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Explaining the Conceptual Considerations of Virtual University in Medical Education: A Systematic Review

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Abstract

Aim: Most of existing literature on the concept of virtual university of medical sciences have been collected in a non-systematic manner. This issue highlights the need to conduct research on virtual university-related topics through systematic research evidence and empirical evaluations. The aim of the present study is to investigate the real complexity and diversity of the concept of virtual university of medical sciences.

Methods: This was a systematic review with the BeHEMoTH approach and aimed to identify, review, analyze and integrate models, theories and frameworks related to the concept of virtual university of medical sciences. Eligible articles were searched in PubMed, ERIC, IEEE, ISI, Scopus, Ecampus research unit from 2001 to 2022 using related keywords in three stages.

Results: A total of 13 articles were finally identified according to inclusion and exclusion criteria. Pedagogical, technology, managerial, educational design, technology implementation, and educational-administrative management components were referred to in 5, 5, 4, 7, 6 and 4 articles, respectively. Thematic analysis of the models was carried out in two theoretical dimensions (pedagogical component, managerial component and technological component) and operational dimension (educational design, administrative-educational management and technology implementation).

Conclusion: The results of the present study emphasize the need to pay attention to these six components in the establishment and development of virtual universities of medical sciences. In order to improve the education process in virtual universities, the process quality evaluation framework can be used.

Keywords: Virtual university, medical education, systematic review, models

Introduction

The use of online education as a means of delivering education has grown dramatically over the past decade. Online learning environments have become an important part of online training and evidence shows that this trend will continue with the technological advancement. Organizations and educational institutions have welcomed this movement and are using the advantages of using computer and communication technology as a tool to transfer learning to learners.[1,2]

The virtual learning is a broad and multifaceted term that includes different methods of special presentation. Although virtual learning has different specific architectures, the physical separation of the teacher and the learner is the basis of all types of this phenomenon. Besides, it is assumed in virtual learning that the educational materials are presented using technology to facilitate learning.[3]

The terms e-learning, distance education, virtual education, online education and other similar descriptions are synonymous and are all used interchangeably in the present research. Decades ago, virtual education could be thought of as a video recorded lecture by a teacher that was listened to by students using a videocassette player. Today, this term means using a computer and usually the Internet to provide this content.[5] Modern virtual education uses methods such as e-mail, chat rooms, online forums and discussions with the guidance of instructors. It can be stated that the virtual university is a multimedia network learning environment that is different from traditional learning environments in terms of the possibility to personalize and customize the teaching environment.[2]

Harasim et al. state that the virtual university supports the design and delivery of courses and programs for any type of graduate education, which can include the provision of academic degrees, staff training services, professional development and workplace training.[6]

Leidner & Jaronpa suggest a similar definition. They state that the mission and vision of any type of virtual learning environment (such as a virtual university) is to redefine the physical boundaries of the classroom; enable more teamwork; transformation of learning into a continuous and time-independent process and the possibility of creating multi-level and multi-speed knowledge using information technology.[7] A critical review of virtual university literature showed that there are many different terms related to virtual universities. Virtual universities are also known as virtual teaching/learning environments, online teaching/learning, web-based teaching/learning environments, virtual learning communities and flexible learning environments.[8]

Benatallah et al. explain that "the online or virtual university has emerged as a powerful vision for the future of higher education by using new information and communication technologies to fundamentally restructure higher education and re-equip the university institution in the face of new environmental changes."[9] Such a scenario generally includes a university without walls, consisting of elements including learners and professors (students and employees), employers (job performance) and graduates, where the entire process of teaching and learning, research is implemented by information technology-based programs.[10]

Despite the validity of the previously mentioned definitions, virtual university is as much related to a method of distance education as it is different from it. The main difference is related to the totality and individuality of its function. This means that the virtual university continues to work and exist

without the need for a geographic environment to represent its existence (for example, traditional academic campuses).

The existing literature on the virtual university has identified some research issues associated with the transformation of a traditional classroom-based university into a virtual university. However, it is important to note that the current literature does not provide a deep understanding of these issues, but tends to only acknowledge their existence.[2]

Dealing with the advantages and disadvantages of virtual universities, as well as providing guidelines for a shift towards virtual universities, should be one of the most basic priorities of any research in this field. This is important because universities should be aware of the positive and negative aspects of virtual universities before converting from a traditional educational environment to a virtual educational environment. It is also important for instructional designers to be aware of these issues. They need to follow such guidelines in order to reduce the potentially harmful effects and increase the advantages of virtual universities.

Most of existing literature on the concept of virtual university of medical sciences have been collected in a non-systematic manner. This issue highlights the need to conduct research on virtual university-related topics through systematic research evidence and empirical evaluations.[11] The aim of the present study is to investigate the real complexity and diversity of the concept of virtual university of medical sciences.

Methods

This was a systematic review with the BeHEMoTH approach and aimed to identify, review, analyze and integrate models, theories and frameworks related to the concept of virtual university of medical sciences. In recent years, the medical science research community has increasingly recognized the potential contribution for educational theories and models in systematic reviews. However, the identification of educational theories and models during a systematic review is generally opportunistic or even incidental in many cases. Therefore, there is a need for systematic, formal and predetermined methods in a systematic review to identify sources that identify theories and models in the literature.[12] Such findings have led to the development of the BeHEMoTH framework as a search method. This approach is a process to identify theories, models and frameworks for developing and testing complex interventions using systematic reviews.

