The Role of Information Technology in the Training of Healthcare Professionals

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The purpose of the study is to analyse the current level of use of information technology in medical universities, as well as to investigate experience from other countries and consequently to design promising methods for enhancing the role of such technologies in training specialists in the field of medicine. After the study conducted, the following results were obtained, namely theoretical and practical statements on the issue. Thus, in the theoretical component, the concept of information technologies has been revealed and their impact on the efficiency of the learning process, particularly in medical universities, has been determined. In terms of the practical framework, it analyses international experience and identifies the main advantages arising from the use of modern programmes in the course of medical education. When it comes to the practical value of the study, it lies in the fact that it can be used not only by teachers, when designing curricula, but also by students during their studies, to facilitate and even accelerate them to a certain extent.

Keywords: medical education, students, health, training, healthcare professionals

INTRODUCTION

The role of healthcare professionals in modern society is extremely important and a high priority. Under current conditions, this is due to the implementation of the international fight against COVID-19 (COronaVIrus Disease 2019), which consequently requires a large number of specialists from this particular field. Therefore, the training of future medics should be conducted with the utmost responsibility, so that in the future the level of healthcare in Ukraine will be high and true specialists will graduate from medical

universities. Consequently, this study analysed modern approaches, methods and tools used in the training of medical students (Nabiyeva et al., 2020). Thus, the system of current training materials consists of general theoretical compendiums, both in electronic and printed form, equipment for carrying out practical studies, which to a large extent no longer corresponds to modern conditions, as well as computer programmes that enable students to check and refine their own skills. However, after reviewing the level of development of material and methodological support abroad, it should be noted that Ukrainian medical education institutions need to change and improve as soon as possible. This primarily concerns the introduction of information technology (IT), as its role is extremely important for the learning process, in particular because it allows it to be simplified to a certain extent, as well as to be more accessible (Zhuravlova et al., 2021; Stukalenko et al., 2013). This practice is quite common in the leading countries of the world, allowing educational institutions of other countries to continuously develop and provide students with quality knowledge (Jumreornvong et al., 2020; Kalkeyeva et al., 2014).

Furthermore, it can be argued, to a certain extent, that information technology is an integral part of the future professional activities of medical professionals, and thus the use and mastery of such tools already at the stage of study will help students prepare for the effective implementation of their professional duties after graduation. In the course of upgrading educational tools and programmes, it is important to understand what the concept of information technology entails. Thus, information technology is a set of methods, software and hardware, combined into a technological chain, providing collection, processing, storage, distribution and display of information in order to reduce the complexity of the processes of using the information resource, as well as to increase their reliability and efficiency (The subject of…, 2020; Leshchenko et al., 2021). In terms of their use in teaching, it is extremely multidimensional, since it involves a large number of options for their possible use. In particular, currently the use of information technology in Ukraine involves equipping classrooms with smart boards, computers, tablets and other multimedia measures. However, there remains the issue of their effectiveness and the quality of their implementation, as the number of educational institutions fully equipped with such tools is generally extremely low at present. Moreover, there is an important aspect that remains undefined in current scientific doctrine, such as comparing the Ukrainian experience with foreign ones, which therefore allows identifying their common and distinctive features and identifying important differences that can form the basis for educational reforms, in particular in the field of medical education (Gaur et al., 2020; Olum et al., 2020; Kovalenko and Kytaika, 2021).

This is why the main purpose of this study is to identify the priority and therefore the role of information technologies in the learning process, in particular in medical educational institutions. After determining the place and impact of modern technologies on the process of training specialists in the medical industry, it is reasonable to develop an algorithm for their implementation in Ukrainian universities, taking into account international experience and the suggestions of Ukrainian scientists. Thus, the objectives of this study can be defined as: studying the concept of information technology, investigating its application in an educational context, determining the current status of information technology provision in medical higher education institutions, analysing international experience on this issue, forming recommendations for enhancing the role of modern technology in the educational process, based on positive changes observed in different countries.

MATERIALS AND METHODS

In order to carry out this study, namely to analyse the role of information technologies in the training of healthcare professionals, various research methods and approaches have been applied in order to explore each element of the issue in depth. Thus, based on a functional-methodological approach, the initial stage of the work took place, since it consisted in formulating the objectives and setting the tasks for this study. Accordingly, a work plan was developed and the key points on which the study focused were identified. As for the dialectical-methodological approach, it helped to develop the logical structure of the study. In other words, its course has been shaped, namely from a general concept of information technology to a narrow one, its application in medical education institutions. Furthermore, the conclusions were based on it, which

logically set out the findings after the study was carried out. When it comes to general theoretical research methods, one of them is the method of logical analysis, the essence of which was to divide the issue in question into separate parts, namely information technology and medical education. This method enabled the characteristics of each of them to be identified, as well as the interrelationships that exist between them to be determined.

