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Original Article

# Explanation of A Framework for the Effective Implementation of E-Learning at Universities of Medical Sciences: A Mixed Exploratory Method

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## Abstract

**Background:** E-learning is considered the most important technology that can support new teaching-learning approaches. The objective of e-learning is to provide the same access and create the same educational space for all learners at any point, and optimize the methods of presenting course content for deeper and more serious learning.

**Objectives:** The present study was conducted to develop a standard framework for the effective implementation of e-learning in medical science education.

**Methods:** This study was conducted in two phases in 2022 using a mixed exploratory method. In the first (qualitative) phase, the initial framework was obtained from a comparative review of existing literature. In the second (quantitative) phase, the calculated standards were prepared in the form of an online questionnaire and sent to 20 e-learning experts in medical sciences. After data analysis, a framework of e-learning standards were proposed.

**Results:** Nine dimensions and 58 standards were approved as the framework of e-learning standards. The lowest and highest content validity ratio (CVR) based on the analyzes were reported to be 0.77 and 0.88, respectively. As a result, all dimensions and 58 standards were approved. Also, the intraclass correlation (ICC) between 0.75 and 0.90 showed good reliability and high agreement between experts.

**Conclusion:** Using a standard framework to implement e-learning helps to improve the quality of e-learning courses in medical sciences and brings more trust from internal and external stakeholders in these courses. Therefore, it is necessary to focus on the field of education and attempt to make educational organizations work in the best way in any situation, such as the fact that the world has recently been exposed to the o COVID-19 pandemic which led to the tendency of universities to use it.

**Keywords:** E-learning, Medical Science Universities, E-Learning Standards, Delphi Technique

## Background

E-learning is defined as active and intelligent learning, which, while evolving in the teaching-learning process, plays a fundamental and central role in expanding, deepening and stabilizing the culture of information and communication technology (1). Some researchers believe that e-learning has more advantages than traditional methods, including ease of use, cost-effectiveness, regular updates, flexibility, support for learners to succeed in education, better control over the environment, and accessibility (2, 3). In some studies, including Costa et al. (4), Wang (5), Singh and Min (6), Ghoreishi et al. (7), and Bali and Liu (8), students have reported high satisfaction with e-learning. In addition, the effectiveness of e-learning is influenced by the active learner, learner-based, content, interaction, consideration of individual differences of learners, flexibility, providing feedback and assessment (2). In their study results, Alqudah et al. suggested the use of suitable technical settings, the support of e-learning systems, the simultaneous use of two asynchronous and synchronous types independent of time (3).

In medical education, there is a growing tendency to replace traditional teaching with electronic courses,

especially blended learning, to meet the needs of students in relation to easy access to information and other technical skills (4). The COVID-19 pandemic caused the closure of universities, and in this great threat that brought the face-to-face education system of universities into serious danger, an exceptional opportunity arose for the position of e-learning in Iran to face a fundamental transformation (5). Although it seems that the advantages of e-learning have overtaken its limitations and it has become an attractive choice in the field of improving competencies and updating medical knowledge and skills in continuing medical education, facilitating the possibility of continuing education at higher levels and promoting lifelong learning culture among professors and students, it should be noted that the design and implementation of successful and highly effective e-learning courses at universities of medical sciences need attention to requirements (6).

A review of the fate of organizations in recent years shows that there have been successful organizations in the field of development that have been able to, with a correct understanding of the environment and its developments and an accurate and realistic assessment of internal capabilities, develop effective brochures based on their mission and provide a suitable platform for the implementation (7). It is necessary to survive in the competitive world, align with the conditions of the new era, think and act globally and find better opportunities (8).

Despite the widespread adaptation of education around the world by electronic methods, especially during the COVID-19 pandemic, this type of education has not yet been recognized in higher education centers, including universities of medical sciences, and is facing challenges (9). These challenges are divided by researchers into three categories "challenges related to students, including inappropriate access or lack of high-speed and efficient Internet connection, software, and hardware limitations, a place to study, and lack of interaction between professors and students; challenges related to professors, including job challenges and increased workload, access to equipment, adequate familiarity with technical issues; challenges related to administrators policymakers, including problems related to the transition to digital learning and challenges related to equipment, infrastructure, and technical issues (10). Selim stated the critical factors for the success of e-learning mainly in four main groups of teacher, learner, content, and support of the university (11). In a study by Fleming et al., which was conducted to identify factors affecting the success of e-learning, these factors included initiative, reducing complexity, and technical support (12).

