Distance Education Programs on the Example of Medical Education

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Abstract. This article is concerned with the use of distance education programs in medical education. The proposed approach includes the development of professionally oriented teaching, the use of multimedia lecture courses, the use of Learning Management Systems, webinars, etc.

Keywords: E-learning · Distance learning · Distance education technologies · Computer technology · Continuing medical education · Higher medical school · Multimedia lecture courses · Computer learning management system · Webinars · Teaching physics

1 Fundamentals of the Use of Distance Educational Technologies in Medical Education

The content of the training of future and current health care professionals is regulated by professional standards that guide the educational process towards the formation of stable knowledge, skills, and practical skills among students based on the results of studying a wide range of disciplines. This led to the emergence of a competency-based approach in medical education [1]. The scope of competence of employees is regulated by professional standards that define labour functions and labour activities.

There is a shortage of personnel in the Russian healthcare system, which will require significant time expenditures to overcome it. Therefore, the industry needs not just a quantitative increase in labour resources but also an increase in the quality of their training. Educational programs compiled on the basis of professional standards for medical specialties contain components aimed not only at improving knowledge, but also at increasing practical training for obtaining both medical and managerial skills.

Orientation to the formation of professional competencies dictates the need to use innovative pedagogical methods and technologies that can be implemented through

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distance learning (DL). At the present stage, it has proved its value and effectiveness as one of the most promising and rapidly developing forms of education.

Therefore, the Russian higher medical school today is also aimed at developing students' information competencies with the possibility of their full use upon completion of training. The use of e-learning and distance education technologies (DET) in the implementation of the educational process in medical universities of our country occurs within the framework of the global educational trend, but at the same time, there are features and limitations due to industry and national characteristics.

New definitions have appeared in the domestic legislative framework in the field of education: e-learning, distance educational technologies, electronic information educational environment.

E-learning is understood as the organization of the educational process using the information contained in the databases and used in the implementation of educational programs and the information processing technologies, technical means, as well as information and telecommunication networks that ensure the transmission of the specified information through communication lines, the interaction of educational process participants.

In the Federal Educational Standards of higher education, there has been a shift in emphasis on the cognitive process, the motivational component of students, since the effectiveness of this process is correlated with the cognitive activity of students.

Modern medical education should train and graduate not only professionals – professionals who are competitive in the medical services market but also creative people who can quickly adapt to changing conditions who can work independently, making decisions and taking responsibility for their actions.

Remote (distance) education technologies are educational technologies that are implemented mainly with the use of information and telecommunication networks with indirect (at a distance) interaction between students and teachers.

The strategic goal of DL is to provide the student with equal opportunities to receive education at any level at the place of residence or professional activity based on the use of information and communication technologies.

The advantages of DL include accessibility, modularity, a high degree of interactivity, dynamic access to information; the possibility of self-control; an active help system, multimedia presentation of information, the ability to study the material at an individual pace and repeated calls to it if necessary, increased motivation, high visibility, development in the learning process, lack of fear of making a mistake, choosing a personal educational path, confidentiality.

Specialists in the strategic problems of education in an environment of global informatization regard distance learning as an educational system of the 21st century. DL allows you to solve such a pressing contemporary problem as rapid information development, including in healthcare.

The electronic information and educational environment (EIEE) is a system that includes electronic information resources, electronic educational resources, and a set of information technologies, telecommunication technologies, appropriate technological means and ensuring that students learn the educational programs in full, regardless of their location. The example of typical EIEE – see Fig. 1.