In addition to the method of logical analysis, the method of synthesis helped to bring together the individual parts of the study as well as to form clear results. It was during its application that the role of information technology in the training of medical students was identified, as it made it possible to establish their common and distinctive features and, most importantly, to determine the impact of such modern tools on the learning process. Based on the design method, the prospect of involving information technology in the training of medical professionals was identified, and the positive changes derived from this process were established. An important part of the study was the method of comparison, which involved examining the achievements of other countries in the field. This method made it possible to study the modern trends used in medical universities of other countries, as well as the prospects for their implementation in Ukraine. The method of scientific literature analysis provides a theoretical basis for this study, as it consists of examining foreign approaches to the issue, as well as the opinions and views of different scholars on the stated topic, and is based on the study of scientific articles, theses, monographs, dissertations, and publications available in electronic libraries.

The study was carried out in three stages. The first stage involved defining the aims and objectives of the study and developing its plan and structure. Furthermore, at this stage, the theoretical component of the study has been examined, in particular by clarifying and comparing the main concepts related to the issue, namely information technologies and medical education. The second stage defined the practical part of the study, in particular by establishing a direct link between information technologies and improvements in the effectiveness of medical training. Also, at this stage, international experience has been considered and, accordingly, approaches and tools that have a positive impact on the learning process and are promising for Ukrainian medical universities have been formed. The third stage was to form conclusions consisting of the results obtained in the study, in addition to which they formed priority areas for further scientific research on the issue.

RESULTS

The role of information technologies, at a time of global informatisation, is extremely high, as they are now the backbone of every socially important industry, including the medical one. Information tools occupy a central place not only in the learning process, but also directly in the realisation of individuals' professional abilities. Accordingly, in order to define the specific role of such technologies, it is first necessary to establish what the concept encompasses in order to understand its essence. Thus, information technology refers to the process of creating, storing, transmitting, perceiving information and the methods of implementing such processes. However, this general theoretical concept has to be compared with the branch of medicine and, accordingly, medical education. Consequently, it can be described as a whole software and hardware complex that prepares and provides for the collection, storage and processing of information in the medical and healthcare fields (Fridrikhson, 2021). Having analysed the concepts mentioned above, it should be established that they are quite general and broad in content, which means that it is not possible to define an exhaustive list of tools and programmes that fall under the category of information technology. However, on the basis of these, it is possible to identify the main areas of application of such technologies in medical education, which will narrow down the content of the aforementioned concepts. Thus, information tools are aimed directly at the use of a laptop or personal computer as the tools for learning, designing all kinds of medical objects and processes that are considered in the course of education. Moreover, information technologies involved in training help to increase the level of visibility, particularly in the process of acquiring professional skills, systematising them and arranging them in a logical manner accordingly (Seitkazy et al., 2015; Pak et al., 2021).

Furthermore, an important focus of today's programmes is to improve the process of testing students' knowledge, as the teacher can monitor the level of both theoretical and practical skills. The most important area is probably the one that aims to teach students how to use information technology tools in their future professional life. This approach develops important abilities that have a greater impact on the competitiveness of students. Therefore, there is a tendency for the vast majority of medical professionals to graduate from universities of other countries, which in turn can be explained by their level of informatisation (Rodriguez-Rios et al., 2020). Regarding the historical development of the industry, the modern healthcare environment has undergone many significant changes, particularly in the last ten years (Khmurova et al., 2021). Thus, this field has gradually integrated into an information-intensive environment and accordingly shifted the focus of training for medical professionals to technology programmes. As a result of these transformations, the effort should focus more on ensuring that future health professionals are fully prepared for such an information environment and the current conditions of society (Tabatabai, 2020). Furthermore, the healthcare system tends to be sufficiently influenced by the advances in the field of information technology. In particular, the involvement of computers in health care dates back to administrative and financial tasks in the distant 1960s. The number of such tasks is, certainly, increasing considerably with each passing decade. Thus, computer-based clinical decision support systems have been developed. Moreover, access to information, as well as its removal and analysis, has had an impact on improving the quality of services provided to patients.

