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EXPERIENCE OF IMPLEMENTING THE DISTANCE E-COURSE “STATISTICAL METHODS IN PHARMACY” IN THE MATHEMATICAL TRAINING OF FUTURE PHARMACEUTICAL SPECIALISTS

Abstract. The article is dedicated to the issue of distance and online learning in higher pharmaceutical education. In the paper, the main principles and characteristic features of the concept of distance learning are outlined, the main advantages and disadvantages of using distance and e-learning in pharmaceutical and medical higher education are discussed. Considerable attention is paid to the use of distance learning technology in the process of math training for students pursuing higher education in the field of pharmacy. In addition to technical means and the structural-methodological component of the distance course development process, special attention is given to psycho-pedagogical aspects, which includes a focus on increasing the motivation of this group of education seekers to master disciplines related to exact sciences.

It is demonstrated, using the example of the developed by the authors distance course “Statistical Methods in Pharmacy”, implemented with the LMS Moodle, that a successful combination of methodological approaches and innovative teaching methods, aimed at implementing a competency-based approach in education, along with modern information technology providing online access to educational content, including tools for feedback support, practical skills development, and automated self-assessment, ensures the effectiveness of achieving educational goals by learners and the formation of professional competencies defined by the educational program. The course was tested, certified, and implemented in the fundamental training of future pharmaceutical professionals at the National University of Pharmacy.

It is concluded, that the implementation of distance learning technology in the practice of Ukrainian higher pharmaceutical and medical education is necessary not only due to the current conditions that

make it impossible to organize full-fledged offline education but also because of the efficiency of these technologies, primarily for organizing independent students' work, that ensures the development of learners' autonomy, contributes to the development of information culture, general digital competence, and a range of soft skills, including communication, interaction, collaboration in a digital environment, and the rational use of study time.

Keywords: distance learning; online learning; electronic (distance) educational courses; Moodle; statistical analysis; pharmaceutical education.

1. INTRODUCTION

The problem statement. Due to global informatization and the integration of Ukrainian higher education into the international educational space, new tasks and challenges arise in the field of higher pharmaceutical education. One of the most important directions in addressing this issue is the integration of informatization with psychological and pedagogical laws, regularities, and principles in organizing the process of professional training for pharmaceutical higher education graduates. In this context, the problem of new information forms and methods of working with higher education seekers comes to the forefront. The problem of access to materials for a specific academic discipline in the absence of the opportunity for personal communication with the educator, widespread dissemination of information here and now for any interested audience, and the organization of the educational process using feedback for real-time monitoring of the degree of knowledge acquisition by learners can be addressed and implemented through the application of modern information technologies and tools for distance and online learning. In addition to the mentioned general advantages of the distance learning technologies development, for Ukrainian higher educational institutions today, it is vitally necessary in the conditions of a state of war, as at the beginning of the 2023 – 2024 academic year, 75.5% of higher educational institutions operated in a distance or blended format, with the eastern region having over 70% of higher educational institutions working exclusively in a distance format [1, p. 10].

It is worth noting that the National University of Pharmacy is one of the first higher education institutions in the field of healthcare, that started implementing distance learning in pharmaceutical education over a decade ago. During this time, in addition to developing dozens of distance courses using the Moodle distance learning system, both in fundamental and professionally oriented educational components, general methodological approaches for creating and presenting educational content have been established. Furthermore, a system for evaluating the quality and certifying distance courses has been approved. Nevertheless, in addition to the technical and organizational-methodological aspects in teaching disciplines of a physical-mathematical nature for students of medical and pharmaceutical specialties, the psychological-pedagogical component remains relevant. This is conditioned by the fact that most students lack the desire to deepen their knowledge in exact sciences, which, in our opinion, is associated with inadequate school preparation, while the education seekers typically argue that such knowledge is unnecessary for their future professional activities [25]. Therefore, finding ways to effectively combine information technology tools and distance learning system instruments with methodological approaches and pedagogical technologies becomes particularly significant in this context and crucial for ensuring the quality of education.