According to the existing literature, the focus of most studies has been on introducing capacities, challenges, and solutions for the effective implementation of e-learning. In fact, few studies have been conducted to propose a framework for its effective implementation in medical science education. What is certain is that the e-learning system at universities of medical sciences in Iran is on the path of development. The conducted studies have shown that the use of e-learning at universities of medical sciences in Iran, despite the advance in recent years, is facing shortcomings compared to advanced countries. Therefore, reflecting on the above issues suggest the necessity of a basic and fundamental action in education, especially in the main and fundamental component (development of the main effective components of its implementation). Also, with the knowledge of the environment and identification of the existing developments, the necessary changes should be made in order to continue the dynamic life. These changes should be along with current knowledge and meet educational needs. As a result, the present study was conducted given the need for the effective implementation of e-learning in the field of medical science education by a strategic approach to developing a standard framework for providing effective e-learning.

## Objectives

The present study was conducted to develop a standard framework for the effective implementation of e-learning in medical science education.

## Methods

Given that the items related to the effective implementation of e-learning at universities of medical sciences have not been identified and there was no structural and theoretical guide, exploratory mixed methods design, which is one of the strategies of the integrated method, was used. This method includes the collection and analysis of quantitative and qualitative data in one study (13). A sequential exploratory design is a mixed research design in which the quantitative phase of data collection and analysis follows the qualitative phase of data collection and analysis (14). The present study was conducted in two qualitative (the review of literature related to the study question) and quantitative (the use of the opinions of experts in the field of e-learning in medical science education) phases.

### Qualitative phase: content analysis

In the first phase, using the content analysis method, the basic structure and the influencing factors in each of

the dimensions of the model were identified by analyzing the existing literature. The statistical population of the study included all the studies conducted on the components affecting the implementation of e-learning in medical and health sciences education. The articles using the keywords "e-learning design, development standards courseware, instructional design standards, technical standards, e-learning implementation, delivery standards, online, e-learning, virtual education, and education" were searched in Web of Science, Education Resources Information Center (ERIC), Scopus and PubMed databases. The screening process of the articles in this field included checking the non-repetition, appropriateness of the title, abstract, introduction, and conclusion with the research topic, and the result was the selection of 41 articles. After selecting the articles that are completely related to the objective of the research using the qualitative content analysis, a six-step process including "familiarity with the data, creating initial codes, searching for selective codes, forming subcategories, defining and naming the themes, and preparing the report and drawing of the thematic network" was reviewed and finally, the initial format of the framework was prepared (15) (Figure 1).

