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The Criteria for Evaluation of the Integration of Information and Communication Technology in the Curriculum

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Abstract

Background & Objective: This study aimed to review the criteria for evaluating the integration of information and communication technology (ICT) in the curriculum, and given its significance, providing the necessary assessment recommendations.

Materials and Methods: This study was a theoretical-systematic review performed with keywords such as "integration," "evaluation," "information and communication technology," "medical education," and "curriculum" in the Latin databases of Ovid Science direct and PubMed. Similar Farsi keywords were looked up in SID, Iranmedex, Normagez, and Magiran databases by the search engines of Google and Yahoo from 2008 to 2019. From a total number of 158 articles, 22 works were selected according to the inclusion criteria such as the study title, objectives, and specified timeframe, and were analyzed by the synthesis research method.

Results: According to the results, criteria such as support, educational materials and resources, teacher, student, and assessment were influential in evaluating the integration of ICT in the curriculum. The evaluating criteria of this study were extracted as following: teacher (knowledge, ICT skills), student (interaction, skills of digital content creation), support (planning, culture, and human resources training), educational materials and resources (hardware and software resources, digital content), and educational assessment (feedback, digital assessment and cartable).

Conclusion: According to the results of this study, the criteria for evaluating the integration of ICT can be a valuable framework for higher education experts and officials to provide critical curriculum improvements, enhance the quality of assessment, and facilitate the educational procedure.

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Introduction

The emergence of information and communication technology (ICT) and its developing techniques have been influential in lifestyles and the educational system, which is a fundamental pillar of societies. The integration of ICT with different levels of the curriculum has introduced a new approach that is consisted of opportunities for independent learning, teaching styles, and various content design methods (1). The integration of ICT with the curriculum is called Electronic Learning (e-learning) that includes the following examples: web-based training, internet-based training, computer-based training, electronic system, technology-based training, online learning, distance learning, virtual learning, and distance learning. This type of training ICT method to manage, design, present, select, exchange, guide, support, and develop the learning (2).

Medical education is part of the academic system that is responsible for providing a wide range of knowledge, attitudes, and skills to students for the required qualifications (3); therefore, it is not excluded from this rule and should employ ICT in its curriculum (4). According to international organizations such as the United Nations (UN) and the World Health Organization (WHO), the integration of ICT into the curriculum is necessary to address the educational needs of developing countries (5). In recent years, the medical science

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system has tried to provide an infrastructure design that addresses all aspects of the country's excellence in various fields in upcoming years via compiling a document entitled "Transformation and Innovation Packages in Medical Education Based on the Higher Education Program of Healthcare." This package has emphasized the development of virtual education in medical sciences and the use of ICT in the curriculum. The goals of this package include the integration of electronic technologies, training skillful human resources for cyberspace, launching a virtual university, expanding the technology infrastructures, updating curriculums according to cyberspace, the design of international models of virtual education in line with face-to-face or virtual (Double Affiliate) of the medical universities, and designing an incentive model of medical universities for developing virtual activities (6). In order to keep pace with the existing e-learning scene at the international level, which is associated with the daily entry of universities and institutions of face-to-face e-learning, medical education must evaluate the use of technology in education (7). The emergence and development of information technology (IT) has given the education and learning a new form and set them free of the limitations of time and space and made them available even for the most remote locations (8). Therefore, it is necessary to determine the criteria for evaluating the integration of ICT in the curriculum and improve its assessment.

The establishment of an efficient evaluation system can contribute to the education system and fulfillment of its goals, provide a more accurate and comprehensive evaluation of the performance of educational institutions, students, and teachers (9). The development of evaluation criteria can enhance the educational multimedia contents in line with the growth of teaching-learning principles (10). A systematic and persistent evaluation is necessary to understand the capabilities of ICT, its value, and integration in the curriculum. This systematic evaluation can help create a welcoming and flexible learning space that is beneficial to students. These evaluation criteria are comprised of a set of recognized assessment characteristics that, according to their potential contribution, are categorized into four indices of utility, feasibility, propriety, and accuracy (11). Given the multiplicity of ICT evaluation criteria, it is necessary to identify its underlying factors in order to assess the learning environment.