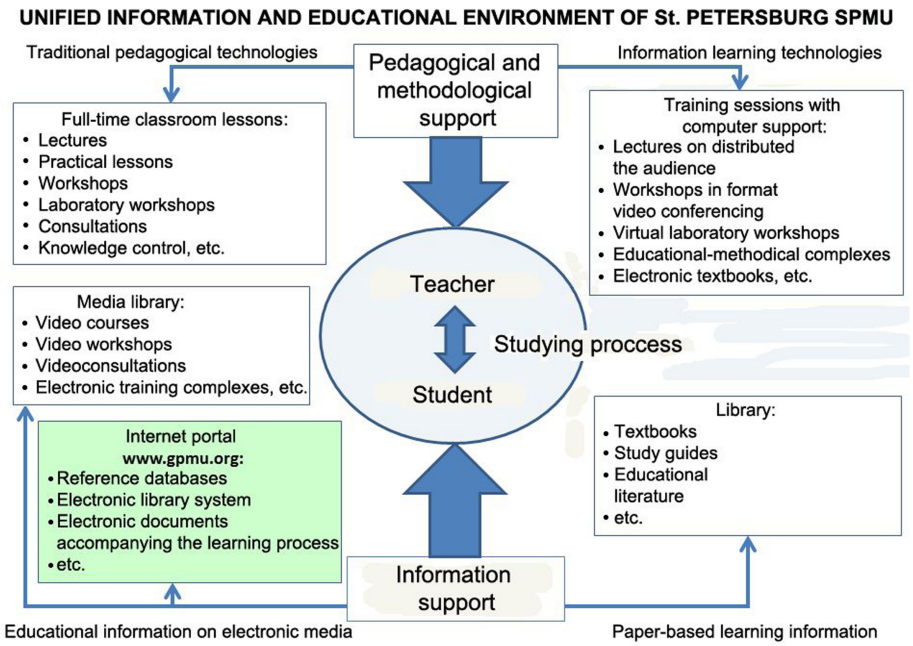

Fig. 1. Unified information and educational environment of St. Petersburg State Pediatric Medical University

World Federation for Medical Education (WFME) distinguishes two periods in the training of health care professionals: basic (undergraduate) education and postgraduate education.

The specifics of using DET in the training of medical workers is due to the fact that they can be used mainly in the implementation of theoretical training of students, therefore, within the existing periods of medical education, it is possible to distinguish the stages associated with the degree of integration of DET in them:

Stage 1: pre-university education, admission to the university (submission of documents, passing entrance examinations conducted by the university, a competition of certificates) can be implemented in full using distance technologies.

Stages 2 and 3: undergraduate and postgraduate studies can be implemented in a mixed form: theoretical courses, non-clinical disciplines, some sections of clinical disciplines, independent work using DET (for example, humanitarian, socio-economic and mathematical disciplines), the remaining disciplines in the traditional form characteristic of full-time education.

Stage 4: Continuing Medical Education (CME) involves the implementation of a well-established approach in which the educational program is modular in nature and the proportion of pre-school education in it is at least 50%. This allows you to significantly expand the possibilities of postgraduate education of medical specialists and implement the principles of the CRISIS Model, which is used in modern medicine and consists of six main components.

An acronym CRISIS means [2]:

Convenience – the convenience of training: the student of the course chooses the individual speed of the course, the place and time of training.
Relevance – relevance of the course content to the practitioner.
Individualization – individualization of training and the choice of modules that are most important for a particular student.
Self-assessment – the ability to self-test and obtain immediate results of verification tests and tasks, which allows you to pay attention to the most difficult topics for a particular listener.
Independent learning – independent learning in which the student plays the most active role.
Systematic approach – clearly structured programs and courses.

Distance learning systems provide users with a wide range of tools for implementing communication between participants in the educational process: chat, forum, blog, and conference. When creating educational content, you can use a variety of tools to solve problems of various complexity levels: from developing test tasks to creating complex multimedia courses. The students are remotely provided with methodological support; if necessary, they can communicate with the teacher in off-line and on-line modes. Also, group work can be implemented for course participants and partners to discuss, exchange views and information, present achievements through the communication capabilities of the Internet. A large amount of additional information is available to trainees remotely, which they can use during training on the course.

The control of learning outcomes is organized by the leading teacher and consultants at intermediate stages during the development by students of training materials and the final stage in the form of tests, presentations, creative assignments.

Moreover, DL is not an addition to the traditional education system, it is a special education technology based on high-quality methodological materials available regardless of the time and location of the student.

The introduction of DET leads to a change in the pedagogical paradigm: the central place in which is assigned to students, the main goal is to develop the ability to self-education; students play an active role in the educational process; the basis of the educational activity is the collaboration of the student and teacher, which entails a change in teaching methods, models of activity and the interaction of teachers and students.

DL allows you to plan, implement the educational process and manage it. Such an organization of the educational process most fully meets the global pedagogical practice in medical education, the principles of evidence-based medicine, the requirements of the standards for the provision of medical care and recommendations for the management of patients.

Specialists distinguish three organizational and technological forms of implementation of DET [3, 4].

Unit media – the use of any one training tool and channel of information transfer. The model is characterized by the use of primarily printed material as a means of training. There is practically no two-way communication, which brings this distance learning model closer to traditional distance learning.