Analysis of recent studies and publications. As of today, there is a substantial theoretical and practical experience worldwide and, particularly, in this country in implementing distance learning in higher education, in particular in the field of healthcare. Various aspects of distance learning have been widely covered in both international and domestic psychological-pedagogical literature, especially in recent years. The organizational and pedagogical aspects of distance learning have been thoroughly explored in the works of N. Dekhtiarova, Yu. Rudenko, I.-L. Wu, P.-J. Hsieh and S.-M. Wu, T. Pakhomova,

O. Komova, O. Belia, Y. Yivzhenko, E. Demidko, V. Kukhareenko, V. Bondarenko and others [2], [3], [4], [5], [23]. While educators' interest in distance learning arose with the development of information and communication technologies (ICT) and their integration into educational practices, the particular relevance of distance learning emerged during crisis conditions such as quarantine, natural disasters, and the outbreaks of hostilities (T. Sari and F. Nayir [6], B. Williamson, R. Eynon and J. Potter [7], C. Suárez-Guerrero, P. Rivera-Vargas and J. Raffaghelli [8], M. Shermaman, E. Puhovskiy et al [9]). The study of the theory and practice of distance learning has led to the conclusion that, due to age-specific characteristics, students in secondary schools better perceive educational information when working in the format of video conferencing, especially using platforms like Zoom (C. De Medio, C. Limongelli et al [10], Yu. Kumagai [11]), while in higher educational institutions, the organization of distance learning is more effective on the Moodle platform, which can be used both in the development of online courses (H. Dhika, F. Destiwati and M. Sonny [12], P. Angriani and H. Nurcahyo [13], C. Costa, H. Alvelos and L. Teixeira [14]) and to facilitate the learning process, its regulation, self-education, time management, control and self-control of the level of acquired knowledge, skills, competencies, and assessment through testing (M. Simonson, S. Zvacek, and Sh. Smaldino [15], O. Kirmizi [16]).

In the context of the research, our attention was focused on the peculiarities of organizing distance learning for future pharmaceutical professionals, as discussed by L. Galiy and T. Seropian [18], and the integration of ICT into their education, particularly in fundamental disciplines, including natural and mathematical subjects, as studied by E. Romero, L. Garcia and J. Ceamanos [19]. Considering the specifics of pharmaceutical activities, which, due to its humanitarian mission, is closely related to medical practices, the conclusion has been drawn regarding the expediency of adopting a blended approach in pharmaceutical education, which involves a rational combination of online and offline forms of organizing educational activities. Our assumption is confirmed by the results of a series of empirical studies. For example, according to the survey of 1873 students at the colleges and schools of pharmacy in the USA, conducted by L. A. Hamilton, K. J. Suda et al [20], it was found that future pharmacists prefer a combination of traditional and online learning. They acknowledge the relevance and value of ICT in the educational process but also emphasize the importance of not reducing education exclusively to a distance format. According to the research findings of A. I. Fathelrahman, M. Alrobaian et al (Pharmaceutical college, Taif University, Saudi Arabia) the conclusion has been drawn that e-learning is currently one of the relevant concepts in pharmaceutical education. The results of a survey involving approximately 700 higher education students and 74 educators indicated a profound interest among educational stakeholders in online learning. The majority of respondents acknowledge the positive impact of distance education technologies on the formation of professional knowledge, skills, and abilities of future pharmacists. However, they emphasize that the use of online learning should be measured and predominantly employed in the assessment of the academic achievements of future professionals [21].

Despite the fundamental nature of the conducted theoretical and empirical-applied research on the introduction of distance learning into the educational practice of preparing researchers, professionals in the development, testing, and production of pharmaceuticals, as well as employees of pharmacy networks, it should be noted that the development and effective implementation of distance courses with educational components of a mathematical nature for students in the medical-biological and pharmaceutical field have not been the subject of comprehensive scientific research. This gap in research has motivated the choice of the topic for this paper.

The research goals are the description and analysis of the experience in developing and implementing a distance course “Statistical Methods in Pharmacy” for higher pharmaceutical

education students along with the disclosure of the essence of the concepts of distance and online learning, analysis of the advantages and disadvantages of these forms of education for pharmaceutical and medical education, and characterization of the Moodle platform as the basis for developing distance courses.

2. THE RESULTS AND DISCUSSION

2.1. Distance and online learning (e-learning), its advantages and disadvantages for medical and pharmaceutical education

In the scientific and pedagogical literature, the concept of distance learning is defined in various ways. Most scholars consider distance learning to be a form of education that utilizes information and communication technologies, ensuring reciprocal interaction between subjects at all stages of learning, as well as independent learners' work with informational resources. In other words, it is an organized educational process capable of meeting the educational needs of an individual regardless of her/his spatial and temporal location in relation to the location of educational institution, that includes means, processes, and results that adhere to educational standards, realized through telecommunication technologies facilitating interaction between the educator and the learner within a specific educational environment [10], [11], [21], [22]. During the implementation of such a form of learning, there is active mutual interaction between the educator and the student, and through the teacher-developed curriculum, independent study of academic subjects by future professionals is supported [17].

