

Role of E-Learning in Teaching Anatomical Sciences

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ABSTRACT

Introduction: Medical undergraduates usually understand and memorize anatomical course material with difficulty. Also, the current text books and atlases of anatomy and histology do not fulfill all the learning needs of the undergraduates. Therefore, it is necessary to consider the role of internet websites and computer programs (i.e. the role of electronic learning) in teaching. The present research aimed to introduce the new teaching facilities in the field of anatomical sciences to improve learning among medical undergraduates and ameliorate the present teaching deficiencies. The present research also aimed at facilitating the continual training of graduates and lecturers in the anatomical sciences.

Methods: In this research, content analysis was conducted on 9 internet websites and 4 projects and computer programs related to anatomical sciences on the basis of those introduced by the lecturers of the anatomical sciences department of medicine faculty of Shahid Beheshti University of Medical Sciences. This review was conducted on the basis of teaching processes and technologies needed in electronic learning environment and also the necessary teaching facilities in learning of the anatomical sciences.

Results: Having interactive programs, atlases and virtual tests, the capability of updating material and continual education are some of the properties of electronic learning environments in the teaching of anatomical sciences. According to this research, 100% of the investigated projects and the computer programs and 44% of the websites, had interactive programs. Furthermore, 50% of the projects and computer programs and 22% of websites had virtual updated atlases, and 22% of websites had virtual tests.

Conclusion: By using the facilities in reliable educational sites of anatomical sciences and also the interactive learning computer programs, difficulties in learning and understanding anatomical sciences syllabus can be reduced and the level of knowledge in the field raised so that the way can be paved for improving clinical skills in the areas of diagnosis and treatment. Besides, the use of these technologies is effective in updating the knowledge of graduates and lecturers in the field of anatomical sciences.

Key Words:

Electronic learning, Teaching, Anatomical Sciences, Anatomy, Histology

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1. Introduction

Various forms of e-learning are based mainly on online learning. Facilitation of learning occurs in the e-learning environment via the use of diverse technologies like interactive applications (including multimedia applications such as movies, photos, audio materials, simulated environments, and applications installed on cell phones or tablets) and via links with other learners (e.g. e-mail, video-conferencing, and chat) which provide suitable environments for group discussion [1].

Courses in basic anatomy for medical undergraduates have always been hard to understand and memorize. The commonly available resources namely anatomical and histological textbooks and atlases do not meet all their needs regards accessing all anatomical structures and related topics in physiology and other basic or clinical sciences, as well as having access to images, interactive samples, and the latest updates. Bearing in mind advances in technology and the availability of new teaching technologies in the virtual space, exploring the role of electronic learning, including websites and computer programs for resolving these deficits is recommended.

2. Materials and Methods

One of the objects of the current research was to examine the role of e-learning in presenting the processes and new training facilities in the field of anatomical sciences (anatomy and histology), to enhance undergraduate learning in basic medicine, to alleviate the deficits, and to fill in the gaps in the teaching of the anatomical sciences. Furthermore, this study by introducing these training prospects sets the scene for continual training of graduates and lecturers in this field.

In this review, 9 websites and 4 projects and computer programs related to the field of anatomical sciences were investigated according to proposals made by the lecturers of anatomy at the Anatomy Group of Shahid Beheshti University. This review was based upon the educational processes and technologies required in the e-learning environments and also the necessary training facilities in learning the anatomical sciences. The studied websites consisted 6 cases belonged to university centers, 2 cases to non-university specialized training websites, and 1 website contained sorted information on various scientific fields.

Websites belonging to university centers

- ect.downstate.edu (SUNY Downstate Medical Center, Office of Educational Computing & Technology),

- www.med.wisc.edu (University of Wisconsin, School of Medicine and Public Health),
- www.udel.edu (University of Delaware, Department of Biological Sciences),
- library.med.utah.edu (University of Utah, Health sciences library),
- www.columbia.edu (Columbia University, College of Physicians & Surgeons, Department of Anatomy and Cell Biology),
- <https://le.ac.uk> (University of Leicester).
- Specialized non-university training websites:
 - www.instantanatomy.net (website for anatomical education with numerous applications for training in anatomy) and,
 - vesalius.com (the Internet resource for surgical education).
- A database website in various fields of science:
 - <https://archive.org> (A non-profit library of millions of free books, movies, software, music, and more).

