Received: July 16th 2011
 Accepted: August 15th 2011
 (c) AVICENA 2011

AIM 2011; 19(3): 161-167

doi: 10.5455/aim.2011.19.161-167

Information Technologies (ITs) in Medical Education

Izet Masic¹, Haris Pandza¹, Selim Toromanovic², Fedja Masic³, Suad Sivic⁴, Lejla Zunic⁵, Zlatan Masic⁶

Faculty of medicine, University of Sarajevo, Bosnia and Herzegovina¹

Health Center Cazin, B&H², Faculty of medicine, University of Vienna, Austria³

Faculty of Health Sciences, University of Zenica, Bosnia and Herzegovina⁴

Faculty of Pharmacy, University of Tuzla, Bosnia and Herzegovina⁵, XION Company, Vienna, Austria⁶

Review

SUMMARY

Advances in medicine in recent decades are in significant correlation with the advances in the information technology. Modern information technologies (IT) have enabled faster, more reliable and comprehensive data collection. These technologies have started to create a large number of irrelevant information, which represents a limiting factor and a real growing gap, between the medical knowledge on one hand, and the ability of doctors to follow its growth on the other. Furthermore, in our environment, the

term technology is generally reserved for its technical component. Education means, learning, teaching, or the process of acquiring skills or behavior modification through various exercises. Traditionally, medical education meant the oral, practical and more passive transferring of knowledge and skills from the educators to students and health professionals. For the clinical disciplines, of special importance are the principles, such as, "learning at bedside," aided by the medical literature. In doing so, these techniques enable students to contact with their teachers, and to refer to the appropriate literature.

The disadvantage of these educational methods is in the fact, that teachers often do not have enough time. Additionally they are not very convenient to the horizontal and vertical integration of teaching, create weak or almost no self education, as well as, low skill levels and poor integration of education with a real social environment. In this paper authors describe application of modern IT in medical education – their advantages and disadvantages comparing with traditional ways of education.

Key words: medicine, education, information technologies, distance learning..

1. INTRODUCTION

The term technology is of Greek origin and means a skill, while the word logos implies – a science. Technology refers to the applied knowledge or the applied science. According to the "Office of Technology Assessment," "Medical technology is a set of techniques, medicines, equipment, tools and procedures used by the health professionals in providing health care to the individuals and systems, in which such technology is used (1, 2, 3). Broader concept of medical technology constitutes the health technology, a term that includes all the procedures, tools and techniques that are used in order to improve health, as well as the simplest and the most effective way to treat and rehabilitate certain population. Information technology, in medicine and healthcare can be presented by one complex technological model, (e.g. Technology Package), which includes all the com-

ponents of technological packages, such as: hardware, software, brain ware and orgware that can actually cover all the medical technology and technology in health activities (4, 5, 6). Advances in medicine in recent decades are in significant correlation with the advances in the information technology. Modern information technologies have enabled faster, more reliable and comprehensive data collection (7, 8, 9, 10). These technologies have started to create a large number of irrelevant information, which represents a limiting factor and a real growing gap, between the medical knowledge on one hand, and the ability of doctors to follow its growth on the other. Furthermore, in our environment, the term technology is generally reserved for its technical component. This terminology essentially means not only the purchase of the computer and related equip-

ment, but also the technological foresight and technological progress, which are defined as the specific combination of fundamental scientific, research and development work that gives a concrete result; – (e.g. from fundamental discoveries to their application in the form of innovations) (11, 12, 13, 14, 15).

Education means, learning, teaching, or the process of acquiring skills or behavior modification through various exercises. Traditionally, medical education meant the oral, practical and more passive transferring of knowledge and skills from the educators to students and health professionals. For the clinical disciplines, of special importance are the principles, such as, "learning at bedside," aided by the medical literature. In doing so, these techniques enable students to contact with their teachers, and to refer to the appropriate literature. The

disadvantage of these educational methods is, in the fact, that teachers often do not have enough time. Additionally they are not very convenient to the horizontal and vertical integration of teaching, create weak or almost no self education, as well as, low skill levels and poor integration of education with a real social environment.