The concept of medical informatics is an interesting one; in particular, it is a dynamic scientific vector concerned with the storage, search and optimal use of biomedical information, data and materials to address issues and decision-making in the field of medicine and health care. In the modern context, medical informatics has taken a leading place in the education of future medical professionals, moreover, it is integrated with all fields of medicine. Several reasons can be identified that respectively influence the development of such an important academic discipline, in particular the development of computing and information technology, as well as the systematic use of traditional paper-based methods and the important level of informed decision-making in the modern healthcare environment (Kravchenko, 2021). It should be noted that the fields of medical informatics applications are generally not limited to a certain level. Thus, they refer to all the levels, in particular from the cells to the macro level. In general, medical informatics focuses on four prominent areas, namely: clinical informatics, public health informatics, imaging informatics and bioinformatics (Mikitenko, 2021).

Generally, all applications that are appropriately patient-centred take an active part in clinical information. Furthermore, healthcare informatics is characterised by the fact that it makes use of the same methods and techniques in a large number of patients instead of just one patient. As for imaging informatics, it includes areas that are respectively related to radiology, imaging management, molecular imaging and dermatology. Bioinformatics operates at the molecular and cellular levels. However, it should be emphasised that the fields of medical informatics applications are quite numerous, and accordingly each application has its own distinctive potential in health care. Thus, depending on the type of information used, the use of clinical informatics can be differentiated for a specific patient and a group of patients. In addition, patient data are generally created and applied for effective patient care in health care facilities, while information based on medical knowledge is the scientific basis (Bulatov et al., 2021).

Given the above, one can agree that information technologies occupy an important place at every stage that a medical student goes through. As for the current situation regarding the application and development of such information tools in medical higher education institutions in Ukraine, it should be noted that formally it should be positive and sufficiently developed, but in reality, it is much worse. When it comes to the methodological framework and materials enshrined in the state educational standard, it is accordingly stipulated that medical students in higher education institutions should master the subject of computer science. It should be studied from the second year onwards, and its subject matter consists of information processes, those described above, in particular the collection, processing, accumulation, retrieval, storage, use and distribution of information. Furthermore, a distinctive feature of this academic discipline in medical universities is that such processes relate directly to the biomedical, clinical and preventive problems of

medicine. Thus, according to the overall data, this course serves as a base for future doctors, particularly in the context of implementing information technologies in the health care system (Goh and Sandars, 2020).

Having defined the general framework for the implementation of educational policies in the context of medical education, it is possible to immediately describe the main problems that exist in Ukraine, and are therefore inherent in such a sector, in particular the insufficient level of preparation of first year students to acquire specific knowledge in this academic discipline, as well as the lack of comprehensive training for the use of the knowledge acquired in medical technology, by senior students. These problems are to some extent of a subjective nature, but there are also acute objective problems at this stage. In particular, the main one among them is the low level of technological provision of higher education institutions. To a large extent this applies to state educational institutions, because state funding is insignificant, which is why there is such a negative tendency for such universities, which are provided with high-quality, modern information technology facilities, to have only a few classrooms. In addition, a significant problem is the fact that the vast majority of higher education institutions have teachers of above-average age, who lack perfect knowledge in the use of the computer technology and information tools they are offered (Mian and Khan, 2020).

DISCUSSION

Having established the theoretical part of the study and having investigated the current level of application of information technology in Ukraine, it should be determined how directly it can be used in the academic and future medical activities of students. Thus, the main purpose of information technology in education is to directly prepare students not only for life in the information society, in which various kinds of activities, in particular those related to information processing, take a prominent place, but also to successfully implement their knowledge in practice, especially when using information systems. This objective is directly attributable to the fact that such technologies are currently at the forefront of all sectors of both production and science (Kachur et al., 2021; Broshkov et al., 2020). Thus, an example of an effective information technology tool for training purposes is certainly training simulators. The main purpose and focus of such training simulators is for the student to acquire the complex ability to make quick decisions. This skill is based on the direct ability to project active response of the simulated, considered object to the medical student's arbitrary interaction, particularly aimed at executive mechanisms (Shahrvini et al., 2021; Syzdykbayeva et al., 2020).