In our opinion, distance learning is, above all, a form of education that allows future professionals to simplify and improve independent work in mastering the provided educational material, as well as automatically assess their knowledge and skills acquired in the learning process.

This form of learning provides the freedom to choose the place, time, and pace of education. It also allows studying for residents in regions where other opportunities for professional education are lacking or where there is no university of the required profile, or where there are no instructors of the necessary qualification level. In other words, distance learning is organized self-education, an effective way to acquire knowledge that allows for a harmonious balance between learning and daily life.

Distance learning allows organizing the educational process without leaving one's place of residence, following an individual schedule and based on individual needs. It reduces the cost of education, enhances the quality of education through the implementation of unique educational programs and the combination of courses, eliminates moral losses due to age or other limitations. The effectiveness of distance learning also lies in the fact that the opportunity to learn remotely does not limit the possibilities of learning and improving in professional activities while working in an enterprise [22], [23], [24].

Thus, the advantages of distance education include learning according to one's own schedule, unrestricted choice of a higher education institution regardless of the location of both the learner and the instructor, continuous learning, the use of modern technologies relevant to future work, independent time planning for lectures and practical sessions, studying in a familiar and comfortable atmosphere created by the learner, and convenient participation in classes for learners with special needs [20], [21], [24].

However, distance education also has significant disadvantages, including the absence of in-person interaction between the instructor and the learner, insufficient communication among students for sharing experiences, the lack of opportunities to apply knowledge with examples (although this issue can be addressed by including practical examples in the course materials), inadequate competence of educators in organizing distance learning process, lack of internet

access in the place of residence, insufficient provision of technical equipment, and the inability to use this equipment [17], [24]. Moreover, in the case of distance learning, the process of completing assignments remains invisible for teacher. Therefore, firstly, assignments may be performed not by the learner herself, but by someone else, and secondly, this limits the educator's means of monitoring the educational process and eliminating gaps in the teaching methods applied. At the same time, it should be noted that the effectiveness of distance learning is based on the fact that education seekers themselves feel the need for further education, rather than succumbing to pressure from others, meaning there is a high level of motivation among higher education learners.

Thus, the process of distance education inherently relies on the presence of actual information technologies, the necessary skills to use these technologies, and access to the Internet by both participants in the process, as well as on the foundational trust between the higher education learner and the instructor and the motivation of the student to engage with the educational component.

If historically, at the beginning of the development of distance education, among the telecommunication technologies used were email, computer teleconferences, television and radio broadcasts, telephone and fax communication, which facilitated the transmission of educational content from the instructor to the student, and the submission of educational assignments from the student to the instructor, nowadays, this functionality is typically provided by specialized software tools – Learning Management Systems (LMS) or e-learning platforms. LMSs provide tools for the development and management of educational content, including communication features among participants in the learning process, organization of individual and group work, and automated monitoring of the mastery of educational material. It should be noted that LMS technical tools are currently used not only for pure distance education but also for organizing online learning, which gained particular popularity during the 2020 pandemic. And if until then many Ukrainian higher education institutions preparing students for medical specialties were not particularly actively implementing elements and technical means of distance learning into their educational process, emphasizing the impossibility of distance education in the field of medicine, the forced quarantine conditions in 2020 changed this situation. The gained experience provided an understanding of the feasibility of developing distance learning technologies and the possibility of their effective use for mastering the theoretical component of fundamental and professionally oriented educational disciplines. In addition to this, distance learning is widely used worldwide for CME (Continuing Medical Education).

Today, in the majority of higher medical and pharmaceutical educational institutions in Ukraine, distance learning systems are successfully implemented. Typically, the Moodle platform is used for the development and support of high-quality online courses. Analyzing scientific and pedagogical research in the field of online learning, it can be stated that a distance course is a set of educational objects united by a single pedagogical scenario, that are developed in accordance with the working program of the educational discipline and ensure the achievement of its learning objectives. The structural elements of the educational and methodological support of a distance course include a brief annotation, introductory section, working and educational programs, criteria and scale for assessing the knowledge of learners, formulation of course goals and tasks, a list of competencies that future professionals should acquire according to the needs of higher education, practical skills, professional knowledge and skills that the learner should master during the study of the discipline. It also includes a glossary, a list of necessary printed and internet sources, a list of auxiliary educational materials, and other necessary information regarding the organization of the educational process. This includes educational and methodological materials for independent work, practical tasks, methodological recommendations for their completion, test tasks for assessing knowledge in

the discipline, situational tasks of a professional nature, self-control tasks for learners, and summary modular control works [2], [5], [17], [22], [23].