Curriculum planning is defined as a set of learning opportunities for the audience (12). Curriculum planning determines the number of elements and their relationship with one another. The experts have estimated the number of these elements from four to 11. According to Francies Klein, the nine dimensions of a curriculum is composed of objectives, content, teaching-learning method, educational material and resources, learner learning activities, evaluation, learners grouping, instructional time, and instructional space (13). The integration of ICT with curriculum materials provide the following benefits such as individual learning, active learning, learning in any time and space, diverse assessment methods, analyzing questions, assessment results, and comparison of academic achievement of learners from different educational institutions. ICT also enables teachers to remotely communicate with each other and discuss curriculum materials (14). The objectives of a curriculum evaluation are the fulfillment of pre-defined goals, acquire decision-making information, and determining the value of the curriculum itself, given that the integration of ICT with curriculum elements of the modern world, it is critical to train human resources that are capable of utilizing technology as a tool for productivity, creativity, and learning. It is crucial to determine the criteria for evaluating the integration of ICT with the curriculum as a suitable response to the growing changes of technologies in education, proper guidance, and management of educational programs in the information age; so that the medical, educational

institutions can improve students' knowledge and skills in line with the demand of societies (7). The integration of ICT has assisted the medical education institutions to design a curriculum according to the evaluation criteria. Such knowledge can be achieved by determining accurate and reliable criteria for evaluating ICT integration that yields appropriate, relevant, and new information; and provide practical solutions to enhance the quality and accelerate the development of ICT integration medical sciences universities.

Materials and Methods

This study was a theoretical-systematic review. The sample articles were published electronically between 2008 to 2019 in the Latin databases of PubMed, Ovid, and Science direct and the Persian database of Iranmedex Magiran, Normagez, and SID. The Latin keywords of "Medical education," "Information and Communication Technology ICT," "Evaluation," "Curriculum," "Criterion," and "evaluation of online education" were used in various word order and combinations to find English articles. The Persian articles were found by following articles including "medical education," "evaluation," "curriculum," "integration of information and communication technology," and "criteria." Table .1 presents the search strategy in the databases.

Table 1: Search Strategy

Search strategy	Number of articles	data base
("Evaluation of"+ E-learning [Title]) OR ("Evaluation of"+ virtual education [Title]) OR (Integration of ICT[Title]) OR (("Evaluation of"+Electronic education [Title]) OR ("Criteria of"+ Integration of ICT[Title]) OR (Integration ICT + in medical education [Title]) OR ("Integration ICT" + in Curriculum [Title])	50 articles	PubMed ،Ovid ، Science direct

From a total number of 158 scientific articles, 136 articles were omitted due to duplication and overlap, deviation from the research objectives, inaccessibility of the complete article, and indirect reference to the study topic. Finally, 22 articles were selected by two members of the research team according to the inclusion criteria such as the study title, objectives, and specified timeframe and analyzed by the synthesis research method. The main objective of this step was to extracting criteria for evaluating the integration of ICT in the curriculum. The search results and the selection process of the articles are illustrated in Figure.1.