The examined programs and computer projects were as follows

- Virtual Reality Brain Project (a project consisting of images of various cross-sections of the human brain with the capability of interactive use),
- The Visible Human Project (a project consisting of real images of extremely thin slices of the human body),
- Visible Human Server (A collection of 3D images based on data from The Visible Human Project) and,
- Instant Anatomy Applications (A collection of applications that can be installed on cell phones and tablets that contain flash cards for learning anatomy which allow the user to review important anatomical points).

3. Results

The comprehension of anatomical knowledge of a number of organs and their detailed structure and interconnections are hard to understand. The use of usual anatomical texts and atlases alone cannot assist much in

Table 1. Training processes and the technologies employed used in the studied e-learning resources.

	Resources	Interactive Programs	Virtual Atlases	Virtual Tests	Training to Use Instruments	Continual Training	Capability to Be Updated
University center websites	ect.downstate.edu		*	*		*	*
	www.med.wisc.edu						
	www.udel.edu				*		
	library.med.utah.edu						
	www.columbia.edu	*	*				
	https://le.ac.uk			*			
Non-university specialized websites	www.instantanatomy.net	*					*
	vesalius.com	*					
General websites	https://archive.org	*					
Projects and computer programs	Virtual Reality Brain Project	*					
	The Visible Human Project	*	*				
	Visible Human Server	*	*				
	Instant Anatomy Applications	*					*

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comprehending these structures, their interconnections, and spatial structures. In such cases, using various cross-sectional images of the organ at various positions helps towards a better comprehension of its structure. A case in point is brain structure. This facility is presented in the relevant computer programs.

Accordingly, in a program entitled “Virtual Reality Brain Project”, which uses the computer technology of “Quick Time”, the facility has been provided for observing the various cross-sections of the human brain interactively allowing change of the size of these cross-sections, their rotation, and selection of a specific region for observing its structure [2]. Regarding some anatomical areas of the body, textbooks and atlases are unable to display them in a way that can be understood. In these cases, using computer programs and websites that display the relevant spaces from different directions in 3D are helpful. Some examples of these displays are the pterygopalatine fossa [3] and the peritoneal space [4].

Computer simulation of a number of complex anatomical structures can be helpful in the comprehending such organs. In such simulations, the user can rotate and observe the relevant organ or take away and remove some parts so as to observe the underlying structures and simplify the organ in order to gain a better comprehension. For instance, under the Visible Human Server using the images obtained from The Visible Human Project and 3D technology; an interactive computer program is created

and a collection of images and 3D videos of the various body organs together with supplementary information is incorporated [5]. Obviously, such capabilities do not exist in anatomy textbooks or atlases. In addition, these interactive programs give one the opportunity to interactively inspect organs despite not having physical access (through a corpse or a model) to them. Also, such programs indirectly reduce the costs of training centers for the provision and retaining of various models or parts of the body.

Images or concrete descriptions and likening the anatomical structures lead to their better comprehension. For instance, in one of the websites affiliated to a university center, by using metaphorical descriptions and images, the anatomical structure of the larynx has been likened to a collection of pipes and elastic bands [6].

In such cases, the utilization of images of real corpses can assist learning process. Likewise, in cases such as scarcity of an organ or lack of necessary resources, the option of dissection of some organs such as the brain does not exist. In this situation, using real images of brain cross-sections in such internet atlases can assist comprehension.

A project entitled The Visible Human Project was undertaken in the year 2000 in the US with the goal of achieving a better comprehension of human anatomy. In this project, after fixation, the corpse of a man and a woman were axially cut in thin slices. Then, images of very high resolution were prepared out of them. Finally, a website

containing all the ensuing images together with their descriptions and detailed explanations was composed [7].

The use of real specimens not only assists comprehending and longer lasting memory but also assists the basic medical undergraduates in gaining higher diagnostic skills on entering clinical courses at hospital departments. In this regard, they would relate the basic scientific topics with the clinical topics and realize that acquiring the basic scientific knowledge is essential for working in the clinical sphere. A few websites affiliated to university centers introduce deceased clinical cases together with an account of the disease and patient history, examinations performed, and para-clinical measures (tests and imaging) performed. Then, they discuss the dissection and autopsy results and their anatomic pathologic findings after death and explain and interpret these according to the person's primary disease [8]. The elucidation of anatomic pathologic structures, especially assists the basic medical science undergraduates to better comprehend the clinical topics. Furthermore, such cases should be incorporated alongside training on the normal human anatomy. A few internet resources train these topics by using images and in addition describe surgery techniques for restoring such structures. For instance, presentation of images of inguinal hernia and its variations, its anatomic connections and surgery techniques leads to a better comprehension of such a disease [4].