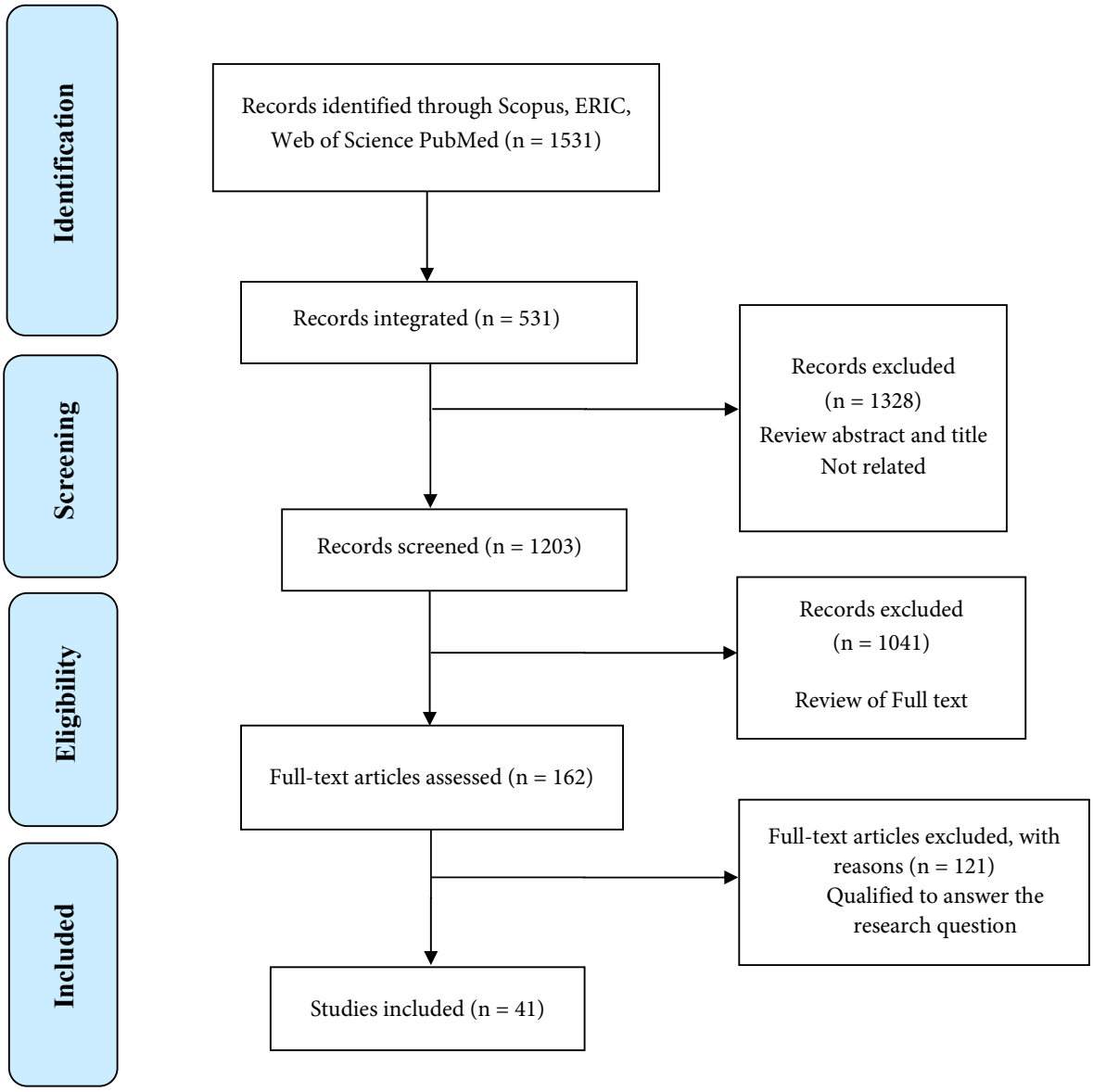


Diagram 1: Flowchart of screening and selection of articles

### Quantitative phase: Delphi technique

In the quantitative phase, after identifying the components of the framework to improve the results and check its details, the Delphi technique (16) was used twice to determine the final factors and criteria. To collect opinions, a semi-structured questionnaire on a five-point Likert scale (completely agree, agree, no idea, disagree, and completely disagree) was used that was distributed online using Porsline (https://porsline.ir). The statistical population of the research included experts in the field of e-learning in medical sciences, who were purposefully included in the study, and due to the lack of complete knowledge, the snowball method was also used to identify the research samples. Finally, 20 experts in the field of e-learning with written articles, scientific lectures, student theses in bachelor's and doctorate degrees in this field, and were also faculty members of medical sciences universities, were included in this study (17). In order to verify the obtained information, the questionnaire was sent to experts in the field of e-learning in the country's medical sciences through email, and analyzing and summarizing.

After receiving the completed questionnaires in the first phase and organizing the answers and applying the comments, the questionnaires were again sent to the participants through Porsline in order to collect the opinions and suggestions of the experts regarding the compliance of the proposed standards with the educational conditions of the country and achieve a relative agreement.