Information technologies (i.e. ITs) have the capacity, more than any other medium, to facilitate student learning and problem solving, in addition to many other benefits (16, 17, 18, 19, 20).

A few decades ago, with the emergence of television, IT was expected to becoming the dominant medium, when it came to the information technologies that are used in medical education. Today it is clear that computers and computer technology took over the primacy of it, among other things, because they are already, by definition, either interactive mediums or require constant engagement of students and teachers.

Computer, in general terms, is the device, by which the information is processed, or a device for the automatic processing of data of numerical and non-numerical nature. These devices comprise the bases for computer information systems (e.g. CIS) or (i.e. information technology packages), which traditionally have been composed of at least two components or two subsystems consisting of multiple elements such as (1):

- Hardware
- Software

These two components act synergistically and both are essentially important for the proper operation of a computer system and its use in the medical education. Therefore, Hardware refers to all mechanical, visible and “tangible” computers’ components. We can divide the elements of the hardware system into several groups that act in interactive computer systems such as:

- Data entry mechanism;
- Data processing mechanism;
- Data storage mechanism;
- A mechanism for retrieving of the processed data.

Software part of the computer is a general term for software of a computer, (i.e. a set of instructions prepared so that it is performing in an appropriate way to obtain an adequate final result). The software is further divided into the system and application software. System components would belong to the operating system, (i.e., now the predominant Microsoft Windows operating systems, and to a lesser extent Linux, Mac, etc.). Examples of the application software are components of the Microsoft Office (Suite) package; (e.g. Microsoft Word processing, Microsoft Excel spreadsheet, Microsoft Access database, Microsoft PowerPoint presentations etc., and the extremely large number of other programs (applications), used for various purposes). In this context, we will mention another term that is rarely used – “a Firmware”, which is generally described as a special type of software that provides system functions within a computer system. As such, in principle, it cannot be changed without the danger of serious damage to the basic logical relations in instances when the computer is blocked by the end user (21, 22, 23, 24).

1. COMPUTER INFORMATION SYSTEMS (CIS) IN EDUCATION OF HEALTH PROFESSIONALS

Various forms of information systems have been developed; which can be broadly classified into four main groups: (26)

- systems based on computer support for learning of basic medical sciences,
- computer simulation systems for training and testing of clinical competency,
- systems-based computer consulting, and,
- systems based on computers for data management and quality assurance.

Since these are complex systems that require a basic knowledge from many disciplines, it is nec-

essary to have enough trained people who utilize information systems. Therefore, educators, in addition to their academic scientific fields must be sufficiently IT literate. To this end, the manufacturers are developing information systems’ applications that are easily acceptable to users, by organizing training of users and by providing continuous support to the functioning of the system. Today, at the time of the general movement of globalization, we have such a global software development (e.g. GSD – Global Software Development), where the virtual teams are developing information systems, educate consumers and support the work of such systems. These particular systems can be developed at the level of a facility for education; (i.e. university information systems for education) and can have separate subsystems for students, teachers and specialized training systems for special purposes, (for example, Blackbaud’s solution for small universities – Blackbaud Student Information System). Educational information systems can be arranged for one region or may be national and international educational systems. An example of these systems is MEISE, (Michigan Education Information System), EUDISED (European Documentation and Information System for Education), NEIS (National Education Information System) in South Korea and many others. For the purposes of the national system of

Figure 1. The E-learning framework

education in India, IBM India proposes the formation of a network for cooperation in education (ECN – Collaboration Education Network). The Figures 1, 2 and 3 shows how the network would look like:

2. E-LEARNING

E-learning encompasses all forms of electronically supported learning. Informational and communication systems networked or not, serve as a specific medium in the process of knowledge transfer. Applications and processes for e-learning include: web-based learning, learning with computers, virtual classrooms and digital collaboration. Content is delivered via Internet, intranet, satellite TV or portable media (26). The basic definition of e-learning says that "... it encompasses the use of multimedia and Internet, in order to improve the learning quality to accessing the facilities and services and facilitating cooperation and communication at a distance. "Eva Kaplan-Leiser, in her "online dictionary 2000" wrote, that "e-learning covered a wide range of applications and processes such as: web-based learning, computer-based learning, virtual classrooms and digital collaboration. It includes the delivery of content via: Internet, intranet/extranet (LAN/WAN), audio and videotape, satellite transmission, interactive television and CD ROMs (27, 28). One of the major goals of e-learning is providing individual, comprehensive and dynamic content in real time, in order to maintain the pace with the changes that are now rapidly taking place (29, 30).

3. INTERACTIVE CLASSROOM

Interactive Classroom allows students to actively work with the dynamic content, rather than passively listening to the teachers. Interactive technologies based on modern IT developments, become tools that provide students with a world rich in resources. This positive scientific development facilitates customized learning environment for students of different learning styles, which create a time-specific and ad-

justed estimates of success. With modern technology at its core, interactive classrooms improve the learning process clearly and effectively by illustrating the new concepts and enhancing students 'motivation. Interactive classrooms are equipped with modern interactive hardware and corresponding software.

3.1. Interactive panel and digital pen

Interactive panel is a computer aided interactive table that displays the desired content. It allows the students to work together by supporting multi-user writing and sharing activities in multi-touch control, an innovative IT feature that is supported in the latest operating systems such as Microsoft Windows 7. The software allows free interaction, where two students can work together on a single task, such as free writing or manipulation of digital objects anywhere on the desktop.

3.2. The camera for documents and multimedia projector

These two innovative devices allow the display of documents or objects on the interactive board, giving them the interactive features at any time during the class, so that students remain interested and attentive for prolonged periods of time.

3.3. Wireless electronic board

In actuality it represents a remote controller of interactive board. It allows the teacher or student from the other end of the room to enjoy the interactive presentation on the interactive control panel. By doing so, it creates a freedom of participants in interactive classroom activities.

3.4. Device for student answers "clicker"

This small device allows the teacher to interview the students

Figure 2. Interactive panel and digital pen

during the course. Students use it to give an answer to this question, after which the computer system calculates the percentage of students who gave correct answers. In this way, the teacher gains insight into how students are understood presented content.

3.5. Electronic notebook for joint learning

This interactive and innovative device allows easier development and distribution of the educational material. Software for co-creation, delivery and management of interactive teaching material in one application, becomes the standard of modern interactive classrooms and it contains an electronic notebook.

Numerous other interactive parts of hardware, in order to facilitate education and provide a very interesting method of presenting educational material are also used. In addition, there are also hardware and various software products tailored to different types of education. Thus, for example, basic operating system (i.e. say Microsoft Windows7) can be added to the DICOM protocol for exchanging medical imaging facilities and other patient data. With the addition of these new features, physicians can safely analyze the patients' situation without the patients ever being present. In this way, we can take the content from much of the information technology and

efficiently and effectively use it for diagnostic analysis or students' education.

4. COMPUTER SUPPORTED INDEPENDENT STUDY PROGRAM OF BASIC MEDICAL SCIENCES

Unlike the traditional methods of learning information systems, telecommunications technologies offer the possibility of Independent Study Program (ISP – Independent Study Program), in which students progress through the curriculum independently. The main difference from the earlier traditional view is that there are more variables during the learning process when a students' learning progress reaches a certain level of competence to move him or her to the next level. Individual progress requires that the students complete the basic knowledge that would allow them to move on to the sphere of a clinical education.

These training programs were first developed in the 1960s and 1970s, first in Canada and then in the United States, only to be later expanded to Western Europe. First in medicine among them was the State University of Ohio in 1970, followed by the University of Wisconsin in 1972.

