Data analysis

After extracting and vectorizing the selected sources, subject classification was used to summarize the findings. The findings were categorized into seven main areas: online education for students, instructors, and physicians; health literacy; patient education; general education; vocational training; prevention and treatment.

Results

After screening the retrieved results, articles related to MOOC education in the field of health and medicine were selected for analysis, and their results were examined (Table 1).

Continuous education for university students, physicians, and instructors

Studies by Setia et al.²⁰⁻²³ and related research have demonstrated that MOOCs have gained attention from universities, businesses, and healthcare professionals in a short time, providing individuals worldwide with easy access to their content. The findings of these studies indicate that continuous medical education through MOOCs not only improves the knowledge and skills of physicians and students but also leads to better patient care outcomes and sustainable student education. Providing continuous education via MOOCs helps students and physicians accept evidence-based practices while eliminating or reducing less effective care practices. Medical students prefer MOOC courses over traditional

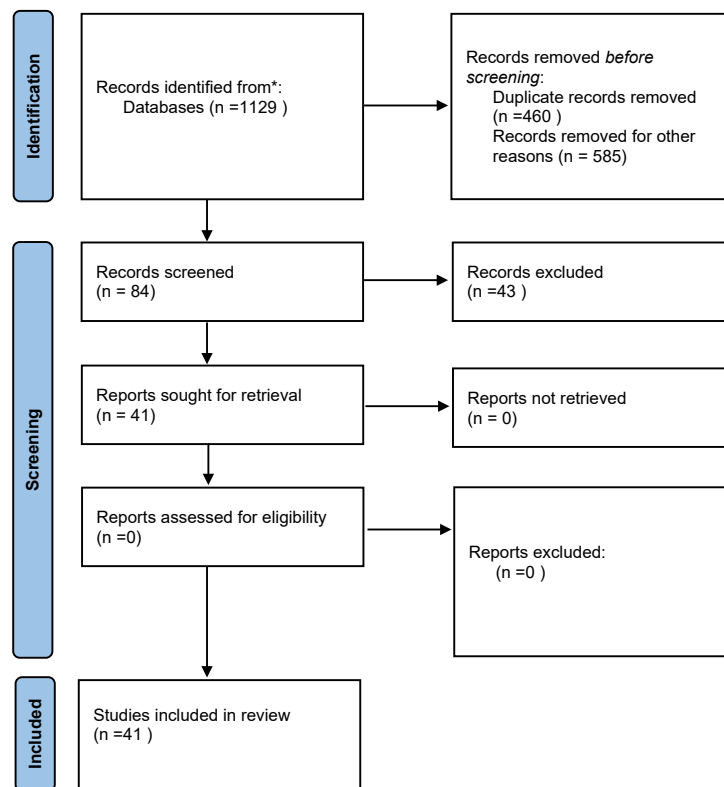


Figure 1. PRISMA flow diagram

classes because they provide flexible learning times, improved study skills, efficient teaching, and lower costs compared to traditional courses.

Furthermore, Olivares et al. and Hendrik et al. have shown that MOOCs are now offered as either independent or complementary education to traditional class courses in the healthcare sector and offer an exciting opportunity for collaboration to enhance healthcare and interprofessional education.^{24,25} Volandes et al argue that online learning techniques through MOOCs can empower physicians, students, and patients and can be used as a method for continuous medical education.²⁶ Moreover, Hoey suggests that MOOCs can provide an easy and cost-effective way to provide medical students who are transforming into health specialists with additional and up-to-date information continuously.²⁷

The study by Tucker showed that the MOOC course “Clinical Terminology for International and US Students” offered by the University of Pittsburgh is highly useful for new medical students and can complement traditional medical education or even serve as a replacement experience where MOOCs replace lectures.²⁸ Similarly, Maxwell et al showed that MOOC education provides a basis for enhancing interprofessional collaboration and innovation in learning models within diverse educational frameworks, offering exciting opportunities for disseminating knowledge on a large scale to diverse populations of learners and complementing traditional healthcare education programs.²⁹ In the same vein, Robinson’s study showed that MOOC education has

attracted more participants with higher participation rates and shorter courses.¹⁸ To date, many MOOCs have been developed for medical students’ and healthcare professionals’ education.