Considering that the goal of researchers is to combine frameworks; models and theories instead of examining interventions, therefore, with such a presumption in mind, the BeHEMoTh approach was used in the present study in order to search for theories, models and educational frameworks related to the concept of virtual university. In this approach, four main elements of Behavior of interest (Be), Health context (H), Exclusions (E) and Models or Theories (MoTh) are determined. Then various related theories are identified and the practical application of each theory is identified subsequently.[13]

To define and guide the final search strategy, the BeHEMoTh model was used to systematically identify models, define Be, H, E, and MoTh (Table 1).

Table 1. **Definition of BeHEMoTh framework elements in the present study**

Be:	Behavior of interest	Virtual university, Open university, Cyber university
H:	Health context	Healthcare, Medical education
E:	Exclusion	No reference to the model, framework and theory No studies in the field of medical sciences Articles published before 2001 Non-English articles Articles published in newspapers, General journals, Reports and letters to the editor
MoTh:	Models or Theories:	*model* or theory* or concept* or framework**

Search strategy: In this systematic study, all published and peer-reviewed articles and related theses published between 2001 and 2022 were searched in PubMed, ERIC, IEEE, ISI, Scopus, Ecampus research unit using keywords including (Virtual university) OR (Open university) OR (Cyber university)) AND ((health care) OR (medical education))) AND ((((theor*) OR (model*)) OR (concept*)) OR (framework*).

The search process was guided in three different stages (Table 2).

Inclusion and Exclusion Criteria

The inclusion criteria included peer-reviewed English articles published from 2001 until now that were related to the concept of virtual university of medical sciences. In order to achieve the research objective, the following exclusion criteria were taken into account: no reference to the model, framework and theory no studies in the field of medical sciences, articles published before 2001, non-English articles. articles published in newspapers, general journals, reports and letters to the editor.

Selection of Articles

To avoid selection bias, the search was conducted by two researchers independently, and then similar and repeated searches were excluded from the study. At baseline, the titles of the articles that were searched by the research team using the above-mentioned keywords were equal to 64,571 titles. Finally, 66 articles were fully reviewed and 13 related articles were included in the final analysis phase after the searching process (Figure 1).

A checklist was designed based on the study objectives and literature review, which investigates 6 pedagogical, technological, managerial, educational design, technology implementation and educational-management components (Table 3).

Quality Assessment

To assess the quality of theoretical studies, there are no comparable tools like other types of studies such as the PRISMA checklist, PICO for clinical evidence, or CASP and SPIDER for qualitative studies.[14] On the other hand, theoretical evidence cannot be evaluated using a variety of tools that have been developed for routine systematic reviews, most of which focus

Table 2. **Steps to conducting a systematic search based on the BeHEMoTh approach**

Steps		Search strategy	Database	All articles found	Number of articles after removing duplicates
Step 1a	Be AND H	((Virtual university) OR (Open university) OR (Cyber university)) AND ((health care) OR (medical education)) 1990- 23 Jul 2021	PubMed, ERIC, IEEE, ISI, Scopus, Ecampus research unit SID, Magiran	64571	138
Step 1b	Be AND H AND Models, Theories, Concepts or Framework	(((Virtual university) OR (Open university) OR (Cyber university)) AND ((health care) OR (medical education))) AND ((((theor*) OR (model*)) OR (concept*)) OR (framework*))		20831	53
Step 1c	Be OR H AND Models, Theories, Concepts or Framework	(((Virtual university) OR (Open university) OR (Cyber university)) AND ((((theor*) OR (model*)) OR (concept*)) OR (framework*))) OR (((health care) OR (medical education)) AND ((((theor*) OR (model*)) OR (concept*)) OR (framework*)))		123477	168
Step 2	Step 1(a,b,c) with list of most common theories	Step 1(a AND b AND c) with Number of lists of most common theories		Step 1(a AND b AND c) :359	Step 1(a AND b AND c) :64 Number of lists of most common theories:4
Step3	Step 2 AND key Original model citation(s)	Step 2 AND key original model citation(s)		Step 2(68) AND key Original model Citation (5)	73