ISP has an integrated curriculum, modular study objectives, computer-managed evaluation system and the means to manage the independent student progress. Each student's progress is monitored through the computer or a supported self evaluation leading system for the assessment (i.e. TES – Tutorial Evaluation System) in an interactive session, between a computer and a student. When a student answers the question correctly, his or her score increases and he or she passes on to the next question, but if the answer is incorrect students must complete corrective action(s) before they could try to re-answer the question.

5. DISTANCE LEARNING

For the development of distance learning is crucial the development of telematics. Telematics is the science, which studies the techniques

and methods of information transmission on distance (1, 2). There are two broad approaches to Telematics:

First aspect of these is the one that sees as important the possession of knowledge about the use of Telematics in learning (e.g. teaching medical students to use tools such as the Internet) (1). Another approach is considered essential for the use of Telematics for teaching (e.g. the use of WWW as a platform for CAI Computer-Based Instructions).

Today, distance learning and Web-based education are often used as synonyms. However, distance learning is much more general term and is certainly more comprehensive by including the WBE. It can be defined as follows: "Distance learning is planned learning that takes place at the remote site of teachers, and as a result requires special techniques, curriculum design, special instructional techniques, special methods of communication, as well as special organizational and administrative arrangement(s) (Moore and Kearsley, 1966). Forms of distance education include: individual participation, teleconference, tele-seminar(s), web conferencing, electronic classrooms, etc. (26, 27, 29, 30)

6. WEB BASED LEARNING

Web-based learning (i.e. Web-based Education – WBE) covers all aspects and processes of education using the World Wide Web (WWW) as a communication medium in combination with its associated technologies. There are many other terms for WBE, such as online education, virtual education, internet-based education, etc. (25, 28, 30)

WBE is characterized by:

- the separation of teachers and students (no longer in the process of teaching face to face),
- The existence of educational organizations (as opposed to self-education or private tutoring),
- Use of Web tech-

nology for presentation and distribution of educational content,

- Providing two-way communication over the Internet, so that students can communicate with each other, with teachers and faculties' administration.

Since the 1990s of the last century, WBE has become an important branch of educational technology. WBE provides the students with virtually unlimited information and educational facilities. As a highly innovative, effective and efficient agent it provides many opportunities for: self - learning, distance learning and collaboration while at the same time providing the clear benefits of independent learning. On the other hand, teachers and authors of teaching materials may use many features of this platform for distance learning, by having suitable tools for the development of educational materials and for archiving and distribution of this material. E-learning courses give you the opportunity to plan students' time more efficiently, since the on-line learning material can be accessed at any time of day and night, seven days a week and 365 days in a year. If we take into account the aspect of communication, between students and sources of knowledge, we can say that distance learning can be interactive and passive. Passive learning involves viewing content on the screen, but without a significant influence on the contents that will be published.

There are many concepts of Web-based training, such as e-learning, of whom we have discussed previously, in addition to the distance education and adaptive learning that we also

Figure 3. The system of E-learning with main components

talked about a little earlier.

7. VIRTUAL CLASSROOM

Virtual classroom is a form of computer - based education, where the teacher communicates with students through video-conferencing, internet or e-mail. Working in the classroom is completely directed by on-line system, with the access to: the rooms for a "chat" (i.e. chat rooms), E-mail and messages in the real time (1). The teacher is making presentations and is preparing the teaching material that students can download from the internet in order to solve problems and send comments via e-mail or chat rooms to other students or the course teacher. The basic idea is that the different sets of possible ways of learning are available to students. In this way, the students can choose the way of learning that suits them best.

Blackboard Learning System is an example of Web-based virtual classrooms, invented by a Blackboard Inc., headquartered in Washington D.C., USA.

From June of 2004 on, the system created to date is used in more than 3700 educational institutions in 60 countries around the world. Exactly, this is a comprehensive system, because, in addition to providing a virtual learning environment, it also provides a system for managing of the learning activity. It is designed to be installed on a local server and one served by an interactive classroom and/or can be fully available over the internet.