Health literacy

Perestelo-Perez et al recognize health literacy as the ability to search for, understand, and evaluate information from digital media and use it to solve health problems. They believe that many individuals have not developed these skills, endangering their health management and the sustainability of healthcare services socially. Developing extensive online MOOC courses to improve health literacy skills and facilitate shared decision-making processes can be a useful tool, and MOOCs can be an effective educational resource for promoting health literacy and facilitating shared decision-making.³⁰

Ferri and colleagues’ study showed that designing an extensive online training course provides an opportunity to enhance learning experiences and increase children’s knowledge and awareness of digital health literacy issues, particularly cyberbullying.³¹ Atique and colleagues’ study revealed that the internet and social media are now primary channels for searching for health information and support. However, since there is a significant amount of unreliable and counterfeit information available, trustworthy MOOC education can help reduce this challenge in social media health with reliable digital health literacy.³² Other studies have shown that despite organizational controls and national and international

Table 1. Education of students in thematic areas of health

Rank	MOOC training in the domain and subject area of health	The frequency of articles
1	Pandemic Viruses and Microbiology	129
2	AIDS	96
3	Medical Education	44
4	Nursing	43
5	Sickness	41
6	Exercise (physiology, etc.)	39
7	Mental and Psychological	28
8	Prevention	26
9	Mouth	26
10	Dementia	20
11	Nutrition	18
12	Health literacy	16
13	Elderly	15
14	Nutrition	14
15	Cancer	13
16	Suicide and Death	13
17	Skill training in health fields	11
18	Pathology	9
19	Primary care	7
20	Anatomy	7
21	Cancer	7
22	Dental	6
23	Children's Health	6
24	Obesity	5
25	Addiction and drug use	5
26	Surgery	4
27	Medical Informatics	4
28	Diabetes	3
29	Organ transplantation	3
30	Medicine	3
31	Health ethics	3
32	Urology	3
33	Kidney	2
34	Ophthalmology	2
35	Health Professional	2
36	Radiochemistry	2
37	Obstetrics and Gynecology	2
38	family doctor	1
39	self-care	1
40	Concussion	1

filtering tools to eliminate confusing and low-quality information, the key to using information remains the user. Therefore, using MOOC education to empower users is an essential factor for improving their health literacy and digital health literacy, ultimately improving

self-care behaviors.³² The findings of Vázquez Martínez et al and Sørensen et al show that MOOCs are an effective tool for improving health literacy, as improving health literacy is a challenge for society and healthcare services, and individuals with low health literacy levels may have difficulty interpreting prescriptions or hospital reports, which MOOCs can address.^{33,34}

Alvarez-Perez and colleagues' study showed that MOOCs are a promising tool for diabetes care that can help reduce the limitations associated with low digital health literacy and serve as a fundamental aspect of self-management education for individuals with diabetes to develop the necessary skills to improve health outcomes.³⁵ The findings of another study showed the high potential of MOOCs as a means of increasing health literacy among people, enabling them to gain greater knowledge of their general health aspects and continuously update their health literacy in all areas while utilizing international knowledge in this field. also, Liyanagunawardena's study showed that using MOOCs as a way to combat loneliness among the elderly exists by engaging them as learners.³⁵

Patient education

Perestelo-Perez study showed that patient-centered MOOCs, integrated with knowledge-based decision-making, can provide education and information to patients when needed and be beneficial for improving their self-management skills.³⁰ Dolores-Maldonado and Walsh study demonstrated that due to the widespread effects of COVID-19 and mandatory social distancing measures, routine care for disease prevention and health promotion has significantly decreased. In this regard, extensive online MOOC courses provide opportunities for health education, promotion, and disease prevention.^{36,37} Gleason and colleagues' study showed that MOOCs offer the potential for providing evidence-based safety science education in healthcare and fundamental principles of patient safety to learners, including interested patients, through health experts.³⁸ Hauer and colleagues' study demonstrated that MOOCs have great potential for disseminating scientifically validated knowledge about human health, with unknown probabilities of directly impacting human health outcomes, to patients in counseling programs for behavior change in health sciences.³⁹

Another study showed the importance of self-management among patients. Increasing self-management levels may prevent patients from experiencing more disease-related complications, and tailoring education to meet patient needs and providing subsequent education on various topics can significantly improve patient understanding. Remote education through online MOOC courses can be useful.^{40,41} Stathakarou and colleagues' study demonstrated the importance of integrating virtual patients into MOOCs to enhance interaction

and strengthen clinical reasoning skills education.⁴² The results of multiple studies have shown that MOOCs are innovative tools for improving education, easily accessible to empower patients with chronic illnesses to find quality, fair, and patient-centered education to achieve better health outcomes. Additionally, by engaging potential users and healthcare professionals, MOOCs can lead to an effective strategy for designing possible solutions aimed at increasing patient self-efficacy and empowerment.^{43,44}