### Results

After collecting the questionnaires of the second phase, data were analyzed to verify the developed standards, and for this purpose, CVR and content validity index (CVI) (18-20) were used. According to the number of participants (n=20), items whose CVR was less than 0.49 were excluded from the questionnaire (21). Then, using the mean CVR scores, the remaining CVI questions were measured. CVI higher than 0.75 or 0.80 was considered as acceptable and desired (22). To confirm the reliability of the questionnaire, ICC was used (23).

The results of the first phase showed the development of the initial framework of e-learning standards including 9 dimensions and 58 standards (Table 1). The results of the second phase showed that according to the demographic information of the participants, 57% of the respondents of the Delphi technique were women. The validity of the content showed that the score of 3 standards was lower than the desired level. Therefore, these questions should be excluded from the questionnaire (Table 2). The validity of the whole questionnaire was 0.82 and its subscales were between 0.77 and 0.88. Given that the coefficient of all dimensions was close to 1, the questionnaire has high validity (Table 3).

Cronbach's alpha coefficient for the questionnaire was calculated as 0.95 and between 0.55 and 0.87 for its subscales. Given that these values were higher than 0.70, the questionnaire showed a satisfactory internal consistency, and the assurance of the internal correlation of the questions was obtained. The value of the Pearson correlation coefficient was obtained at an interval of one week for the questionnaire twice 0.90 and was significant at the 0.05 level, and reported between 0.71 and 0.91 for the subscales, indicating the reliability of the questionnaire. The ICC value for the questions of the questionnaire was calculated at 0.95 and between 0.83 and 0.95 for the subscales, indicating the high level of agreement between experts in the questionnaire (Table 4).

**Table 1.** Dimensions and standards of the effective implementation of e-learning framework in medical science education

| Dimension | Standard |
|---|---|
| Course management standards (6 standards) | In the content of the course, the information of the university and the producer should be included, and the content should be free of any advertisements outside the university. |
| | The training provider should take reasonable and reliable measures to reduce the risk of fraud and misconduct of learners and other people. |
| | Before the start of the course, the duties of the learners should be given to them, and the consequences of not complying with they should be fully explained. |
| | Access to the course shall be restricted to users with access credentials issued by the University. |
| | Comprehensive and complete guidance on how to work with the system should be given to learners and details should be provided to each student and show where they can get guidance. |
| | All the course content should be provided to the learners at the same time in the electronic learning management system. |
| Educational design and pedagogy standards (6 standards) | The design of the course and the learning topic should be in accordance with the principles of educational design (at the beginning of the course, a dedicated storyboard should be developed). |
| | Continuous interaction between learner, teacher, and content should be considered. |
| | Support a wide range of learning styles (visual, auditory, etc.). |
| | Learning topics should include activities, assignments, and reflections, and appropriate feedback should be given to learners about them. |
| | The content should be presented in a logical order based on the objectives of the curriculum. |
| | The introductory part should have a brief review of the lesson and act in an inductive way that can motivate the learners to pay attention to the lesson. |
| Curriculum standards (4 standards) | The content and arrangement of the course should cover all topics and objectives of the curriculum. |
| | The course plan or lesson plan for the courses should be developed and provided to the learners at the beginning of the course. |
| | The course should use formative e-learning assessments and quizzes throughout the course to gauge student understanding of the subject matter. |
| | Up-to-date and new content should be used in content development. |
| Technical standards (8 standards) | The electronic learning management system should be easily accessible to all users. |
| | The content of the course should be accessible at home or university with low bandwidth. |
| | The content can be used on all operating systems such as PC and Mac |
| | Multimedia content is optimized for size and use with standard computer graphics and systems (for example zipped files, MP3 files, JPEG or TIFF for photos, and GIF or PNG for computer graphics). |
| | Video, image, and audio file formats can be played in commonly used plugins or players. |
| | Textual content should be available to learners in standard formats along with audio and visual content. |
| | The content contains full information about the author(s) of the content, respecting the rights of the authors to use pseudonyms or remain anonymous. |
| | The learning management system should allow the user to control the pace of his learning; Especially when looking at videos, animations and text (providing content navigation to learners). |
| Design, visual and media standards (7 standards) | The content of the menus, icons, or navigation signs (such as the reading icon, audio file, video, etc.) should be compatible with each other in terms of form and function. |
| | The content should use a standard font visible on the web for content. |
| | Spelling and terms used throughout the learning topic are correct and abbreviations are fully defined. |
| | Key terms should be displayed on the screen and defined in the e-learning management system glossary. |
| | Regular formatting includes white space, effective use of color and graphics when necessary, and text color that is clearly readable against background colors. |
| | The text is organized in readable paragraphs for presentation on the computer screen. |
| | The provided content should have an appropriate tone, readability, look and feel. |