WebCT has also developed an online virtual environment for the advancement of the education. This is the world's first successful management system and training tool on the Web platform. It is used by more than 10 million students in 80 countries around the world. Both Blackboard and WebCT are commercial products.

There is also the open source software specifically developed for these purposes. It is known as, "MOODLE" (e.g. Modular Object-Oriented Dynamic Learning Environment) - a modular object - oriented dynamic environment for education.

It has characteristics similar to e-learning, such as: the authorization, a discussion forum, the base material for the education, assessment, calendar, news and announcements, a quiz, etc.

Since it was developed in 1999 and until October of 2010, it had the customer base of 49952 sites with 36,920,681 users. In the same time period it has presented 3,732,772 different courses, been translated into 75 languages in 210 countries

worldwide .

8. INTERACTIVE DISTANCE LEARNING

Distance learning is more effective if there is interaction between students and software. Students solves tasks choosing one or more correct answers. The answers to the question are displayed after pressing submit button. The student can see correct answers and explanations why some

Vrsta imena / Prezime	Started on	Završeno	Time taken	Grade/10	#1	#2	#3	#4	#5	#6	#7	#8
Andre Cotic	17. Novembar 2009. 05:10	17. Novembar 2009. 05:10	open	-	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17
Sanela Bencic-Coppe	11. Novembar 2009. 10:24	11. Novembar 2009. 10:40	1 dan 2 Sat	7.82	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17
	17. Novembar 2009. 12:24	17. Novembar 2009. 12:24	12 sekunde	0	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17
	12. Novembar 2009. 08:11	12. Novembar 2009. 08:11	1 minut 20 sekunde	0	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17
Anto Andrija	11. Novembar 2009. 08:31	11. Novembar 2009. 08:38	7 minuta 54 sekunde	3.84	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17
	13. Novembar 2009. 10:32	13. Novembar 2009. 10:40	8 minuta 31 sekunde	4.38	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17
	13. Novembar 2009. 13:48	-	open	-	-0.17	-0.17	-0.17	-0.17	-0.17	-0.17	-0.17	-0.17
Ermina Begić	12. Novembar 2009. 09:40	13. Novembar 2009. 09:40	29 Sat 58 minuta	5.88	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17	0.17/0.17

Figure 4. Student sheet that shows information about students, dates of quiz and results for each question

1 Malaria is caused by

Obilježiti: -- /1

Choose at least one answer.

☐ a. plasmodium falciparum

☐ b. Plasmodium ovale

☐ c. Plasmodium malariae

☐ d. mosquito

Submit

Submit page Submit all and finish

Fill with correct Start again Close preview

Figure 5. Multiple Choices question

1 Malaria is caused by

Objekti: 0/1

Choose at least one answer.

☐ a. Plasmodium malariae

☐ b. plasmodium falciparum

☒ c. mosquito Plasmodium is a protozoan parasite, one of the species of Plasmodium that cause malaria in humans. It is transmitted by the female Anopheles mosquito.

☐ d. Plasmodium ovale

Plasmodium falciparum is a protozoan parasite, one of the species of Plasmodium that cause malaria in humans. It is transmitted by the female Anopheles mosquito. P. falciparum is the most dangerous of these infections.

Submit

Incorrect

Marks for this submission: 0/1. This submission attracted a penalty of 0.1.

Figure 6. In case of incorrect answer program shows comments that can help in answering.

Figure 7. The example how correct answer program shows comments that explain why answer is correct.

answers are wrong or correct. The test can be repeated many time and results should be better after each run. Eventually student can answer all questions correctly.

This method is efficient but requires a lot of time for preparation of question and answers. This is the main disadvantage of this method. The questions should cover all knowledge in specific area.