Another study showed that MOOCs can help reduce the risk of non-communicable diseases by controlling risk factors such as stress, sleep, and physical activity and can be used in behavioral medicine to focus on chronic disease management techniques to achieve maximum lifespan.⁴⁵⁻⁴⁶

General education

A study by Magaña-Valladares et al showed that MOOCs can be an important public health strategy for improving understanding of risk reduction and providing an active and stimulating environment beyond traditional classroom sessions, offering a unique opportunity to provide accessible online education to international learners. Furthermore, MOOCs can serve as a useful educational strategy for preparing personnel and the public for emergency situations.⁴⁷ Another study by You et al demonstrated that MOOCs aim to increase awareness and understanding of public health challenges and continuously implement health system improvements to address new health challenges for the public. Also, A multi-disciplinary MOOC can help increase awareness and understanding of topics addressed by new policies.⁴⁸ Wang and colleagues' study showed that extensive participation in learning through MOOCs is important in terms of behavioral, cognitive, emotional, and social communication learners acquire.⁴⁹ MOOC education can be used as a tool for public education on important health issues. It can help individuals educate themselves without the need to speak with a health specialist. For example, public education on destructive subjects such as "drug addiction" can also be achieved through MOOCs and be a way of educating the public.

Prevention

Coursera, study showed that using relatively high-level MOOC courses teaches prevention needs. Moreover, MOOCs provide opportunities for international learners to measure, analyze and offer unique opportunities to present general education and prevention programs. Additionally, they provide insights into best practices, as well as the related challenges for preventing suicide internationally.⁵⁰ Milbourn and colleagues' study showed MOOCs can be beneficial in improving the ability to respond to concerns related to suicide and mental health and help understand and quickly implement suicide

prevention programs safely online.⁵¹ Another study showed that mental health problems among college students are common, and alarming levels of suicidal ideation are often observed in this population. There is a need for evidence-based mental health education and suicide prevention programs. Therefore, MOOCs have been used to manage crises. Farrow and colleagues' study showed that dementia is a global public health priority and reducing its risk is a public health response. It is estimated that 40% of cases are attributed to modifiable health and lifestyle factors, there is low public awareness of scientific evidence, and individuals' opportunities to adopt risk-reducing behaviors are limited. Thus, MOOC courses are crucial for preventing dementia.⁵²

Treatment

Álvarez-Pérez and colleagues' study showed that prioritizing chronic care conditions in facilitating high-quality healthcare is an important issue. The effort to provide high-quality healthcare and focus on recognized chronic care conditions is a priority for the best use of available resources. Healthcare organizations encourage patients and other stakeholders to work together to identify evidence-based care processes consistent with best practices and organize prevention and treatment programs for behavior-related health risks to improve cancer diagnosis and management. Access to quality health information can help patients deal with potential health consequences.⁵³

Skills training

Studies in this area show that MOOCs enable individuals to explore healthy career options and develop skills for their future careers. With training in resume and cover letter writing, job searching, interviewing, professional networking, and professional communication, it creates the potential to provide exploratory resources and health careers and job readiness for global populations and examines key challenges and opportunities for health care professions.⁵⁴⁻⁵⁹ Huang and colleagues' study showed that MOOCs are very important in improving clinical skills and are worth supporting as an additional tool for clinical education.⁵⁵

Discussion

In recent years, MOOCs have emerged as a new educational model in the field of health to broaden participation and provide free access. MOOCs have gained rapid popularity across all areas of health education, including public health, continuous education, health literacy, treatment, and prevention research findings indicate that MOOCs have been widely accepted for learning in higher education by top universities around the world, for continuing education of students, physicians, and teachers, and are being used extensively worldwide. This

type of education provides an advantage for individuals who wish to complete their academic courses without attending universities physically or supplement their face-to-face learning with online courses. As a result, MOOCs have been successfully employed in various health fields for remote teaching, and they are now being widely utilized as a primary educational tool in the health sector. They are also being used extensively to improve the quality of medical education, making them an excellent opportunity for faculty members and students to learn regardless of geographical location or physical space. Moreover, research findings demonstrate that MOOCs have deeply penetrated the healthcare system and are being used extensively to teach various aspects of health, such as radiology, nursing, ophthalmology, pharmacy, parasitology, public health, sports science, dentistry, and more. The use of learner-centered approaches, evidence-based practices, current concepts in education, and addressing challenges in education are crucial elements of MOOCs.¹