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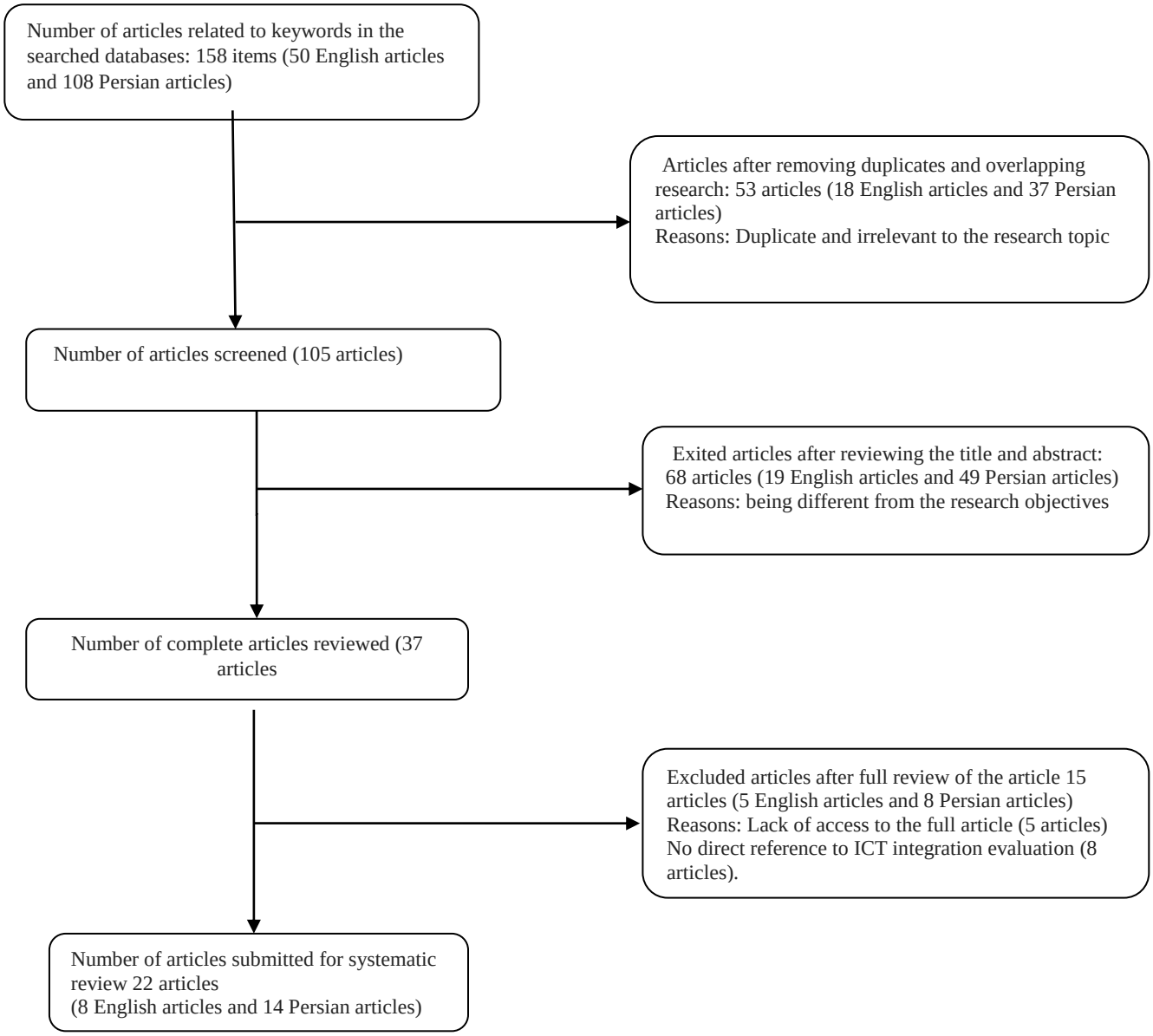


Figure 1: Flowchart Search Results Search Article Selection Process

Results

Table.2 presents the characteristics of the 22 selected articles according to criteria for evaluating the integration of ICT in the curriculum. These articles are categorized based on the researcher's name, year, research title, the type of study, and the research results.

Table 2: Studies on the criteria for evaluation of ICT

The researcher name	Year	Research title	The type of study	Results
Dargahi et al. (16)	2008	The role of e-learning in Medical Sciences Universities	Review	Before the implementation of e-learning in medical sciences, a set of infrastructures, equipment, and skills are required.
Hermans et al. (17)	2008	The impact of primary school teachers' educational beliefs on the classroom use of computers	Descriptive survey	Teachers' beliefs are a significant determinant of utilizing a computer in the classroom besides the impact of computer experience, attitudes, and gender.
Sun et al. (18)	2008	What drives successful e-learning?	Descriptive survey	Six satisfactory elements for the learner include student, teacher, learning courses, design, technology, and learning environment.
Emami et al. (19)	2009	Key elements of a successful e-Learning	Descriptive review	The key elements of a successful medical sciences e-learning include technology, organizational and financial readiness, curriculum content, human resources, teaching methods, standards, literacy, communication systems, educators and language