It is important to focus on the fact that certain requirements need to be met when creating such training simulators. First and foremost, this concerns the interface of the training device, as it needs to be as similar as possible to a simulated management system, so that students perceive the tool as a direct object of training rather than simply a computer programme. Furthermore, the training device should project the technological processes and mechanisms of the automated technological complex, which is accordingly simulated, in particular, using mathematical modelling methods (Imanbayev et al., 2021). A further prerequisite is that the training simulator should contain data on the course of the simulated situations and accordingly display messages about the student's erroneous actions. Moreover, such an information tool should have the functions to carry out analysis of the future doctor's actions. It is also necessary that such a simulator system should be able to provide a large number of simultaneous training workplaces, the possibility of simultaneous training on all training computers should be available. In the end, such a mechanism should necessarily be provided with many combinations and sets of exercises that the student can take accordingly, depending on his or her level of knowledge and the direction of the speciality. It should be noted that in the process of research into the development and use of such training simulators for training medical professionals, it has been found that all current training simulators that are freely available on the World Wide Web can be divided into two separate groups according to their nature, namely simulators and virtual software packages (Berk et al., 2020).

So, a simulator is a model of a professional activity that is used in order to enable each student, to perform his or her professional activity or only an element of it in accordance with professional standards or the rules of health care delivery. The first such computerised full-length human simulator for the

appropriate study of anaesthesia was designed at the University of Southern California in the mid-1960s. Certainly in today's environment, there is a constant and dynamic development of various stimulation technologies, which in turn are beginning to cover an increasing range of medical specialities. Thus, among simulators, the most common are: simulation models, biomechanisms and mannequins for practicing medical techniques for injections, punctures, catheterisation, as well as for medical examinations and patient care in various branches of medical practice (Drachuk et al., 2020). It should be noted that at the end of the twentieth century, as a result of the rapid development in computer technology, a new generation of medical training simulators called virtual software complexes emerged. In order to understand their essence, one such complex can be characterised by a direct practical example. So, let's consider a simulator-expert system for training and testing the knowledge of medical professionals, "Virtual Therapist", which accordingly provides training for doctors, in particular in the context of diagnosing patient illness based on the suggested signs that they should identify in the course of a virtual examination of a simulated patient. Thus, the student or full-time medical professional undertaking a professional development course works either through a computer screen, respectively in an interactive interface format, or vice versa, using more effective interaction, which is more efficient since this approach is more realistic, involving the use of various sensors and virtual reality system glasses (Fedchenko and Shikhova, 2021).

On this basis, it can be argued that this system is not only for knowledge testing but also directly for training, as it contains lists of diseases, allowing the student or intern to study their signs and characteristics, coordinating them into specific syndromes, and there is also the possibility to prescribe the necessary treatment and make a diagnosis for the simulated patient. Such complexes also enable students and doctors to practise generating different symptoms in order to further identify a specific disease. An important feature of this way of using information technology is that once the trainee has completed the independent simulated examination, making the diagnosis, and prescribing treatment, the system automatically assesses the trainee's actions and accordingly presents a list of errors on screen, provided they are present (Chatterjee and Chakraborty, 2021). It is also worth considering the virtual software package called "Human Skin Structure". It uses the technology of three-dimensional graphics and animation, which in turn allows the structure of the human skin, as well as other structural layers of the skin, to be visually examined and studied, with a vivid and clear visualisation of the internal structure of vessels and tissues. In addition, this package contains reference information and has a reference test mode, which is performed by specifying a model element by name or purpose. There is also an exam mode in this programme, which respectively consists of selecting the correct answer from the choices offered. Thus, this programme is in demand among both students and working doctors, since it is constantly being updated, which consequently ensures its continuous development and expansion (Thakur et al., 2021).

With regard to international experience on this issue, the national health system in the United Kingdom (UK) is characterised by the active use of artificial intelligence. This is directly linked to the publication in early 2018 of the report "Artificial Intelligence in the UK National Health System". Thus, this paper has revealed the issues concerning the ways in which artificial intelligence can be applied to the medical education process, the country's general healthcare system, the design of prostheses and, among other things, vaccination methods. The involvement of artificial intelligence comes more in the context of the implementation of public policies to promote a national health system (Soedjono et al., 2022). It is characteristic of this country that researchers from the industry consider artificial intelligence to be quite promising in learning, as it can be used not only for primary knowledge acquisition, but also to improve the existing level of results and methods of general testing in the health care system as a whole. Moreover, artificial intelligence could well be a factor in the area of cost-cutting. This issue is extremely voluminous, as it encompasses a bunch of areas and corresponding structures of practical application. However, one can safely say that for an industry such as medicine, artificial intelligence can be applied as a tool to implement complex decision support, which in turn allows future doctors to act more effectively and quickly during diagnosis, especially in urgent cases. Furthermore, artificial intelligence can serve as an intelligent virtual assistant, which is accordingly able to help practitioners quickly, in particular by planning more precisely and establishing control over the procedure (Al-Balas et al., 2020; Kassabolat et al., 2020).