**Table 1.** Dimensions and standards of the effective implementation of e-learning framework in medical science education (continue)

| Dimension | Standard |
|---|---|
| Content standards (9 standards) | All content should be appropriate for the audience and designed to enhance learning. |
| | Clear instructions for using the content should be provided at the beginning of the course. |
| | Explanations of all rules, technical considerations for the content of each session should be provided. |
| | The content should include graphics and images related to the content, and all graphics and images should be appropriate, relevant, and complementary to the learning. |
| | If additional references are included for further study, the references should be current, useful, relevant, and available to learners as additional references from the beginning of the course. |
| | The content should be downloadable for future use by learners. |
| | Learners should view all the content of the e-learning course with correct spelling, grammar, and punctuation. |
| | The course should provide a positive and interactive learning experience for the student and the content should be consistent with the objectives. |
| | Spelling, grammar, and punctuation should be correct in all contents. |
| Comprehensive assessment and course standards (12 standards) | A comprehensive assessment should be on time to avoid the gap between the end of the course and the beginning of the the assessment process and harming the learners. |
| | Any learner who is unsuccessful in the assessment can be offered again using an alternative assessment. If he fails the second attempt, he should re-enroll in the course. |
| | Assessments should include clear instructions so learners know how to complete them. |
| | Exam questions should be organized at three easy, medium, and difficult levels. |
| | The questions should be diverse and should not include several types of questions, including multiple-choice, sorting, drag and drop, filling, and descriptive types. |
| | The learner should be free to select the first question to answer; i.e., like a paper question sheet, he should be able to start from wherever he wants and move between answered and remaining questions. |
| | After the end of the test, an option should be available to the learner, by clicking on it, he can review the question, the wrong answer, and the correct answer. |
| | Tests should include appropriate feedback, and meaningful, useful, and relevant feedback should refer to the learner to additional information where necessary and where it can be found. |
| | Through continuous review, the opinions of the learners should be assessed and revised. |
| | The content of the course and its presentation method should be assessed and revised under the supervision of experts in the field of e-learning and medical education. |
| | A quality assessment should be performed to ensure that the course functions correctly and that there are no errors. |
| | Audio and visual content should be assessed in terms of quality. |
| Learner support standards (6 standards) | Online content should be provided to all learners participating in an online course, and learners should be informed of how to access this content at the beginning of selecting a unit. |
| | All educational content such as books and supplementary content should be made available to online learners. |
| | Appropriate support and guidance for e-learning and assessment should be available. |
| | Learner service support is designed to promote and maintain a collaborative virtual learning community and support learners. |
| | Learners should be informed of any planned breakdowns and disruptions in the e-learning system. |
| | Supplementary and supporting information should be provided to the learner and used as a reference tool after completing the course. |
| Professor support and training standards (3 standards) | Self-learning and training of hardware and software used for the development of e-learning content should be available for all professors. |
| | There should be technical support for the content produced and presented by the professors. |
| | The professors who develop e-learning courses should successfully complete the e-Learning Accreditation Course. |

**Table 2.** Standards removed according to CVR

| Dimension | Standard | CVR |
|---|---|---|
| Course management standards | Access to the course shall be restricted to users with access credentials issued by the University. | 0.4 |
| | All course content should not be provided to learners at the same time in the electronic learning management system. | 0.2 |
| Comprehensive assessment and course standards | Students who are unsuccessful in the assessment can be offered again using an alternative assessment. If they fail the second attempt, they should re-enroll in the course. | 0.3 |