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				learners, environment and motivated culture.
Ozkan & Koseler (20)	2009	Multi-dimensional students' evaluation of e-learning systems in the higher education context	Review	The e-learning evaluation model consists of six dimensions, including system quality, service quality, content quality, learner perspective, trainer attitude, and supportive factor.
Khatib Zanjani et al. (21)	2012	The Structured Analysis of Requirements and Challenges of E-Learning and Proposing a Practical Model for Successful Implementation of E-Courses in Medical Sciences	Review	Factors and structures of e-learning include human infrastructure, cultural infrastructure, management infrastructure, economic infrastructure, pedagogical infrastructure, social infrastructure, administrative infrastructure, and supportive infrastructure.
Asghari et al. (22)	2012	An investigation of the challenges of e-Learning in medical sciences from the faculty members' viewpoints	Descriptive survey	The challenges of e-learning can be stated as six approaches of administrative, electronic, educational, economic, psychological, cultural, and social.

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				The majority of faculty members believe they do not have enough time or skill to prepare and assess e-learning content.
Rahimi et al. (2)	2013	Barriers to implementing e-learning in the field of medical science and provide necessary solutions	Descriptive survey	The most critical implementation barriers include the required technical and engineering infrastructure, insufficient knowledge and skills, lack of specialized human resources, and lack of management roadmap, respectively.
Anarinejad & Mohammadi (23)	2014	Practical Indicators for Evaluation of E-Learning in Higher Education in Iran	Descriptive survey	The results indicated that while aspects such as environmental design, educational, management, and administrative section are suitable in the universities, they struggle to provide support, ethical issues, technology, and assessment.
Wivell & Day (24)	2015	Blended learning and teaching	Descriptive survey	The educational approaches' topics include time and space for an integrated teaching program, students' interaction for

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				learning, technical points of technology, student orientation, relationship development, and interaction.
Mousavi Sahebalzamani et al. (25)	2016	Assessing E-Learning Readiness among Students of Zanjan Medical Sciences University	Descriptive survey	The readiness of the majority of students was suitable in terms of technology accessibility, motivation, media-learning ability, and online communication.
Naderifar et al. (26)	2016	Challenges of E-learning in Medical Sciences	Review	Teachers do not seem interested to use technology since they are not aware of their practicality, have insufficient skills and resources.
Nazeri et al. (27)	2017	The Effective Factors on Success of E-learning in Medical Sciences Fields	Descriptive survey	The active factors on the success of e-learning are management, educational content, required facilities, instructor, regulations, and learner, respectively.
Azizi et al. (28	2017	Synthesis Research on the Effectiveness of E-Learning in Medical Sciences Education and Its Design and Implementation Requirements	Synthesis research	Successful and effective implementation of the e-learning system requires the provision of appropriate infrastructure, adequate

				preparation and attitude, skills and knowledge among professors and students, and proper design of educational programs.
Mirsaidi et al. (29)	2017	A Model to develop E-Learning method based on Grounded Theory Approach in Islamic Azad University	Qualitative data-based approach	The factors of establishing e-learning include management and leadership, technology, pedagogy, human resources, and infrastructure.
Abbasikasan et al. (30)	2018	Pathology of the University of Medical Sciences E-learning System based on Khan Model	Qualitative research	Pathology of the e-learning system can be stated in eight dimensions of institutional, pedagogic, e-learning technology, management, ethics, e-learning resource support, and e-learning evaluation.
Shahmoradi et al. (31)	2018	The challenges of the E-learning system: Higher educational institutions perspective	Descriptive survey	Implementation of e-learning requires identifying educational, technical, and cultural skills.
Mtebe & Raphael (32)	2018	Key factors in learners' satisfaction with the e-learning system at the University of Dar es Salaam	Descriptive survey	Key factors of a satisfactory e-learning system are the quality, of course, learning system, service, instructor, and

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				practicality.
Ghasemi et al. (7)	2018	Evaluation of the Electronic Learning System of Medical Education	Content analysis	The evaluation of the e-learning system is emphasized on content, support, personnel, technology, and planning
Youzbashi & pajhohi (33)	2018	Identification of Professors' Professional Competencies in e-learning environments	Delphi Survey	The main personal characteristics of professors are individual competencies responsibility, etiquette, and social behavior with students and mutual respect. The main educational characteristics of professors are online classroom management methods, active participation of students in educational topics, use of appropriate and diverse teaching methods in the environment. The main technical characteristics of professors are proficiency level for organizing and producing e-learning content.
Mirmoghtadaie &	2019	The Effectiveness of Blended Learning in the Field of Medical Education:	Qualitative-content analysis	The active components in e-learning include

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Ahmady (34)		Explaining Dimensions and Components Based on Stakeholder Experiences		teacher competency, technical aspects, pedagogical area, and supportive environment.
Ghalyan et al. (35)	2019	Identifying Factors of Success in E-Learning Case Study	Descriptive survey	The four influential factors of students' e-learning success are the quality of service and units, information, online interaction, system, and infrastructure.