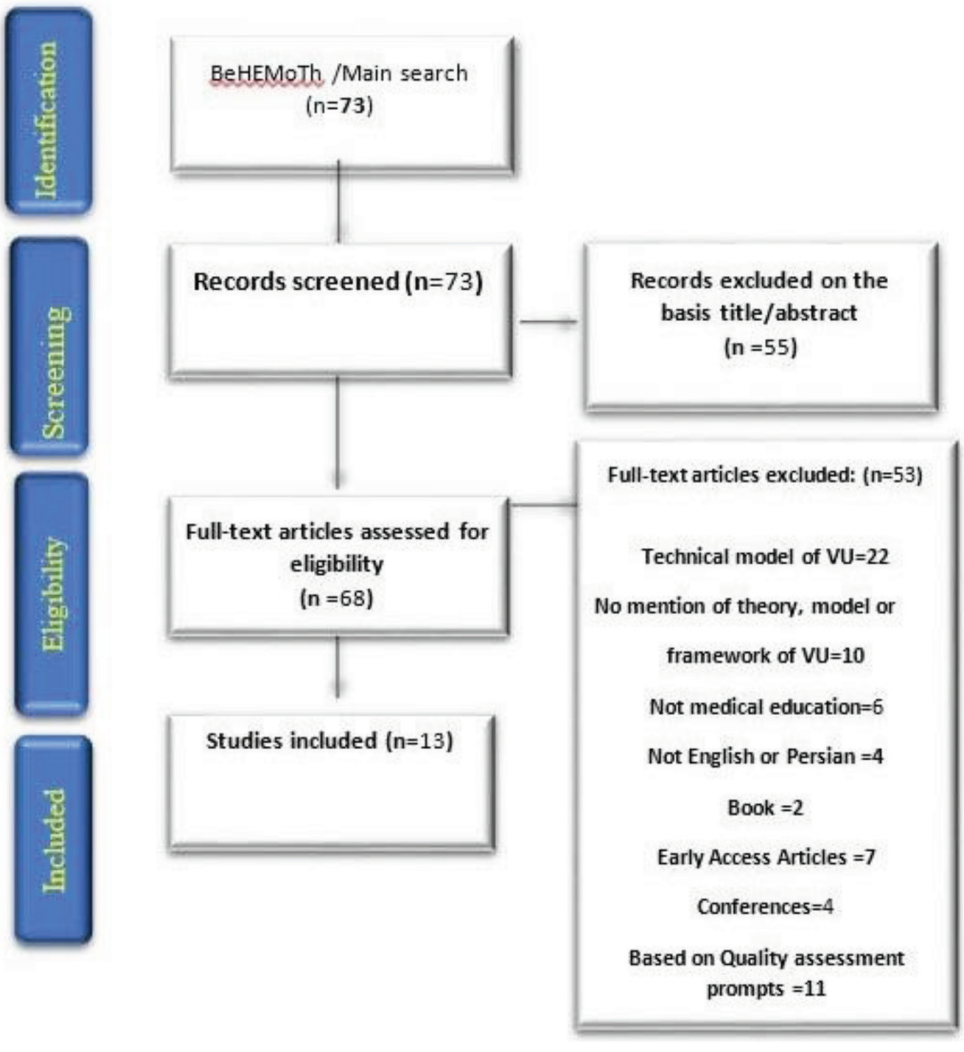

Table 3. **Checklist designed based on study objectives**

Themes extracted in the framework	Building A Virtual University for Orthopaedics (46)	An IoMT based cyber training framework (45)	Virtual university education in the context of the health emergency due to COVID-19 (44)	Towards Grid Services for a Virtual Research Environment (43)	The evolution of pedagogic models for work-based learning within a virtual university (42)	Methodology for Design of Virtual Learning Environ-ments–Virtual Universities (41)	A Dynamic Model for a Cyber-Physical Healthcare (40)	A study of pedagogi-cal aspects of a virtual university (39)	A Framework Proposal for Blockchain-Based Scientific Publishing Using Shared Governance (38)	The Virtual Health University (37)	Modelling of Web-Based Virtual University Adminis-tration for Nigerian Universi-ties (36)	Innovation Model in Human Resources Capacity Development in Supporting Universitas Terbuka as A Cyber University (35)	A strategic model of virtual university (34)
Pedagogical component	✓				✓			✓		✓		✓	
Technology component	✓	✓					✓		✓			✓	
Management component				✓		✓				✓			✓
Educational design	✓	✓	✓		✓			✓		✓		✓	
Technology implementation	✓	✓				✓			✓		✓	✓	
Administrative-educational management		✓		✓		✓							✓

on internal validity and study design. In fact, study methodology and theoretical development are different areas of research that require different skills.[15]

Therefore, the research team adopted a recommended inductive and subjective approach instead of using checklist-like tools. "Applied quality assessment prompts" were used as the most appropriate framework to ensure clarity of objectives, having a specific and appropriate research design, providing a clear report of findings and sufficient data to support the interpretations and appropriate analysis.[15] Methodological quality assessment was carried out with data simultaneously.

Table 4 shows the five steps to quality assessment guidelines as a framework that is used in research to assess the quality of articles and perform the final synthesis.

Results & Discussion

The aim of the present research was to identify, investigate, analyze and integrate models, theories and frameworks related to the concept of virtual university in the field of medical sciences and health system. A total of 13 articles were identified in the data extraction stage. The articles were reviewed using on a checklist. Pedagogical, technology, managerial, educational design, technology implementation, and educational-administrative management components were referred to in 5, 5, 4, 7, 6 and 4 articles, respectively.

The research team performed the thematic analysis of the extracted models based on two theoretical and operational dimensions (Figure 2), which include

1. Theoretical dimension: This dimension includes three main components:

- Pedagogical component.
- Technology component.
- Management component.

2. Operational dimension: This dimension considers the strategies, actions and procedures based on which subsystems of a university operate and includes three main components:

- Educational design.
- Technology implementation.
- Administrative-educational management.