Because of the high price, volume, and weight of some books and atlases; their inaccessibility; and their shortage in displaying all cross-sections, virtual atlases in computer programs be employed. They can be downloaded from a number of websites. Lecturers and undergraduates are always searching for suitable training resources corresponding to their needs and requirements and are sometimes forced to spend much time in libraries or non-specialized search websites for finding these references. However, familiarity with specialized websites in any scientific field that introduces the resources for that course frees one from spending time and money. Also, as regards the anatomical sciences, in a number of specialized websites affiliated to the universities, the references for these sciences are cited and some of them allow users to download freely online [9]. Access to old and historical references concerning anatomy and histology is sometimes necessary for conducting research. Such facilities have been provided in the virtual space, which are certainly less demanding of time and money compared to the usual practice of going to libraries and searching printed references.

Other ways of updating the sciences include becoming acquainted with distinguished persons in one's specialized field and having the opportunity to discuss and ex-

change knowledge with colleagues in one's scientific field and participate in conferences, seminars, or workshops. For information on such programs a number of websites announce creditable conferences and their agendas. Considering the daily advances in various sciences, including anatomy and histology, updated accessibility to news about these sciences through books and atlases, which are usually published and edited once every few years is not feasible and the use of reliable internet references in this field is mandatory. In a number of these resources, advances in these sciences become momentarily available [10].

Continual training, which is in fact necessary for graduates in any field requires a well-organized and well-defined scheme so that by upgrading and updating the knowledge of graduates and lecturers in each field the graduates under training benefit indirectly. Anatomical sciences are no exception to this rule and suitable programs of graduate education are present on a number of websites affiliated to creditable universities and by referring to them the necessary training can be received [11]. Such continual training programs have advantages over the traditional ones in terms of time and money saving on attending lectures, conferences, or workshops; as well as having updates of references and well-organized and purposeful training programs.

In recent years, in some medical schools, including some in Iran, the training of some topics of the basic science courses like anatomy and histology has become system-based (according to various systems of the body such as the nervous system, the digestive system, and other ones) and integrated (i.e. integration of various topics such as anatomy, histology, embryology, physiology and other topics in the frame of each organ of the body). In this respect, suitable textbooks have not been provided for the undergraduates. This can lead to disorientation and impairment of this novel training process, whilst there are references in the websites of creditable universities which offer this training system [11].

Sometimes, familiarity of working with medical instruments and devices is taken for granted and no training is given in this respect and the undergraduates learn how to work with these instruments by trial and error. Conventional textbooks do not teach the undergraduate using these instruments. There is, therefore, a need for references that introduce these instruments and explain how to work with them. For instance, familiarity with the construction of a microscope and the way to use it and with the inspection of a slide in histological laboratories is taught in such websites interactively by video or software simulation [12].

For training medical undergraduates, dissection halls are always in need of provision of corpses. Considering the repeated use of these corpses, which have limited and restricted durability, it is indispensable for these centers to be provided with new corpses. Nowadays, in a number of websites affiliated to the university centers, there is a scheme entitled Body Donation Program in which persons above 18 years are requested to sign a form announcing their consent for donating their body after death. They can participate in this way in the training of the forthcoming physicians [13].

Finally, the training processes and the technologies employed in each of these e-learning resources are introduced in the following table.

4. Discussion

Devising interactive programs, atlases, and virtual tests, as well as the ability for updating the material and continual training are some of the features of e-learning environments for the training of anatomical sciences. In the present review, 100% of the projects and computer programs (4 cases out of 4) and 44% of websites (4 cases out of 9) under review had interactive programs. Also, 50% of the projects and computer programs (2 cases out of 4) and 22% of websites (2 cases out of 9) had virtual updated atlases and 22% of websites (2 cases out of 9) had virtual tests. Therefore, their utilization in the training of anatomical sciences contributes towards counteracting the gaps in traditional educational resources (the customary textbooks and atlases), and also towards reducing learning difficulties among undergraduates in the basic medical sciences regarding anatomical sciences.

Besides, their clinical skills in the fields of diagnosis and treatment are facilitated by advancing their knowledge in these fields. In addition, using these technologies for the continual training and updating the knowledge of graduates and lecturers in the fields of anatomical sciences is effective and economic. In this regard, more research is essential in the area of novel technologies like e-learning to advance training in disciplines of anatomical sciences and subsequent results could be employed in constructing training processes founded on technology.

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Conflict of Interest

The authors of this study declared no conflict of interests.

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