In order to determine the criteria for evaluation of ICT in the curriculum, the main components of teacher, support, educational materials, and learning resources, student and assessment were selected, which each of them includes evaluation indicators. Table.3 presents the evaluation criteria, the number of sources for measuring the criteria, indicators, and the authors of the articles.

Table 3: The Criteria for Evaluation of the Integration of Information and Communication Technology in the Curriculum

Evaluation criteria	Number of resources	Markers	Articles
Teacher	16	Teacher knowledge, teacher attitude, teacher ability, content production, interaction ability, educational design tailored to ICT	Rahimi et al,2013, Dargahi et al, 2008, Khatib Zanjani et al, 2012, Abbasikasani et al, 2018, Naderifar et al, 2016, Emami et al, 2009, Mirsaidi et al, 2017, Ozkan &Koseler, 2008, Wivell et al, 2008, Mousavi Sahebalzamani & maleki, 2016, ghasemi et al, 2018, Asghari et al, 2012, Shahmoradi et al, 2018, Sun et al, 2008, Hermans et al,2008, Youzbashi & pajhohi, 2018, Mirmoghtadaie & Ahmady, 2018.

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Support	15	Equipment support, planning, culture building, human resource training, teaching professors and supporting produced works	Rahimi et al ,2013, Khatib Zanjani et al, 2012, Abbasikasani et al, 2018, Emami et al, 2009, Ghalyan et al, 2019, Mirsaidi et al, 2017, Ozkan& Koseler 2008, Wivell et al, 2008, Mousavi Sahebalzamani & maleki, 2016, Anarinejad & Mohammadi,2014, ghasemi et al, 2018, , Mtebe & Raphael, 2018, Wivell & Day, 2015, Shahmoradi et al, 2018, Sun et al, 2008.
Educational materials and resources	14	Hardware Resources, Software Resources, Electronic Content, Content Update, and Multimedia	Rahimi et al ,2013, Dargahi et al, 2008, Khatib Zanjani et al, 2012, Abbasikasani et al, 2018, Naderifar et al, 2016, Emami et al, 2008, Ghalyan et al, 2019, Mirsaidi et al, 2017 Ozkan & Koseler, 2008, Wivell et al, 2008, Mousavi Sahebalzamani & maleki, 2016, Anarinejad & Mohammadi,2014, ghasemi et al, 2018, Sun et al,2008.
University student	9	Knowledge, attitude and skills towards ICT, interaction with others, production of electronic content	Rahimi et al ,2013, Dargahi et al, 2008, Emami et al, 2009, Ghalyan et al, 2019, Ozkan& Koseler, 2008, Mousavi Sahebalzamani & maleki, 2016, Mtebe & Raphael, 2018, Sun et al,2008, Wivell & Day, 2015.
Evaluation	3	Conducting electronic evaluation, giving electronic feedback, electronic portfolio	Dargahi et al, 2008, Abbasikasani et al, 2018, Anarinejad & Mohammadi,2014,

In response to the study question on "the criteria for evaluation of ICT in the curriculum," the results of Table.2 indicated that the evaluation criteria are teacher, support, student, educational materials, and learning resources and assessment, which each of them includes evaluation indicators. In terms of percentage of frequency, the criteria found in 22 articles have emphasized teacher (72%), support (68%), educational materials and resources (63%), student (41%), and assessment (15%).

Discussion

The review of the articles indicated the main criteria for evaluation of ICT integration in the curriculum are "teacher", "support", "student", "educational materials and resources", and "assessment" should be used in educational institutions. Each of these criteria is discussed separately in the following section.