All these dimensions and the relationship between them will be explained separately. It is also necessary to mention that the operational components of this framework are semantically placed among the theoretical dimensions of the framework considering their operational nature, and therefore, each of these components will be explained in combination with the theoretical components.

Theoretical dimension

Pedagogy and Educational Design

Pedagogy is defined as guiding the child and is known as the art and science of teaching children. Pedagogic techniques for effective content transfer include learning content, learning style, time of learning, learning with the help of the instructor, and responsible instructor.[16]

Table 4. **Qualitative assessment of articles**

Review stage	Criteria
Inclusion criteria	To include a model/theory or framework in a study, a mechanism should be defined in which the main components of a virtual university in the health system and the relationship between them were clearly shown.
Literature search	The review included multiple forms of formal electronic and manual searches and citation tracking to follow the development and impact of known theories on subsequent relevant literature.
Data extraction	Spreadsheets were created from the data extracted from the models.
Quality control	The review of models and theories did not involve conducting a standardized critical evaluation.
Synthesis	They were graded according to the review question as well as by checking the details or originality.

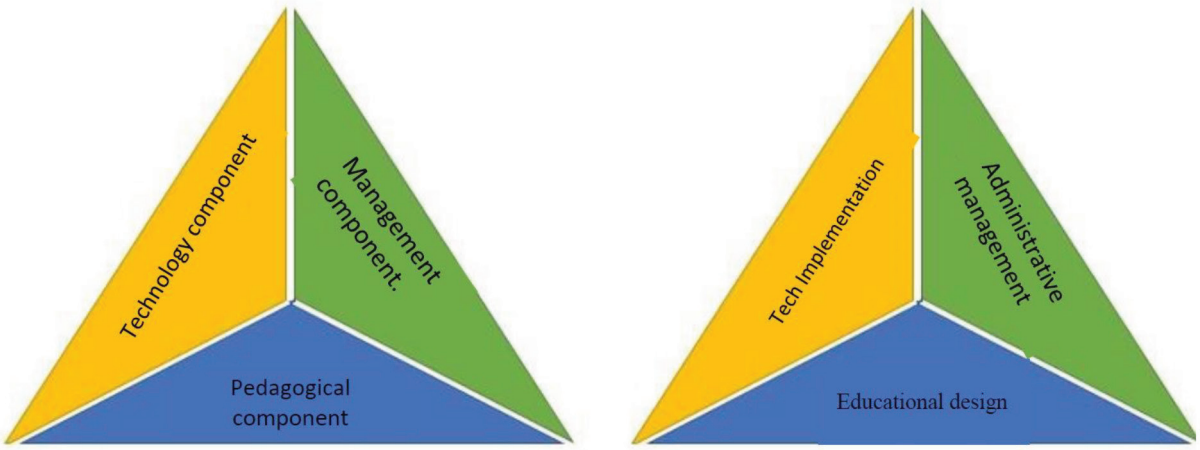

Fig. 2 **Components of the virtual university.**

Such definition is based on the perspective of theorists in the field of education and is thus consistent with the "teacher-centered approach" at the school level. Developments in the field of education and learner-centered and learning-centered approaches, emphasis on the facilitating role of the teacher, as well as the development of pedagogy in higher education have led to the redefinition of pedagogy. Also, the current understanding of pedagogy is not limited to child education, but is considered as a basic teaching concept for in all academic courses.

Considering such a definition of the pedagogy and looking at the extensive changes made in different pedagogic concepts, the change of the educational paradigm is reflected in this component of the proposed framework. Here, the curriculum is seen as a continuum where the main importance is acquired competencies, not just completed assignments.

Besides, assessment becomes an important element in the teaching and learning process and is not merely a punishment or a factor for determining grades. The main focus of this component is on learning modules, communication, interaction and cooperation between learners, and the use of the latest information and communication technology is also emphasized. Technologies that provide the possibility of academic networking between students and professors.

In this component, a "learning unit" as a wide conceptual area includes three basic elements, namely "content", "interaction" and "evaluation".[17] As these elements play an important role in the learning process and the type of their evaluation based on the theory of active learning. The content, level of interaction and types of communication activities are determined by the learning objectives. Then, the educational design layer is placed as one of the operational components of the framework at a higher level where the basic planning, design and implementation of teaching-learning processes, especially the learning units and related activities are determined.[17–19]

Educational design as a basic component of the framework is carried out in six separate but related steps:

1. Specifying and explaining the available educational and technological options: In this step, the learning needs are identified, the target audience is defined, the human and financial resources and the existing technological infrastructure are evaluated. In other words, possible options are identified and selected for a successful educational design.
2. General design of the course (main program): In this step, goals, background, prerequisites, themes, content and keywords are determined for each educational course. In a general view, this step includes deciding on the structure of the course and summarizing the anticipated activities and strategies, as well as compiling the course timetable and relevant bibliography.
3. Designing course units: In this step, teaching and learning units are designed along with units related to modular learning. The educational strategies for each unit, as well as the content and calendar of activities are determined according to the duration of the course.
4. Interactive system design: In this step, learning activities, their dynamic level, the sequence, the resources and tools used, as well as the writing of practical guides and other teaching strategy elements are designed to ensure their proper implementation.
5. Designing a feedback system: Here, while emphasizing the educational effect of the concept of feedback, the aim is self-evaluation design, systematic and final evaluation of the course, for continuous and interactive feedback during the teaching-learning process.
6. Final design and presentation of general information: Upon reaching the final step, the final evaluation of the entire process will be implemented. In this step, there is the possibility of final adjustment of the general program and its reorganization according to individual activities (second and third steps) as well as the evaluation program (fourth step).[17-20]

After expanding the concept of the pedagogical component and identifying some of its most important elements, the present framework proposes the following schematic view as the pedagogical components of the virtual university in the health system (Figure 3).