**Table 3.** Validity coefficients of the dimensions of the standards framework for the effective implementation of e-learning in medical science education

| Dimension | CVR |
|---|---|
| Total | 0.820 |
| Course management standards | 0.87 |
| Educational Design and pedagogy standards | 0.80 |
| Curriculum standards | 0.77 |
| Technical standards | 0.81 |
| Design, visual, and media standards | 0.88 |
| Content standards | 0.82 |
| Comprehensive assessment and course standards | 0.80 |
| Learner support standards | 0.83 |
| Professor support and training standards | 0.80 |

**Table 4.** Reliability coefficients of the dimensions of the standards framework for the effective implementation of e-learning in medical science education

| Dimension | Internal consistency (Cronbach's alpha) | Pearson's correlation coefficient (test-retest) | ICC |
|---|---|---|---|
| Total | 0.95 | 0.90 | 0.95 |
| Course management standards | 0.63 | 0.83 | 0.91 |
| Educational Design and pedagogy standards | 0.55 | 0.75 | 0.85 |
| Curriculum standards | 0.76 | 0.78 | 0.87 |
| Technical standards | 0.71 | 0.83 | 0.91 |
| Design, visual, and media standards | 0.77 | 0.91 | 0.95 |
| Content standards | 0.87 | 0.72 | 0.83 |
| Comprehensive assessment and course standards | 0.87 | 0.87 | 0.91 |
| Learner support standards | 0.63 | 0.92 | 0.94 |
| Professor support and training standards | 0.78 | 0.91 | 0.95 |

## Discussion

According to the results of the present study, in order to effectively implement e-learning, a framework was proposed with 9 dimensions and 58 standards, including "course management standards, educational design and pedagogy standards, curriculum standards, technical standards, design, visual and media standards, content standards, comprehensive assessment and course standards, learner support standards, and professor support and training standards. One of the strengths of the present study was the attention to the development of a standard framework that takes into account all educational, content, technical, and executive dimensions. In addition, what highlights the implementation of the present study was the use of the opinions of medical science faculty members who simultaneously had scientific activities related to e-learning.

E-learning has found its place and identity in today's information age. It seems, today, e-learning can eliminate some of the limitations of face-to-face training. While policy-making and planning should be done in a way that does not become a challenge. There are different frameworks in different studies. For example, the general framework of e-learning in a study by Khan includes eight categories of success factors including "technology, education, organization, management, interface, support, assessment and ethics" (24).

AbuSneineh and Zairi proposed a framework that addressed the five dimensions of "training, technology, support, faculty members, and institution" (25). Bhuasiri et al. investigated the success factors affecting the adoption of e-learning systems in developing countries and their results showed 6 dimensions and 20 factors, which mainly focused on the importance of

curriculum design, knowledge of technology, motivation, and behavior of learners (26).

Other research has attempted to standardize various aspects of e-learning. Although they have not directly mentioned the word standardization, the measures they have taken to improve the quality of e-learning through the integration of learning theories have in practice led to the standardization of e-learning. For example, Holsapple and Lee-Post investigated the content quality and content usability services in e-learning systems (27). In order to identify the critical success factors of e-learning in higher education, Basak et al. in a study proposed a framework based on 8 topics including "technological, management, organization, education, assessment, resources, and social and ethical interaction" affecting the ease of use and perceived usefulness (28).

As mentioned in the present study, curriculum design standards are an important part of e-learning quality. Similarly, in a study by Blieck et al., curriculum design was generally consistent with expectations or requirements for knowledge, skills, and curriculum elements based on professional outcomes. The main challenge for institutions for curriculum design is to combine the flexibility in time and place for learners that e-learning provides without compromising the development of skills or the sense of academic community traditionally associated with academic governance (29).

Technical standards requirements include reliability and security standards. The e-learning system should be reviewed and monitored to ensure that it continues to meet the needs. Many studies have been conducted on the technological dimensions of e-learning, and several researchers have emphasized the important role of technology in the successful implementation of e-learning. Technology plays an important role due to its possibilities, flexibility in presentation methods, and interactions in online settings (11). The effective use of technology for providing courses to learners is essential for the success of e-learning, which makes the process as smooth as possible (28). The factors such as "infrastructure, compatibility and effectiveness of information technology, reliability, accessibility, hardware, software, interface design, support and training of information technology (for professors and students), and compatibility of technology with educational content and ease of use, which are also confirmed in various studies are located (11, 25, 26, 30-33), are related to each other.