1. Teacher

Individual factors have been the main component of the integration of ICT in the curriculum. These factors include employees' perceptions, attitudes, and skills toward ICT, which affect the level of acceptance and use of technology (36). Since human resources and teachers play a leading role in the integration of ICT in the teaching and learning process, they required to have the necessary working knowledge of

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digital technologies. The negligence of programs, solutions, resources for ICT integration, and the pivotal role of teachers can lead to a severe and critical threat. In other words, no innovation and improvements can occur without the support of instructors (37). The significant role of teachers for integration of ICT has been highlighted in this study by obtaining the highest percentage of evaluation criteria. Other roles include provide assistant in the background instead of being the leading educational role (38), provide consistent and stable electronic communication with learners and address their problems, provide robust and constant instruction and learning process via electronic tools (39), cooperation and electronic interaction with other electronic resources and universities (40). According to Harris et al., teachers must be familiar with modern ICT tools (41). It is not possible to utilize ICT as long as the instructors are not trained and prepared for it (26). Many teachers are afraid to use ICT in the classroom because they believe they lack the specific and required expertise for using technology (42).

Along with the necessary skills (17), teachers' beliefs have the most significant impact on the classroom use of computers since they have the most pivotal role in the educational system. ICT based teaching demands specialized training of teachers (22). The educational factor caused considerable damage to the e-learning system of Tehran University of Medical Sciences (30), and studies showed that teachers must be skillful enough to employ ICT in the classroom (33, 29). There is a strong significant and positive correlation between ICT skills and their application in the educational system (43). According to the results, the personal barriers for integration of ICT are lack of required knowledge and skills, negative attitude towards ICT, and reluctancy about the use of ICT (2, 17, 19, 22, 26, 30). Pedagogical components for the implementation of e-learning in professors are changing the teaching-learning paradigm, shifting from traditional education to e-learning and individualistic system, utilizing modern teaching methods (real-time), the transition from teacher-based learning to student-based learning, and shifting the focus from teaching to learning (21).

2. Support

Nowadays, like all the organizations, medical sciences are increasingly dependent on ICT to achieve its goals. Medical education is no exception. One of the main challenges of implementation of ICT is support. The essential aspects of support are providing the infrastructure, passing the required laws in the ministry, and having sufficient resources in the educational institutions (47). Other essential factors of support include financial resources, technical equipment, management infrastructure, planning (20), cultural approach (22, 26) online educational support, counseling, technical support, and necessary resources for nurturing and creation fo a meaningful learning experience (23). The advancement of financial, organizational, and technical infrastructure will improve the requirements of ICT implementation (32, 31). The integration of ICT is not a hardware approach; instead, it is an active culture and educational plan that designs practical medical sciences materials for the third millennium. The software features are essential to supporting ICT and require the organizations to train their personnel in the areas of productivity, exploitation, and employment of e-learning tools (48). It is possible to culturize organizations by running training workshops on the development of medical education studies in universities (21), and the national scale by organizing centralized workshops by the Ministry of Health, the establishment of an e-learning unit in each university and specify the organizational positions in the educational system of the country (26). Contributing factors for a successful e-learning experience are supplying hardware and software equipment for universities, supplying the required number of computers and e-learning courses peripherals, and

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the presence of necessary facilities and technical infrastructure such as high-speed Internet, the internal network of devices (35).

3. Educational Materials and Resources

One of the significant e-learning advancements is gaining access to numerous learning materials and resources. The materials and sources of an e-curriculum are composed of digital libraries, databases, online learning groups, websites, and other digital platforms that deliver educational content. The various types of educational resources are CDs, Text, Video, E-Books, and learning software, each of them has a particular value, and their application depends on the electronic teaching-learning approaches (49). The educational content of these resources should protect the learner from any ambiguity and confusion through the course of study. It is required to carefully design an e-learning material and study plan in order to address this issue and achieve accurate educational goals (7). The accurate educational content goals can be defined as a set of facts, rules, theories, principles, terms, and concepts related to a subject study that is presented in order to achieve the objectives of the lesson and modify the student behavior (50). The reduced content of e-learning educational packages in medical sciences education is more prominent than other disciplines (22). The primary criteria for the development of e-content study plan include quality and update electronic materials, reviewable and revisable content, user-friendly interface, interactive virtual environment, free accessible content, and volume of the content (34). The Mayer's principles for multimedia learning are the most comprehensive and technical set of features for e-learning, these principles include the spatial contiguity principle, the temporal contiguity principle, the coherence principle, the modality principle, the redundancy principle, and the individual differences principle (51). Based on the reviewed articles, the barriers of e-learning are repetition and lack of up to date content, impractical content, and the incoherence of appropriate content (7). The factors of successful e-learning include the accessible and up to date content on the university's website, rich and relevant e-learning courses, and informative materials (35). Since the planning and development of e-contents are costly, it essential to design and create educational content that can be frequently used by a large number of students. Using multimedia content (audio, video, text) according to existing standards can enhance the quality and engagement of the courses. The development of e-learning content and materials needs providing educational and Latin resources (including training guide), user manual guide, reference educational books and CDs, multimedia CDs related to the courses, and digital and online resources available on the Internet (21).