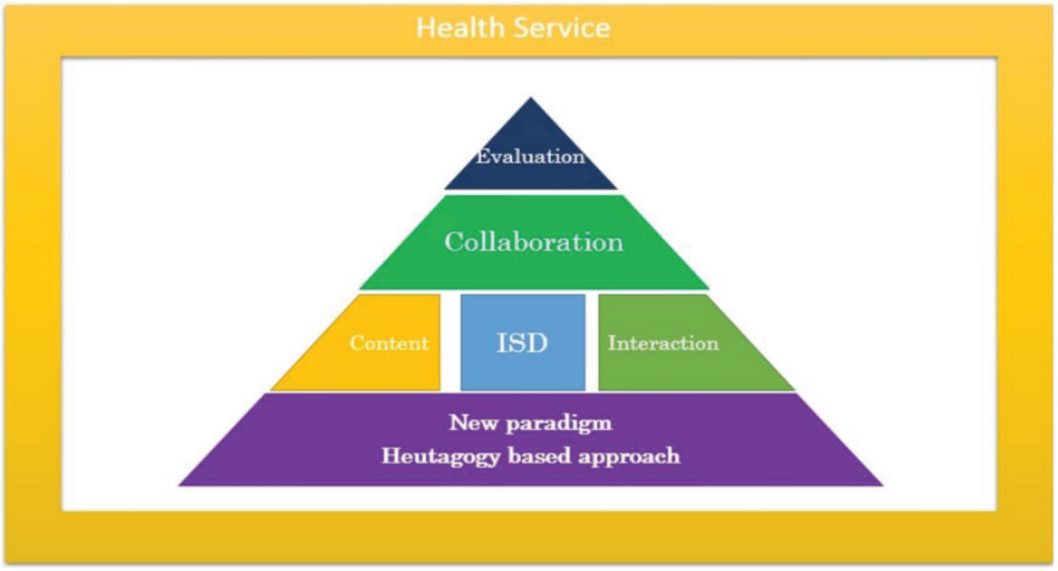

Fig. 3 **Pedagogical components of the virtual university in the health system.**

Technology Components and Technology Implementation

Today, all users of virtual networks have become active producers of knowledge by using open-source software as well as a variety of information technology tools with different levels of complexity. From this point of view, the most important features of the virtual university technology component in the health education system include "interactivity" and the possibility of reusing technology. In this component, the technology implementation element has a strong presence as one of the elements of the operational component of the framework. The implementation of information technology generally consists of a number of successive steps including requirements analysis, project design, testing, establishment and maintenance. Although documentation and training are often added to these steps.[36,38,41,43]

In these components, three basic parts that work together were identified:

Part 1: Technological Support

Online and technical support services are very necessary to speed up the education process for all users, teachers and students. On the other hand, information technology support has an important effect on knowledge process capabilities; because it allows knowledge creation and sharing at lower costs and is considered a key component in knowledge management.

Therefore, the concept of support in a virtual university goes beyond mere provision of different principles and guides and has a direct impact on the process of knowledge management in a virtual university. In the current framework, this part is considered as a basis for providing other services, and its components and tools are shown separately in Figure 4.[19-21-22]

Part 2: Data

This part focuses on accepted international protocols and standards, which, in addition to validating university activities, provide the possibility of cooperation between educational and service institutions, as well as information retrieval. E-learning standards are a set of laws that not only ensure coordinated provision of education everywhere; but also, it provides a common language for the learning management system and e-learning courses, so that they can share information with each other and work together. In fact, components of the training course or training objects are identified and defined using these rules.[23]

E-learning standards are divided in different ways from the meaning point of view. Here, first, they are divided from the perspective of content coverage they provide, and then the most important e-learning standards for use in a virtual university will be discussed.

1. Meaning: This field focuses on the general concepts of understanding: semantics, pragmatics, etc.
2. Quality: This field includes all aspects of quality management, including development, assurance of results, processes and potentials.
3. Didactics: This area focuses on issues related to educational questions: methods, learners and learning environments.
4. Educational technology: This area focuses on all technological solutions that have been created for educational purposes: such as information exchange, interfaces and accessible questions.
5. Learning content: This area includes all aspects related to e-learning objects and collects resources and packaging.
6. Context: The main purpose of this area includes all disciplines and information related to electronic education, including laws and regulations (49). Table 5 shows the most common standards in electronic education.

Our conceptual advancement in the technology component and its expansion gives a more complete picture of the framework (Figure 5).