Such kind of an organization of a distance course with all recommended structural elements evidently contributes to better organization of the educational process and achieving its goals. However, in the absence of student motivation (which, as mentioned above, is one of the key components for successfully mastering the educational component in a distance form), even perfect material organization does not significantly contribute to the effectiveness of learning. From our experience, the motivation of students in medical and pharmaceutical specialties to study educational components that require mathematical background can be improved by changing the teaching methods. The emphasis should not be solely on mathematical formulas, laws, and calculations but on situational tasks related to their future professional activities, which require these calculations and the application of these formulas. The primary goal should not be for students to master the techniques of calculating various indicators but to critically evaluate their results, ability to draw correct conclusions relevant to professional tasks. This should lead to the acquisition of competencies in choosing appropriate statistical methods for the certain task and applying them in practice. This can be achieved through problem-based teaching of the educational material. At the beginning, a situational problem (or a series of similar problems) is presented, and during the discussion of ways and approaches to its solution known for the learners, the necessity of applying new advanced approaches becomes clear to them. This allows the instructor to present new material, ensuring the attention and motivation of the audience for its perception. Certainly, this approach is most effective in synchronous teaching forms, and in distance learning, which often involves asynchronous methods, it can be only simulated, for instance, in a video recording of a lecture. Another technique that will help focus more on the meaningful application of mathematical methods in professional activities rather than their computational aspects is the use of modern IT tools (calculators, specialized software, internet resources, etc.), where instructor should choose most accessible ones and the easiest to use, i.e. having user-friendly interface for non-professionals.

Thus, both distance and online learning utilize the same ICT tools to organize and provide access to educational content and facilitate feedback between participants in the educational process. The ability to use these tools correctly, primarily on the part of the educator, determines the effectiveness of the distance course and the quality of the educational component acquisition by the student. In addition to this, the presence of a specific platform for hosting educational materials is necessary, and both participants need to be able to use the features of the proposed platform. Such platforms should be user-friendly, easy to upload or display materials, and include all necessary services for organizing information according to various criteria. Additionally, they should provide specific cases for implementing modern teaching methods, such as group work, games, training, etc.; various assessment methods for student work and feedback should also be integrated.

The main challenge of distance education, in our view, is the need for high motivation for learning and self-organization in learners. Therefore, we consider this form of education most effective for postgraduate education seekers. For a teacher, the main dilemma is determining whether the academic integrity requirements are being adhered to when a student completes educational assignments in a distance learning format. Online learning, which involves synchronicity and a defined schedule, as well as more “live” contact between instructors and students, solves some of these problems retaining the advantages of providing students with constant access to educational materials and tools for self-assessment, while also giving the teacher more freedom to shape the motivation of the learner. Due to these reasons, from our point of view, online learning appears to be quite promising for undergraduate medical and pharmaceutical students.

2.2. Characteristics of LMS Moodle

As known, the Moodle (Module Object-Oriented Dynamic Learning Environment) system is one of the most well-known platforms designed to efficiently organize distance learning. It is intended for educational institutions, training centers, as well as for corporate training. It is a free and open-source platform that requires a deep understanding of its tools, including the need for self-setup on a server. As the system's main requirements depend on modules, content, and the number of users, crucial tasks for its use include pre-configuration, hosting installation, maintenance, and updates [11], [15].

The Moodle system has extended functionality designed for use by educational institutions. It allows creating educational content for all learning subjects, including the ability to publish materials in text, audio, and video formats, communicate with users through video conferences, and restrict access to posted materials by setting logins and passwords.

In particular, the Moodle LMS environment facilitates effective collaborative work among participants in the educational process, encouraging learners to engage in learning. There is an opportunity for mutual assessment of tasks, commenting on responses, providing recommendations, and exchanging ideas and thoughts in real-time mode [15].

Moodle allows for interactive assessment of learners' educational activities through various elements of the distance course, such as assignments, quizzes, forums, wikis, and glossaries. Quizzes are the most automated means of controlling and evaluating students' educational achievements. The use of quizzes on the Moodle platform contributes to establishing feedback on self-regulation and monitoring the level of one's own knowledge. Education seekers can identify their weaknesses, assess their level of preparedness, and effectively plan their work. Quizzes are of significant value for the final assessment of learners' activities and also contribute to the effective consolidation of theoretical aspects [12].