In the United States, the Food and Drug Administration has rationed domestic sales of such products using a neural network-based drug monitoring and decision support system that has been developed. The system is therefore able to detect signs of stroke at an early stage, in particular through computerised tomography scans. This system is intended mainly for the professional practice of physicians, but it is also frequently used in medical universities, so that students learn how to use it and can also hone their knowledge. Thus, this mechanism, apart from its main function, namely processing computerised tomography scans of the brain, also performs other tasks integrated with a system for alerting doctors in neurovascular centres. Accordingly, medical professionals receive a report of the patient's condition and problems immediately after the computed tomography scan conducted and the examination revealing signs of stroke (Adyrbekov et al., 2021). The experience of Canada in developing a new training device that aims to determine the medical parameters of simulated patients based on their diagnostic data is particularly interesting. Thus, this training simulator is a learning tool for students to organise their work independently, with appropriate assessment of the knowledge gained in the context of testing. An example of a task is one in which the student is required to analyse some indicators of a simulated patient's clinical blood test, which he or she has to determine from the conclusion given to him or her, and to formulate his or her own position and prescribe a treatment. Skills consolidation follows three main groups of anaemia, for each of which a database is developed and attached to perform the test. These groups include microcytic hypochromic anaemia, normocytic normochromic anaemia, and macrocytic hyperchromic anaemia (Shehata et al., 2020).

The programming language underlying the development of this training simulator is Visual C and the programming environment is Microsoft Visual Studio 2015. This choice is due to the fact that it most clearly reflects the ideas of visual programming. In turn, a large set of graphical and structural primitives simplify to a certain extent the process of programme creation and construction, and are also responsible for its future interface. Thus, when the student starts the simulator, a special clinical blood test form appears on the computer screen, with the data in the "result" column independently generated by the computer according to the output given in the lower left corner. Since medical standards are different for men and women, this training device is designed to generate results according to the gender of the simulated patient. Consequently, in the "result" column, some of the data required to produce a given output is not available, so it has to be selected from the proposed list of indicators. In addition, the student has to choose an additional conclusion. When all the tasks have been completed and all the fields have been filled in, the answer will be evaluated automatically and it will appear on the screen as "Correct" or "Incorrect". The aforementioned training devices and simulators will certainly be useful in Ukraine, as they can operate without an Internet connection, allowing for consolidation and testing of the acquired knowledge remotely from the educational institution, which demonstrates its convenience and versatility. This is particularly relevant for students with disabilities and those studying using distance learning technologies or on a part-time basis. Moreover, the possibility of distributing an interactive programme to students' computers can be used by a teacher to monitor knowledge even in a regular classroom, rather than in a specially equipped computer class, in a practical session, which is extremely relevant in Ukraine.

CONCLUSIONS

Thus, the study has established that the role of information technology in the training of healthcare professionals is extremely important and a high priority. This is due to the fact that such learning tools not only simplify the learning process, but also have a positive impact on its efficiency. In particular, this means that thanks to the use of information technologies, students have the opportunity not only to acquire theoretical knowledge, but also to put it into practice, in particular on simulated patients in various programmes. It is also important that such technology should be applied not only to medical students, but also to working doctors, particularly those in the surgical departments, so that they can develop and hone their skills. Thus, the study identified two main sub-types of information technology that are most commonly used in medical training, namely training devices and simulators. Their difference lies in their operating principles and objectives, but the effectiveness is high in both categories.

In the case of Ukraine, the application level of such technologies is below average, which consequently indicates that the mechanism for implementing medical education needs to be reformed. This step is important for the state, because at the moment many capable young citizens are studying abroad, and all because the level of both technical and computer support is high there, which accordingly allows them to gain more in-depth knowledge of the industry and develop their competitiveness. Furthermore, the use of technologies in training will enable students to acquire the skills to use them, which will certainly have a positive impact on their future careers. In future studies on the development of medical education, it would be useful to consider the issue regarding existing programmes for the professional development of medical professionals and the level of their application in Ukraine.

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