Part 3: Services

This part of the technological component indicates the services provided by a virtual university to users, learners and faculty members. These educational services should promote and support an open and collaborative environment. The portal is known as the most basic service for providing virtual university services, but according to the proposed framework, the university portal should act in such a way as to provide access to various resources and services and communication and collaboration tools for all users. It also allows interaction between students, faculty members and users who are interested in the field of healthcare and health sciences as a whole. Such a portal facilitates interaction, communication, study and discussion about clinical cases.

Services are also provided by electronic learning management system. A learning management system creates a communication channel between instructors and learners and helps instructors manage online learning. Software are able to manage all types of content, including videos, courses, documents, etc., and allow students to communicate with learning

Fig. 4 **Technological support.**

Table 5. **E-learning standards**

Standard	Developer	Important component	Website
IMS	IMS Global Learning Consortium	Standard packaging	(www.imsproject.org)
SCORM	ADL	A combination of several standards	(Scorm; www.adlnet.org/Scorm/history/2004/index.cfm)
LTSC	IEEE	Content relevance	(LTSA; http://ltsc.ieee.org/wg1/files/IEEE_1484_01_D09_LTSA.pdf)
LOM	IEEE	Metadata	(LOM; http://ltsc.ieee.org/wg12)
PAPI	IEEE	Learner profile	(www.edutool.com/papi/drafts/08/)
AICC	AICC	Supply, control, presentation and follow-up of results between educational management systems and online courses	www.aicc.org

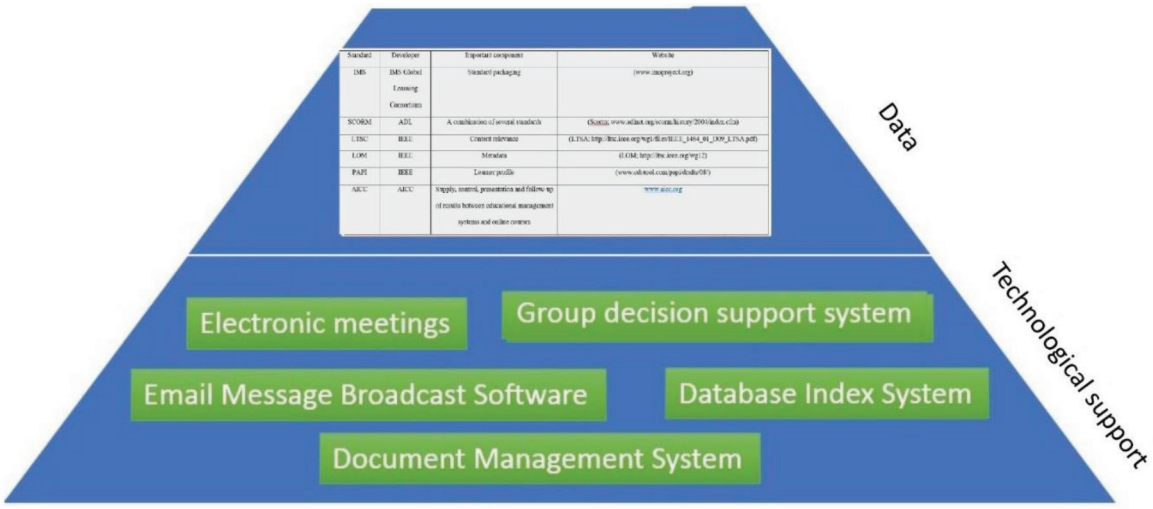

Fig. 5 **Adding the data part to the Part 1.**

management system software through any device. Instructors can also evaluate learners by using features such as receiving their assignment reports, progress status and similar cases. Such a system will be the backbone of a virtual university. Here we are dealing with a web-based software and program that manages, documents, follows up, reports, and provides educational courses and educational programs. This software allows the instructor to provide the content of the educational course as easily as possible to the participants and students, to hold quizzes, tests and exams offline or in person (online in class), assign related assignments to students in a web-based system, follow up student status, and access other such facilities in an internet-based system.

Online classes are one of the other educational facilities that can be held with the help of the university's learning management system. The virtual classroom is an educational tool that is based on communication networks and can replace the traditional classroom and solve the associated problems. Although the virtual classroom does not change the channels of information transmission, it tries to use appropriate tools to carry out this information transfer in the best possible way.[17]

In addition to increasing the educational quality, such optimization also reduces educational costs. The virtual classroom is, in fact, a discussion group whose topic is the same as the lesson subject. A discussion group whose title is the same as the lesson title is created on the network, and the students become members of the discussion group. Then, the faculty member who is also a member of the group, will present the related course materials at regular intervals. They should also be designed as an interactive learning space that simultaneously pursues formal and informal educational activities. Rather being related to educational content, interaction in this class means interaction and mutual effect of educational activities and communication.

The virtual clinic is another interactive space that is identified in the proposed framework, and all learners and faculty members will be able to use its services from the moment they enter the university. Education is provided in this space based on diagnostic discussions (a virtual space in which people discuss the cases of interest to make a definitive diagnosis online), clinical pathology topics (topics related to the postmortem findings of pathologists) and presentation of clinical cases. Education through the presentation of clinical cases and scenarios is currently recognized as one of the leading and effective methods in the field of medical sciences. The use of the case-based learning method prepares students with diverse experiences such as problem solving, building knowledge

in the presence of each other, communication and group participation.