Multimedia – the use of various teaching aids: printed material, computer programs for educational purposes on various media, audio, and video recordings, etc.

Hypermedia – a third-generation pre-release model using advanced information technologies with the dominant role of computer telecommunications [3, 4].

The international pedagogical community regards DET as a tool to eliminate the educational inequality of the inhabitants of geographically separated regions at the state level [5].

The use of e-learning and DET in the domestic higher medical school, on the one hand, is developing within the framework of world educational trends, on the other hand, it has a number of features and limitations related to industry and national specifics.

Assessing the Russian market of distance education services and e-learning, we can state the fact that it lags behind the world level, which is indirectly associated with the underdevelopment of the legislative framework, as well as the lack of a systematic approach in this area.

One of the advantages of using DET in the World is the ability at the state level to eliminate educational inequality for people living in different regions. Specialists subdivide consumers of e-learning into several categories:

- corporate consumers (organizations in which there is a need to regularly train personnel, for example, in a network of branches);
- educational organizations (state educational institutions and private companies providing educational services);
- individual consumers of e-learning.

Distance Learning Systems (DLS), in turn, are divided into:

- technological subsystems Learning Management Systems (LMS), Learning Content Management Systems (LCMS);
- subsystems of business processes that implement distance learning;
- personnel subsystems (teachers, students, specialists serving LMS).

From a strategic perspective, the development of LMS is seen as a transition to TMS (Talent Management Systems) that are aimed at the accumulation and development of human capital.

In our opinion, this transition in domestic health care is most consonant with the developing concept of CME within the framework of the paradigm “Education through the whole life”.

The positive aspects of the use of DET in medical education with advanced training of health professionals include

- reduced time spent on training (no need to travel to the place of study, separation from medical practice for full-time attendance at classes);
- reduction of economic costs for the educational process (for travel, accommodation, classroom fees, teaching fees by reducing the number of teachers required);
- the opportunity to study at any time, regardless of the teacher;
- an increase in the quality of mastering educational material, the possibility of repeatedly acquainting oneself with it if necessary;

- easily implemented updating of training materials;
- transparency of the educational process;
- accessibility and efficiency of obtaining statistics on the educational process and its results.

In this case, we can talk about the formation of a transition from the traditional form of education "by necessity" to self-education "on-demand", that is, when there is a need for information, for example, in the case of a lack of clarity of the clinical picture when diagnosing a disease. In this case, the doctor himself acts as the customer of the necessary knowledge.

The situation is more complicated with the use of DET in the educational process of students of a medical university. To determine the degree of readiness of students to work with DLS by the specialists of the Department of Medical Informatics, St. Petersburg State Pediatric Medical University, a study was made of the level of students developing professional competencies regarding the use of information and communication technologies in educational activities after studying the discipline "Medical Informatics". 55 full-time students were interviewed by the face-to-face questioning method (20 people studying at the Faculty of Medicine and 35 people studying at the Faculty of Pediatrics).

The questionnaire contained the following questions

1. Do you know how to use a text editor?
2. Do you know how to use a spreadsheet editor?
3. Do you know how to use the means of creating presentations?
4. Do you use search engines in your independent work?
5. Do you use electronic library systems in your independent work?
6. Do you use the educational materials of the University's EIEE?

Each question suggested the following answer options: "yes", "find it difficult to answer" and "no".

The study showed that the vast majority of students answered positively to questions about the ability to use a text and spreadsheet editor (86.1% and 73.7%, respectively). Also, high affirmative answers (88.2%) were received on the question of the ability to use presentation creation tools. The use of search engines in independent work was indicated by 100% of respondents, but only 54.4% of them build complex search queries. The use of electronic library systems in independent work was confirmed by 58.6% of respondents. In the oral comments given by the examinees when filling out the questionnaire, it was noted that these skills are most in-demand when drawing up illustrative material in the learning process. 62.2% of the surveyed participants worked with educational materials of the University's EIEE.

At the same time, the study showed that among those who are able to build a complex search query (34.55% of all respondents), the percentage of affirmative answers to questions about the ability to use a text and spreadsheet editors and presentation creation tools was 100%. In addition, these persons were significantly more likely (93%) to use the educational materials of the University's EIEE independently, without additional tasks from teachers.

The study showed that the ability to build a complex search query in a search engine can be a marker of successful mastery of the subject "Medical Informatics" and readiness to use DET in teaching theoretical disciplines at a medical university. To confirm this hypothesis, two groups were identified: the first, which included students who answered positively to the question about the ability to build a complex search query in a search engine – 19 students, and the second group, who were difficult to answer this question – 33 students.