The teacher can see all answers according to student or question. The teacher is able to check all attempts and identify all questions that are problematic for specific student or all students. Reports of activity can be used to assume how much time students spent and how many questions were correctly answered. Questions are grouped in quizzes that can be intended for specific area of knowledge. The number of attempts and time for answering can be limited. Also, the students cannot attempt one quiz before answering previous quiz if it is necessary.

The interactive process of learning by discovery of correct answers can speed up process of learning. Also, the students don't need to look into textbook for explanations of answers because all explanations are provided by program. Usually, the teacher put paragraphs that explain why some answers are correct from textbook.

The students can be scored according to the number of correct answers. Each correct or incorrect answer can be scored independently and impact of particular answer can be determined. Wrong answers can add negative score to total score

if teacher think that some answer is terrible wrong or have no influence to total score. Partially correct answers can carry certain amount of points. In that way the knowledge can be more accurate assessed. Student can see results immediately and progress is displayed to the students (Figure 5, 6 and 7).

9. CONCLUSION

The last quarter of the 20 century, has created dramatical reduction in size and cost, while improved performance of computers have increased CIS availability and led to their use in most aspects of our lives. During that same period, the advances in medical sciences have led to an explosion of information that might be difficult to accept without application of modern information technologies. In recent years, the progress of information technologies and their application in education goes even further. Unlike the earlier mini and micro computer systems in classrooms, libraries and at home, today we are increasingly using web-based networked computer systems for education.

WEB-based training utilizes the World Wide Web (i.e. WWW) as its communication medium and as a technological support to learning. There are many other terms for the WBE - (i.e. Web based education), such as: the online education, virtual education, online education and the education through computer-mediated communication.

REFERENCES

1. Masic I. Information Technolo-

gies in Medicine and Healthcare. In: Izet Masic, Zoran Ridjanovic, Haris Pandza, Zlatan Masic. Medical Informatics. Avicena, Sarajevo, 2010: 397-440.

2. Zunic L. Analiza modela pracenja laboratorijske dijagnostike u porodicnoj medicini. Doktorska disertacija. Farmaceutski fakultet Univerziteta u Sarajevu. Sarajevo, 2011: 14-18.
3. Petkovic D, Sivic S. Osnove tehnologija i menadzmenta u zdravstvu. Zdravstveni fakultet Univerziteta u Zenici, Zenica, 2008: 5-40.
4. Sivic S, Masic I, Zunic L, Huseinagic S. Evaluation of Usage of Information Diagnostic Technology in Family and General Medicine. Mat Soc Med, 2010; 22(4): 212-215.
5. Haux Reinhold, Gietzelt M, Helrung N, Ludwig W. et al. Future Medical Informatics Research and Education. In: Medical Informatics in a United and Healthy Europe (Eds. Klaus-Peter Adlassnig, Bernd Blobel, John Mantas and Izet Masic), IOS Press, Amsterdam, 2009: 14-16.
6. Aldred, SE, Aldred MJ, Dick B, Walsh LJ. The Direct and Indirect Costs of Implementing Problem-based Learning into Traditional Professional Courses within Universities. Canberra: Australian Government Publishing Service, 1997.
7. Masic I. Tele-education as a new method of Medical and Public Health Education. In: Lijana Zalelet-Kragelj and Jadranka Bozikov. Methods and Tools in Public Health. Hans Jacobs Publishing Company, Lage, 2010: 959-974.
8. Shortliffe EH. Medical Informatics Meets Medical Education. Medical technology, vol 1, num 1; September 5, McGraw Hill, 1999.
9. Mills P, Timmis A, Huber K, Ector H, Lancelotti P, Masic I, Ivanusa M. et al. The role of national journals in education. Heart 2009 Dec; 95(24): e3.
10. Kern J, Zuvic-Butorac M. Obrazovanje i usavršavanje. U: Josipa Kern i Mladen Petroveci (urednici). Medicinska informatika. Medicinska naklada, Zagreb, 2009:

- 260-267.
11. Trzebiatowski GL, Williams JH, Sachs LA, Altman M, Bellchambers M. Independent study: 10-year programme review. *Med Educ*. 1987 Nov; 21(6): 458-63.
12. Geertsma RH, Meyerowitz S, Salzman LF, Donovan JC. An independent study program within a medical curriculum. *J Med Educ*. 1977 Feb; 52(2): 123-32.
13. Stone HL, Meyer TC, Schilling R. Alternative medical school curriculum design: the independent study program. *Med Teach*. 1991; 13(2): 149-56.
14. Masic I, Novo A, Deljkovic S, Omerhodzic I, Piralic A. How to assess and improve quality of medical education - lessons learned from Faculty of medicine Sarajevo. *Bosn J Basic Med Sci*. 2007 Feb; 7(1): 74-8.
15. Khan BH. Managing e-learning: design, delivery, implementation, and evaluation. 2005, by Idea Group Inc., 2005.
16. Jakšić Ž, Pokrajac N, Šmalcelj A, Vrcic-Keglevic M. Umjece medicinske nastave. Medicinska naklada, Zagreb 2005.
17. Timothy K. Shih, Jason C. Hung. Future Directions in Distance Learning and Communication Technologies. 2007. by Idea Group Inc., 2007.
18. Rogers P, Berg G, Boettcher J, Howard C, Justice L, Lechenk K. Encyclopedia of Distance Learning Second Edition. 2009. by IGI Global, 2009.
19. Grahame M, Moore, William G. Anderson. Handbook of distance education. Adult students today. by Lawrence Erlbaum Associates, Inc. Aslanian, C.B., 2001
20. Finkelstein MJ, Frances C, Jewett FI, Scholz BW. (Eds.). Dollars, distance, and online education: The new economics of college teaching and learning. Phoenix, AZ: The American Council on Education and the Oryx Press, 2000.
21. Devedzic V. Semantic web and education. Springer Science-hBusiness Media, LLC, 2006.
22. Moore MG, Kearsley G. Distance Education: A Systems View, Wadsworth Publishing Company, Belmont, CA, 1996.
23. Bokonjic D, Petrov B, Mašić S, Hwendiek S, Lozo S. Integration of virtual patients into existing curricula of bh pediatric departments results of two evaluation studies. Bio-algorithms and med-systems, Journal edited by Medical college – Jagiellonian University, 2009; 5(9): 17-21.
24. Díez FJ, Mira J, Iturralde E, Zubilaga S. DIAVAL, a Bayesian expert system for echocardiography. *Artif Intell Med*. 1997 May; 10(1):59-73.
25. Wolfram DA. An appraisal of INTERNIST-I. *Artif Intell Med*. 1995 Apr; 7(2): 93-116.
26. Masic I, Pandza H, Kulasin I, Masic Z, Valjevac S. Tele-education as Method of Medical education. *Med Arh*, 2009; 63(6): 350-3.
27. Masic I, Ciric D, Pulja A, Kulasin I, Pandza H. Quality Assessment of Medical Education and Use of Information Technology. *Stud Health Technol Inform*. 2009; 150: 898-902.
28. Masic Z, Novo A, Masic I, Kudumovic M, Toromanovic S, Rama A, Dzananovic A, Bander I, Basic M, Guso E, Balta E. Distance learning at Biomedical faculties in Bosnia and Herzegovina. *Stud Health Technol Inform*. 2005; 116: 267-72.
29. Masic I, Kudumovic M, Novo A. Education of medical informatics at Medical faculty of Sarajevo. *Med Arh*. 2004; 58(1, supl 2): 88-91.
30. Masic I, Pandza H, Masic Z. Medical Informatics Education and Distance Learning at Sarajevo Biomedical faculties. *Ukrainian Journal of Telemedicine and Telematics*, 2008; 6(3): 131-4.

Corresponding author: prof Izet Masic, MD, PhD.
Faculty of medicine, University of Sarajevo, Sarajevo,
B&H.. E-mail: imasiclol.ba.