Just like traditional universities, another element of the framework that guarantees the success of virtual universities is a virtual library. The virtual library makes it possible to provide all the appropriate information that are supposed to be exchanged between students and faculty members of the virtual university and to support the researches of the virtual university.

Such a library helps users to find the required information through the resources available in the library databases and performs the tasks of information collection, accessibility and dissemination. The virtual attribute mostly refers to the lack of spatial dimension of this type of library. This type of library does not exist physically, is created on computer networks and enables the access of virtual university users to electronic and network resources.[24]

In this framework, it is recommended to use blockchain technology and launch the digital library of the virtual university of medical sciences in such a network.[25] By definition, blockchain refers to a database consisting of a list of transaction records, which are always growing and increasing in number. These records are called blocks, which are connected to each other through cryptography. Blocks are placed in a chain of nodes with a peer-to-peer network, and the resulting storage is called a digital ledger.[26]

This meaning fits well with what librarians have always done, that is to collect, keep, and share authoritative information. Blockchain can help librarians achieve this goal, especially in the world of scientific publications. One of the potential applications of blockchain is to create verifiable and scheduled copies of journal articles. Another potential application of blockchain in libraries is a digital rights management tool.[25]

Digital resources are inherently reproducible, which in turn creates issues for libraries and publishers. Because blockchain creates a unique verifiable record that anyone can access, it can be attached to digital material and used as a way to show the "provable scarcity" of that resource. This enables digital materials to be uniquely identified, controlled and transferred. Publishers can be also assured that there have been no copies of them.

Web 2.0 Tools

Web 2.0 is a set of programs and digital technologies that enable users to interact and collaborate with each other and share their content and information. Unlike Web 1.0, which is called a static and read-only network, Web 2.0 is a dynamic network that can read and write content. This technology allows the user to add, play, evaluate and change information. Although these technologies have not been formed with the approach of educational application, they have formed new conceptualizations regarding the dynamics of virtual university education (Figure 6). Web 2.0 challenges the existing models of designing web-based curricula, entails new epistemological considerations, and proposes a different theoretical basis. In this type of learning, the way educational content is produced and published is similar to Web 2.0. In other words, the content does not follow the traditional method of production, organization and distribution, instead it is a collaborative effort (Table 6).[19-21-22]

Finally, the technology component is displayed in the form of a conceptual pyramid after putting different parts together (Figure 7).

Management components and Administrative-educational Management

These components are identified with the following four basic elements in the current framework:

1. Vision: Vision, which is called perspective, view, imagined future, or ideal and desirable future, is a description of future conditions, in other words, it is an vision of the future state of a group, when goals and strategies are achieved. The vision of the organization should be brief, memorable, desirable and ideal and should take into account all levels (17-26-27).

   Furthermore, such a university is recognized as a virtual campus with a networked, open-source learning method based on real health care processes that are approved by the Ministry of Health and Medical Education.

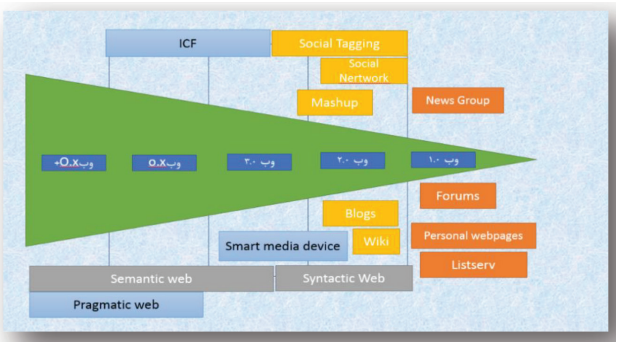

Fig. 6 **Types of web and its applications.**

Table 6. **Classification of Web 2.0-based technologies based on the educational design parts of the framework**

Subcategories	Technologies related to each subcategory
Teaching planning and design	1. Mihanblog 2. Blogfa 3. Crocodile 4. Huppa 5. Rubistar 6. Irubric 7. Ning 8. Edmodo 9. Moodle 10. Google 11. Sketchup 12. Gliffy 13. Google 14. Sites 15. salam.ir 16. Parsijoo.ir 17. Audacity
Presentation and teaching methods	1. FlashcardExchange 2. Wordnik 3. Del.icio.us 4. Flickr 5. Google 6. salam.ir 7. Parsijoo.ir 8. Webspiration 9. Slideshare 10. Gliffy 11. Paint 12. Audacity 13. Evernote 14. Community 15. Walk 16. Footnote 17. Googlemap 18. Create a Graph 19. Movie maker 20. Wordle 21. Viber 22. Telegtam 23. Youtube 24. SurveyMonke 25. PollDaddy 26. PollEveryWhere 27. Prezi 28. Protagonize 29. Glogster 30. Blogfa 31. Mihanblog 32. Powerpoint
Assessment	Edmodo, Ning, Moodle, PollEverywhere Google Trends, Crocodile, Huppa, Viber, Bubble.us Quizstar Telegram, Paint, Footnote, Microsoft office word