Furthermore, research indicates that online learning is becoming a fundamental method of medical education and can be especially helpful during global crises. It can help eliminate unequal opportunities in accessing educational resources, inadequate course content, and delays in clinical education.⁵⁴ MOOCs are increasingly penetrating through electronic learning and are being used as a credible educational approach in the health sector to reach large populations. These courses have the potential to provide better learning experiences than face-to-face courses in learning communities, where students and teachers use them as a necessary approach to learning in higher education, not only in developed countries but also in less developed economies.⁵⁶

Other studies in this field have identified the advantages of MOOCs in health education, including their focus on learning objectives, assessment methods, short course duration, evidence-based content, flexibility, collaborative learning, visually rich technological environment, design, adaptability, navigation, dialogue interaction, learner-centeredness, credibility, quality, and feedback methods for improving educational performance.^{32,57} With the increasing popularity of MOOCs for higher health education, they have gradually become one of the most important topics in the field, assuring the quality and effectiveness of education.⁵⁸ Open online courses offered by MOOCs as an antidote to educational inequalities have challenged location-based learning without regard to subject matter or discipline.⁵⁹

According to other research findings, the benefits of using the MOOC instructional model in health education include live instructional content, improved student capabilities, good interaction between instructors and students, improved learning efficiency of medical students, use of the latest technology methods, current instructional concepts, innovation in assessment

methods, and teaching effectiveness.³² Another aspect of these research findings relates to health literacy. Based on these findings, health literacy is the ability to search, understand, and evaluate information and use it to solve health problems, especially during sudden pandemics. Due to their flexibility, MOOCs play a vital role in promoting health literacy by changing instructional frameworks and diversifying learning models, making them accessible and implementable for health professionals and the general public. Additionally, these findings indicate that inaccurate, misleading, or incomplete information on the internet can lead to harmful health outcomes. Thus, self-management education with credible information is a fundamental aspect of healthcare that requires competencies in managing electronic information resources and a suitable level of digital health literacy, for which MOOCs are critically important.

Studies have shown that extensive MOOCs can improve the digital health literacy of learners by enhancing their skills to identify reliable and useful health information.⁶⁰ MOOCs are an effective tool for improving digital health literacy skills, enabling individuals to play a more active role in identifying which daily health information is accurate and useful, and increasing their empowerment for self-health management.^{27,37} Using MOOC education can provide automatic self-efficacy and empowerment for women during pregnancy, childbirth, early childhood, and nutrition.⁶¹ MOOC courses can increase knowledge about chronic diseases, provide credible information, enhance informed decision-making, and improve quality of life.⁶²

Another aspect of the present research findings is patient education. The findings indicate that MOOCs provide patients with the ability to acquire health education on highly specialized topics, teach patients essential information during the early stages of the disease to help them understand the consequences of the disease, and inform them about available advanced techniques and interventions. Additionally, MOOCs have bridged the language gap (medical terminology) and knowledge gap between patients and physicians. Therefore, patients can participate in discussions with medical specialists regarding the care they receive, and alternative treatments, and be informed about potential therapies, which can facilitate medical tourism for those who have financial means.

Research conducted in this area demonstrates that open-access online MOOCs for patients can expand medical skills, and interaction, and strengthen clinical reasoning skills virtually.⁶³ Patient knowledge and skills improved after completion of MOOC training sessions, which can serve as a source for enhancing patient soft skills for better satisfaction with surgery and follow-up care.⁶⁴ MOOC education in counseling programs is very effective for changing patient behavior.⁶⁵ An online open-access MOOC course provides fundamental principles

of safety in healthcare, using basic safety principles to provide patients with knowledge about safe care.

General education is another aspect of the present research findings. MOOCs create opportunities for sharing ideas and collaboration among institutions locally or internationally, facilitating more meaningful interaction in health education. In fact, MOOC technology has the potential to provide a useful platform for cost-effective, mass health education and learning with many learners. MOOCs can provide high-quality healthcare professional education under almost any condition and increase standardization of curriculum resources and personalized learning experiences.