2.3. Experience in development and implementation of the “Statistical Methods in Pharmacy” e-learning distance course

Taking into account the recommendations of experts regarding the creation, design and use of distance courses in higher education and our own vision of methodological approaches to teaching mathematical disciplines to future pharmacists, during 2020 – 2021, the members of teaching and research staff of the Department of Educational and Information Technologies (now reorganized as the Department of Fundamental and Socio-Humanitarian Sciences) at the National University of Pharmacy, with methodological support from the Department of Sociology and Psychology at Kharkiv National University of Internal Affairs, developed and tested the distance course “Statistical Methods in Pharmacy”. The course complies with the requirements outlined in the “Regulations on the Expertise of Distance Courses”, and is certified and recommended for use in the professional training of higher pharmaceutical education seekers.

The course introduces learners to the general principles of statistical science, practical skills in statistical analysis, modern methods of calculation and analysis of indicators characterizing medical-biological, pharmaceutical processes and phenomena at the micro and macro levels. It also provides explanations regarding the importance and necessity of mastering the educational material in the discipline for further professional activities. This involves acquiring methods for processing and analyzing data from chemical experiments, medical-biological, and pharmaceutical research (Figure 1).



 РОЗРОБНИКИ КУРСУ

 Оглядова презентація курсу

Figure 1. The start page of the course “Statistical Methods in Pharmacy”

According to the educational program, the course contributes to the formation of the following general competencies in pharmaceutical students: abstract thinking, analysis and synthesis, application of knowledge in practical situations, skills in the use of information and communication technologies, and the ability to assess and ensure the quality of work performed. Among the hard skills (professional competences) covered by the course are the abilities to apply statistical methods for monitoring the effectiveness and safety of medications based on clinical and pharmaceutical characteristics data; to organize pharmacy activities to supply medications and other pharmaceutical products to the population and healthcare institutions, and implement appropriate reporting and accounting systems (management, statistical, accounting, and financial); to analyze socio-economic processes in pharmacy, forecast the main economic indicators of pharmacies, calculate basic taxes and fees, and organize and carry out general and marketing management of assortment, pricing, sales and communication policies of pharmaceutical market entities based on the results of marketing research; and to use quality control methods for medical products.

The course is designed for students in the extramural (distance) studies and was first tested with this audience of higher education seekers, however, in the spring semester of the 2021 – 2022 academic year, the use of the course materials also demonstrated high effectiveness for students in the full-time format who were forced to study remotely due to the full-scale invasion of the Russian Federation into Ukraine. During this period, there was the highest level of activity among education seekers using the course (Figure 2), allowing us to test the educational material and the applied methodological approaches to its presentation on a large user sample, analyze feedback, and address any weaknesses.