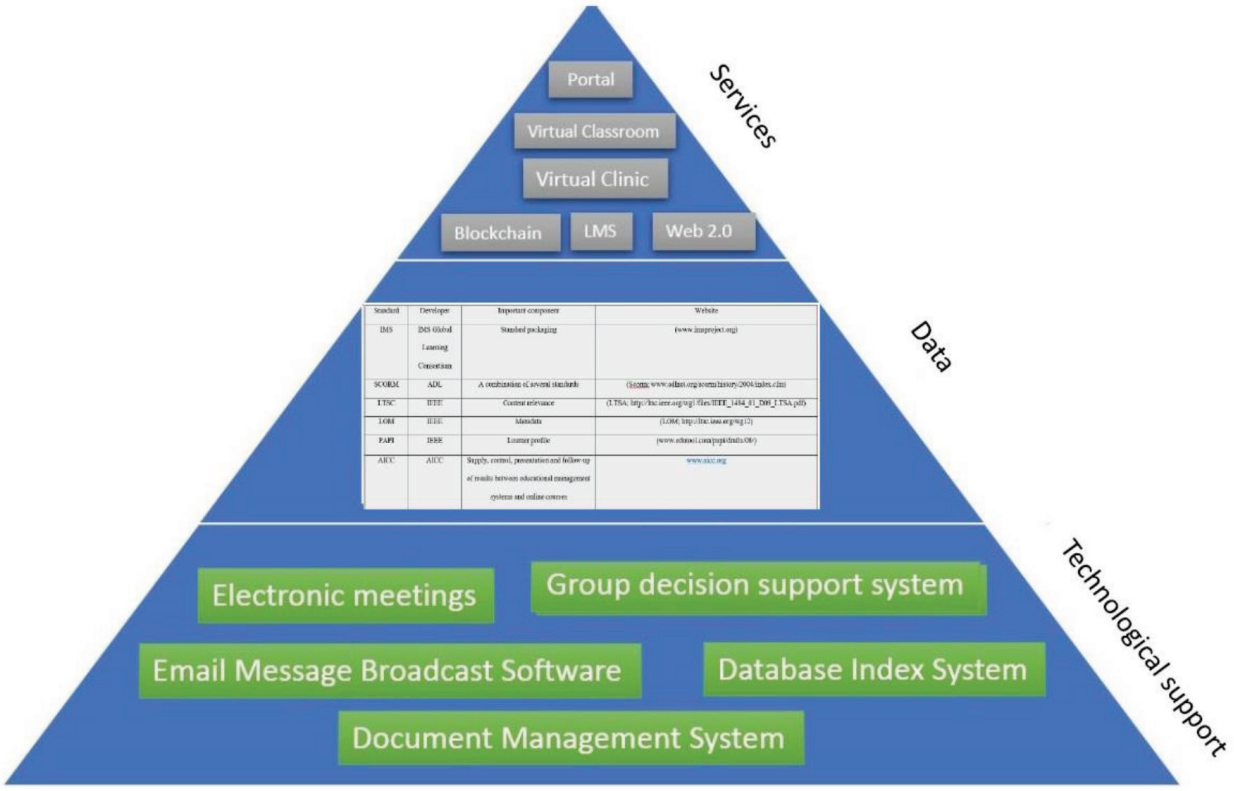

Fig. 7 **Technology component and its elements.**

2. Planning: The implementation strategies of a virtual university in the health education system are considered in this element:
   - Building and maintaining an educational virtual space for online interaction, learning and work in order to develop the professional competencies and qualifications of medical students.
   - Training of human resources for the efficient application of information and communication technology in the fields of education and health.
   - Strengthening the educational capacities of academic institutions and health service providers.
   - Integration and systematization of national health information and knowledge management.
   - Using information and communication technology for online education, based on the technical capacity available in academic health services institutions.
   - Methodological development of clinical training related to the health needs of Iran.
3. Operational management: Project management is a goal-based management model that defines the demarcation of different decisions, allocation of resources and assignment of responsibilities based on different components (courses, clinical topics, etc.) in different academic and service institutions.

In this sense, management takes place in two different parts.

- The first case is pedagogical management, which is related to the teaching-learning process and basic functions of faculty members such as educational design and creation of educational resources.
- The second case is institutional management, which deals with administrative and executive processes, where leaders and managers act at institutional and local levels, including the creation of logistics coordination and training regarding virtual learning environments (42-40-34).

4. Process quality evaluation: In this proposed framework, follow-up, control and evaluation are carried out to improve the quality of the program process through process analysis, academic results and the quality of services provided by the university. In this evaluation, managers' self-criticism has been identified as a fundamental pillar of process improvement. Also, continuous surveying of different university groups (faculty members, students, users) makes it possible to improve the quality of curricula and services at both institutional and curriculum levels.

Conclusion

The results of the present study emphasize that the six components of pedagogy, technology, management, educational design, technology implementation and administrative-educational management are essential in the establishment and development of virtual universities of medical sciences. Virtual university of medical sciences plays an important role in the development of electronic learning, the realization of educational justice and the creation of various educational opportunities in virtual form. In this regard, the process quality assessment framework can be used to improve the education process in these universities.

Conflict of Interest

None.

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