Students of the first group showed a positive attitude towards the subject, an understanding of the role of the formed competencies in further professional activities and a willingness to use elements of DL. Respondents in this group possessed all levels of declared skills. In the second group, a positive attitude towards the study of medical informatics also prevailed, but there was no understanding of the role of competences in further professional activity and the preference was expressed for the traditional full-time organization of classes. At the same time, 5 students (9.1% of the total composition) indicated a negative attitude to the subject.

Based on the results obtained, it can be said that for junior students of a medical university there is a problem of low demand for the use of DET, which is associated with a low level of motivation and a lack of understanding of the importance of the formation and development of competencies associated with the development of the studied disciplines. The authors attribute this to the lack of a sustainable skill in organizing and performing independent work.

2 Multimedia Lectures

Currently it is not enough to use only printed materials [6–12]. These printed publications should be supplemented with modern multimedia materials [13–15].

An important feature of the lecture courses is the combination of fundamental and profilization, which is manifested in the choice of priorities and examples of the application of physics in other fields of knowledge - in medicine, biology, geology, soil science, ecology, etc. [16].

Medical specialties (along with specialties that indirectly use medical and biological knowledge) occupy a special place among many natural science and Humanities disciplines that contain General physics in the educational process. All physiological processes occurring in the human and animal bodies are subject to physical laws. In addition, most diagnostic methods, like many therapeutic methods, are based on the use of physical phenomena and processes. Almost all medical equipment is based on physical principles and is actually a physical device. It can be argued that medicine largely uses the results of theoretical and experimental achievements in the field of physics [16].

It is possible to distinguish professionally-oriented questions in each of the sections of general physics – the main methods for determining physical quantities in medicine and biology; features of physical phenomena and processes in biology and medical practice; use in diagnostics and medical practice of physical phenomena, processes, devices (used in diagnostics and clinical practice); description of the principle of operation of modern medical devices [16].

The use of professionally-oriented physical tasks in the training of future doctors positively affects the results of students' training, contributes to the development of the creative personality of future specialists, and the formation of a student's value attitude to the medical profession. Therefore, future doctors need to know, for example, the main details of vision [17–19], proteins [20], photosynthesis [21], the influence of physical factors on the biosphere [22–25], and others [15].

The authors of this innovative approach to the development of educational and methodological support for teaching General physics to students of natural science areas of St. Petersburg State University, which consists in the profiling and interdisciplinarity of training courses, were nominated by the Academic Council of St. Petersburg State University for the Award of the Government of St. Petersburg for outstanding achievements in higher education in 2020.

Currently, it is very important to give medical students basic knowledge about telemedicine. The main goal of telemedicine is to provide medical services to remote patients who are far from medical centres and have limited access to medical services. Moreover, in the context of the COVID-19 pandemic, the widespread use of telemedicine has proven to be effective. In a situation where there are no reliable guidelines for the treatment of new diseases, consultation with specialists from medical centres becomes simply necessary. The technical basis of telemedicine is modern technologies for data transmission and reproduction, which allows video conferences and high-quality digital images to be transmitted over long distances in an effort to improve resuscitation care and speed up medical decisions [15, 26–28].

3 Learning Management Systems and E-Lab

Learning management systems (LMS) are used as a platform for creating, storing, and presenting various learning materials. The most popular LMS (Blackboard Learn and MOODLE) were considered by the authors earlier [16].

Blackboard Learn is a virtual learning environment and course management system developed by Blackboard Inc. It is Web server software that includes course management, a customizable open architecture, and a scalable design that allows it to integrate with student information systems and authentication protocols. Its main objectives are to add online elements to traditional face-to-face courses and develop fully online courses with few or no face-to-face meetings [16].

MOODLE (abbreviation for Modular Object-Oriented Dynamic Learning Environment) is a free and open-source learning management software system written in PHP and distributed under the GNU General public license. MOODLE is used for mixed learning, distance learning, and other e-learning projects in schools, universities, workplaces, and other sectors. With customizable management features, it is applicable for creating private websites with online courses for teachers and trainers to achieve learning goals. MOODLE allows you to expand and adapt learning environments using plug-ins from community sources [16].