Research conducted in this area shows that increasing hope for life requires vital health needs. MOOC courses are very important for the general population in this regard.⁶⁶ MOOCs offer great potential for disseminating scientifically validated knowledge about human health and unknown probabilities that have a direct impact on public health.³⁰

Prevention and treatment are among the areas of focus in the present research. Research findings have shown that medical education is the cornerstone of the global fight against disease, and extensive open-access online MOOCs are essential educational tools in prevention and treatment, as they impact the knowledge, skills, and professionalism of healthcare providers. From a broader perspective, MOOC-based education can help communities improve their global medical and health education for disease prevention or treatment by providing the latest evidence-based guidelines and advanced research in an easy and globally accessible manner. This issue is particularly important in times of sudden epidemics, where self-care becomes accessible and cost-effective for the prevention and control of these diseases, even treatment, requiring active participation by individuals before and after their illness to understand complications, symptoms, and prevention measures for the treatment process, especially in societies where in-person education is limited.

In line with the research findings, the results indicate that mental health problems are prevalent, and alarming levels of suicidal ideation exist, highlighting the need for evidence-based mental health education and suicide prevention programs tailored to specific needs. MOOCs provide useful educational programs for managing crisis intervention and prevention of suicide through mental health education.⁶⁷ Chronic patients are the main reason for patient referral to healthcare the most common cause of disability and the largest factor in healthcare costs, with personal impacts such as suffering, disability, depression, suicide, and other problems. Considerable effort has been made for prevention, and extensive online MOOCs have been instrumental in this regard.⁶⁸ An extensive online training course can translate concussion prevention knowledge and increase people's literacy before they get involved in it.⁷² MOOCs have been significant in remote

digital therapy interventions based on evidence-based interventions, either independently or in combination with other treatment methods.⁶⁹ MOOCs are effective in infectious disease education and improving learning efficiency.⁷⁰

Skills training is another area of investigation in the present study, as MOOCs offer new options for professional and lifelong skills development in various fields by providing ample opportunities for gaining more knowledge or developing skills, increasing motivation, and job-related competencies among professionals. Additionally, research findings have shown that digital skills are essential not only for information technology and communication jobs but also for employees in all sectors, including healthcare. MOOC training courses can help reinforce employees' digital skills.⁷¹ MOOCs are a crucial tool for unemployed individuals seeking employment, as they provide job-related training and a way for workers who do not receive training from active employers to acquire it.⁷² MOOCs facilitate learners' managerial skills based on time management and resource management factors.

Conclusion

The importance of education in skill acquisition for behavior change and health behavior management has been increasingly recognized worldwide. Online MOOC courses are an innovative tool for providing effective, quality, fair, evidence-based education that has revolutionized health education. They promote lifelong learning and skills development, enhance health literacy, provide online education to patients and the general public, and improve prevention and treatment, as well as education for students and healthcare professionals based on international and credible knowledge. MOOC courses have become a useful educational strategy for preparing personnel, students, and health experts at all times, especially in emergencies, due to considerable time and cost savings, international accessibility, and attention to location-independent education. They offer the greatest potential for transferring interdisciplinary knowledge and skills to a broad population. Today, MOOCs are at the forefront of improving the quality of healthcare, prevention, treatment, and health literacy in response to economic crises and sudden epidemics worldwide. Moreover, recent scientific findings show that a high percentage of health risk factors and lifestyle-related issues are related to a lack of education and skill acquisition in the health field. Despite this, MOOCs are crucial candidates for increasing health knowledge, promoting healthy behavior change, and enhancing health literacy. Improving health factors, increasing health literacy, especially in deprived regions of the world, adopting healthy lifestyles, job-related training, expanding interdisciplinary collaborations, responding to sudden health crises, increasing global aging population, reducing

health inequalities, increasing food insecurity, and drug abuse, decreasing in-person training during epidemics, increasing dropouts from traditional education, and recognizing the importance of health tourism requires skill acquisition. Therefore, the importance of MOOCs in the health sector has doubled compared to the past, which requires policymakers' attention to the relevant infrastructure for this type of education.

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Competing Interests

The authors declare no conflict of interest.

Ethical Approval

Ethical aspects were considered in all steps of the study and texts belonging to other authors that have been used in any part of this study have been fully referenced and cited.

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