4. Student

One of the biggest challenges of ICT-based education is student training who can use modern technologies for learning purposes in the era of information explosion and ever-changing societies. E-learning relies on the students' knowledge and skill of computers. One of the significant approaches of the academic education system is the successful implementation of e-learning, which cannot be achieved without identifying the educational and technical skills (18). In order to use an e-learning system, students need a set of skills such as individual skills, study skills, and general computer and Internet skills (16). Studies have emphasized the readiness of students, particularly in the undergraduate course (37). The essential criteria on adopting ICT and e-learning methods include the learner's ability to use technology tools such as computer and Internet, e-learner's communication with each other, acquiring the required skills and information by the learner for e-learning, and the learner's interest in using e-learning methods (28, 25). Based on the previous studies, the readiness of students is expressed in terms of accessing technology, motivation, the ability to learn through the media, and online communication (25). These abilities will boost the

student's independence in learning, give them free the right to select their preferred content, and recognize their individuality and differences; besides, it can eliminate barriers of time and space, provide more familiar examples for the learner, and expand learning activities (44). There are three types of learning activities for using technology; passive, practical, and integrated. Passive activities involve reading online articles and books and watching multimedia content on the Internet. Practical activities comprise finishing procedures, playing video games, participation in polls, and content creation. Lastly, integrated activities include applying learning in daily life and linking new data with previous knowledge (45). Integrated activity is a systematic combination of face-to-face and technology-based interactions between students, professors, and learning resources (46). The interaction of students in learning activities is one of the critical elements of the integration of technology in the curriculum (24). Interaction is a vital component of integrated learning; it guarantees the success of e-learning systems and plays a role in enhancing the quality of learning in virtual campuses and universities (46).

5. Assessment

Assessment in the curriculum can be defined as the evaluation of the learner or his/her academic achievement. The assessment is a process that determines the desired results of a teacher's educational activities and students' learning endeavors. Due to the multiple applications of ICT in the educational system, it is advised to address an ICT-based assessment system that has been neglected most of the time (52). The pedagogical assessment of professors and students' performance is performed by the constant use of new technologies and evaluation strategies (35). The employment of ICT-based assessment methods is one of the requirements of designing and implementing the e-learning system in educational institutions (28). The challenges of assessment in the e-learning educational system include the lack of specific standards for electronic evaluation, the absence of a proper assessment design regarding the e-learning, uncertain and inaccurate educational assessment, and lack of required skills for using technology in assessment procedure (30, 22).

Conclusion

The criteria for evaluation of the integration of ICT are a leading factor for the implementation of technology in the teaching and learning process. Since most of the educational institutions are now equipped with a variety of new technologies, the efficiency of e-learning courses in medical sciences education relies on the evaluation criteria such as support, teacher, student, educational materials and resources, and assessment. The factors of planning, culture building and the support of integration of technology are critical elements for evaluation of ICT that can contribute to successful e-learning by using hardware, software, and electronic content resources. In this regard, it is suggested that the administrative and educational staff of universities and educational institutions become aware of the criteria for evaluating the integration of ICT in the curriculum. It is also beneficial to run educational workshops on how to use technologies in the teaching and learning process to improve the knowledge and technology skills of professors and students. At last, educational institutions should provide suitable infrastructure, updated materials, learning resources, and quality hardware and software for the users.

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