LMS Blackboard Learn and LMS MOODLE promote effective independent work of students by providing access to electronic tutorials, manuals, by the realization of effective feedback to lecturers via interactive testing, video conferences, and on-line

discussions [16]. Both distance learning systems were widely used in distance learning settings during the COVID-19 pandemic. Thus, Blackboard Learning has become the main distance learning system at St. Petersburg State University. In some cases, St. Petersburg State University also used MOODLE.

LMS MOODLE performed slightly better compared to LMS Blackboard Learn for our specific tasks in medical education. Thus, St. Petersburg State University, which initially preferred LMS Blackboard Learn, has recently started using LMS MOODLE along with this system. At the same time, it is difficult to distinguish the fundamental differences between these two systems for the purpose of medical education. Much is determined by the number of students, the financial capacity of the University, and the preferences of teachers and students.

In the context of distance learning during the COVID-19 pandemic at St. Petersburg State University and at St. Petersburg State Pediatric Medical University, real laboratory work in physics was performed by students remotely, and communication with the teacher was carried out via e-mail.

Another way to realize the idea of distance learning is the use of the informational infrastructure of a program instrumental complex for carrying out a laboratory practicum at the university (e-lab). This complex includes the instrumental part for carrying out real experiments with the available equipment, the program complex of virtual laboratory works and a document management system, enabling to produce the descriptions and reports on the laboratory practical works and to record student's progress and to estimate student's work appropriately [26].

4 Hypermedia

The continuous computerization of recent decades is changing the structure of information, the way it is used, and the nature of human thinking. Science is rapidly developing, interdisciplinary and transdisciplinary connections are emerging, and education is becoming more intensive, but this also creates new challenges. Education (thinking and textbooks) must be adapted, combining speed and flexibility with the stability and integrity of educational units. In this situation, digital educational information and the learning process itself acquire some hypertext (HT) characteristics with their pro et contra, which must be taken into account. We believe that the training course should be built around a minimalist core containing all the basic concepts, closed and self-contained, and surrounded by relatively independent HT-type structures with well-defined boundaries [29–31].

5 Conclusions

Modern medical education should be based on a global approach that emphasizes professional competence, activity, students' independence, and the ability to adapt to changing conditions of professional activity. The use of information and educational technologies and DET opens up new opportunities for the continuous training of health professionals and their retraining, making training more accessible.

Compliance with these fundamental principles will allow one to successfully assimilate training material, will contribute to the formation of a high level of intellectual and moral development of medical workers, and will ensure the specialist's competitiveness and its integration into the global professional process, mastery of communication methods and observance of bioethics rules.

The use of Web technologies in distance learning most fully meets the requirements for modern medical education and complements the existing model for training health workers.

The current set of educational services based on information and telecommunication technologies includes video lectures, webinars, distance learning courses, placement of training materials on Web sites, data exchange between tutors and students by e-mail, distance testing, etc.

The listed elements of educational content can be successfully used to organize independent work and test the knowledge of medical students in the study of theoretical disciplines.

The current need for high motivation for training and the availability of practical training makes the distance form of medical education at the present stage the most suitable for professional retraining of advanced training for specialists with a doctor's diploma.

Competition conditions in the market of medical educational services dictate high demands on the quality of the proposed educational programs and individual modules. The need for annual training of working health care professionals, which may require traveling to another region, is fraught with certain difficulties: the need for a competent replacement for the period of study, on duty, family circumstances. In this regard, it is advisable to use distance technologies to create training cycles that involve intramural and extramural modes of conduct, as well as individual remote modules.

The use of DET requires well-developed teaching materials from the creators of such courses. Moreover, the quality and success of pre-school education to a large extent depend on the effective organization, the quality of the materials used and the skill of the teachers involved in the educational process.

Undoubtedly, distance education is a self-education implemented within the framework of an educational institution, which can confirm the qualifications obtained with an appropriate education document. The specifics of preschool education is associated with the strengthening of the active role of the student in their own education with an increase in the volume of educational arrays and the heuristic component of the educational process due to interactive forms, multimedia training programs, and comfortable learning conditions.

After reviewing a number of available electronic resources and summarizing the practical teaching experience, both at the Department of Medical Informatics of the Pediatric University and at other educational institutions, the authors came to the conclusion that, despite the delay in the development of the Russian e-learning market compared to the world pace, future trends the use of e-learning and distance learning technologies in the educational process of medical universities coincide with global trends:

- mobile training;
- integration with social services (networks);
- development of Software as a Service (SAAS) solutions.

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