In the process of e-learning, visual content such as educational videos and animations enables the effective increase in knowledge among the group of learners. Thomas et al. stated that visual learning improves learning processes at several stages. Visual learners can store information in their minds for a longer period, which helps in the long-term retention of educational content. Proper communication through visual educational content helps to develop the imagination process of learners. Therefore, e-learning courses help to provide better knowledge and stimulate cognitive learning capabilities (34). According to Lowenthal and Hodges, visual learning methods and animations contribute to easier acceptance of learning methods. Therefore, the effective use of e-learning methods provides the possibility of an effective understanding of difficult subjects. The absorption of images and the introduction of graphic and image education increases the energy level of students (35). Sarrab et al. in a study stated that animated films act as a stimulus that increases the learning functions of the human brain. Using live color videos and visual metaphors in e-learning processes is successful in creating long-term effects (36).

E-learning courses allow learners to grow and provide regular assessments. Assessment helps the gradual development of students' learning skills. According to Bawa, the e-learning system provides an opportunity to assess students' performance and portfolios. In fact, the assessment of learners provides a wide range in the improvement of learning methods (37), and in addition to assessing the consideration of feedback from professors, it will help the gradual progress of the effective learning process. Ouhbi et al. in a study pointed out that in e-learning, the development and promotion of courses depend only on feedback and from the perspective of learners, which provides the possibility of improving education (38).

Technical support is part of any e-learning setting. Everything should be maintained and like any other technology, problems occur and should be solved. There are many studies about the types of support in e-learning. Cheawjindakarn et al. stated that support is a key issue. Because e-learning will not achieve its goals without counseling and support (30).

The results of the literature review show these support factors such as "online support, resources (online and offline) (39), compatibility of support services with the educational and technical needs of learners, staff accountability and support services to learner questions (25), institutional support, student support and faculty support.

Professors play one of the important roles in the effective implementation of e-learning. In fact, a direct positive relationship is between the quality of e-learning courses and the role that faculty members play in the

success of their courses. However, the implementation of e-learning in institutions without proper training creates negative experiences for the institutions, teachers, and learners (40). Several researchers have identified faculty member-related factors that have a significant effect on the successful implementation of e-learning, including "competence, either pedagogical or technical, involvement in e-learning activities, innovation, and the creation of new methods that improve the e-learning environment, identification of overload, intellectual participation, etc. by professors, the success of the institution with online learning" (41, 42).

Given the rapid development of countries around the world that increased the intensity of competition in all fields, especially in the field of learning, in the field of e-learning, efforts should be made to prepare educational organizations for any situation such as recently the world has exposed to COVID-19 pandemic, leading to the tendency of universities to use it to work in the best way. In this regard, the use of effective e-learning presentation frameworks developed in the present study can actually be considered in the policy-making of medical universities and help its effective implementation. In line with the development of this framework, it is suggested to use the opinions of medical education and e-learning experts at the international level, which can greatly help the development of these standards. Among the limitations of the present study, we can point out the small number of national experts in both fields of medical science education and e-learning, which was attempted to a large extent by using snowball sampling to select an appropriate number.

## Conclusion

Using a standard framework for the implementation of e-learning helps to improve the quality of e-learning courses in medical sciences and brings more trust to internal and external stakeholders in these courses. As a result, it can be said that all these dimensions are important and have an effect on the implementation of e-learning in medical science education. A systematic understanding of these factors helps designers and developers to successfully implement e-learning courses. It is suggested to evaluate various e-learning courses in medical science education based on the framework proposed in this study, which on the one hand leads to the improvement and development of this framework, and on the other hand, is effective in assessing the quality of these courses and their distance with standards of e-learning courses in medical science education.

**Supplementary material(s):** is available here [To read supplementary materials, please refer to the journal website and open PDF/HTML].

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