СМФарм - Вся діяльність (перегляди і повідомлення) Студент

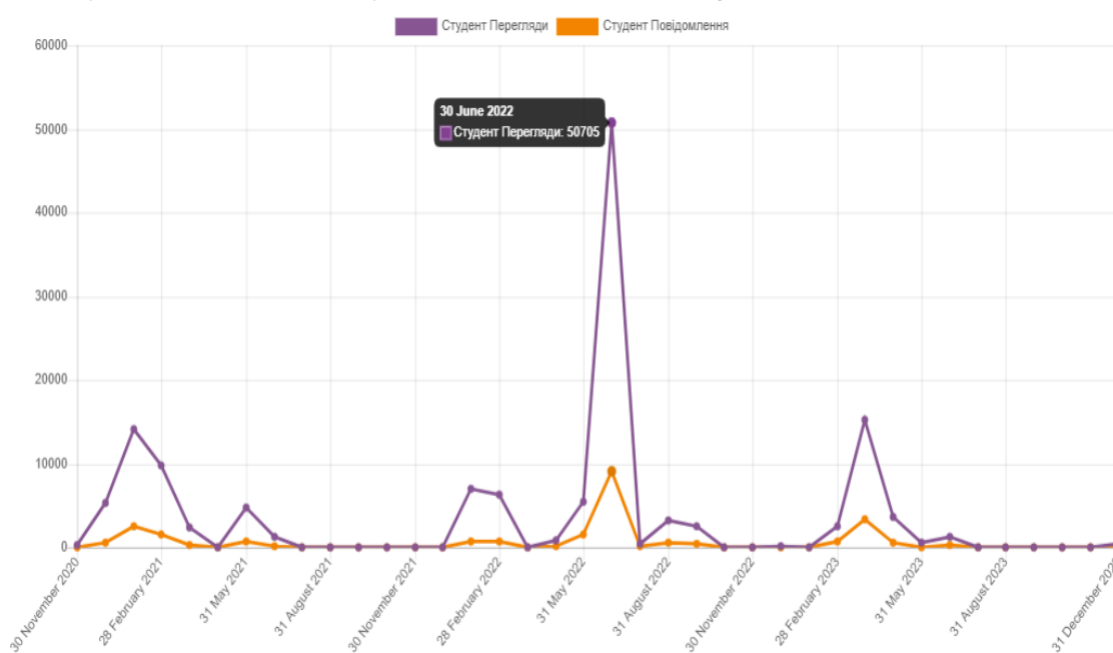


Figure 2. The dynamics of student activity in the distance course “Statistical Methods in Pharmacy” over the entire its life period (LMS Moodle report)

According to the requirements for formatting distance courses, the Moodle version of the educational component “Statistical Methods in Pharmacy” consists of an introduction with a brief annotation of the discipline, information about the developers, and an overview presentation; it also includes the work and educational programs, the study schedule (which serves as a roadmap for students in mastering the course), criteria for assessing the educational achievements of students, the list of necessary literature, and a set of educational and methodological materials for two content modules. The first content module consists of four topics dedicated to the fundamentals of probability theory, laying the basic concepts necessary for mastering the theory and practice of statistical research in pharmacy, that are covered by five educational topics of the second content module.

The thematic educational and methodical material is structured into main and additional sections and presented as a list of educational video materials, lectures with audio and video accompaniment, textbooks on the discipline, educational and methodical guides for practical and seminar classes, collections of tasks, reference materials in the field, and computer simulations, that contribute to an effective learning process. The assessment of students’ learning activities is based on the completion of practical tasks and control test quizzes on the topics of the course. For instance, Figure 3 provides an example of the sequence for presenting educational material for one of the topics in the second content module.

ТЕМА 7

Параметричні та непараметричні методи для порівняльного аналізу двох чи більше фармацевтичних препаратів за кількісною ознакою. Перевірка статистичних гіпотез

Основний інформаційний матеріал

- Лекція з двовибіркових порівнянь
- Вибір критерія для двовибіркових порівнянь

Додатковий інформаційний матеріал

Допоміжні ресурси

- Порівняти декілька незалежних вибірок онлайн
- Порівняти дві залежні вибірки онлайн

Практичні завдання

- Завдання з двовибіркових порівнянь (відпрацювання)
- Завдання з двовибіркових порівнянь для 226Ф 21Фм(4.5з)-де
- Завдання з двовибіркових порівнянь для ДЕННОГО відділення (червень 2022)
- Завдання з двовибіркових порівнянь для Фм21(4.6з)-03 а дз

Тести

- Тренувальний тест. Критерії міжвибіркових порівнянь
- Контрольний тест. Критерії міжвибіркових порівнянь

Figure 3. The structure of presenting educational material for an individual topic within the study of the second content module

Each topic includes a professionally oriented glossary and a test bank comprising over 100 quiz questions of varying difficulty levels. The tests (quizzes) for the course topics are presented in two modes: training mode (with an infinite number of attempts and the ability to check one's own answers) and control mode (with a limited number of attempts and receiving a grade based on the best result). For better assimilation of the material and reinforcement of acquired knowledge, at the end of each topic, students are encouraged to solve a series of diverse situational tasks presented in professional-oriented assignments, illustrating the key points of the course theory. All test materials and tasks are designed considering validity requirements, as well as the problem complexity of learning. The tasks contribute to the development of creative professional thinking and skills in solving specific problem situations of a professional nature.

The rich arsenal of the LMS Moodle regarding the development of quizzes allowed us to assess not only the acquisition of theoretical material by students but also their mastery of practical skills through these tools. An example of one of such questions in the quiz on the topic “Methods of Processing Qualitative Data of Pharmaceutical Experiments” is shown in Figure 4.

За даними таблиці частот, показаними на малюнку, знайдіть **точкову оцінку стандартного відхилення** для відносної частоти зустрічальності побічної реакції “свербіж” серед усіх побічних реакцій на фармацевтичний препарат.

побічні реакції	кількість випадків
свербіж	23
пропасниця	11
почервоніння шкіри	56

(Відповідь вкажіть числом, округливши його до трьох десяткових знаків)

Відповідь:

Figure 4. An example of a quiz task for automated control of mastering practical skills on the topic

The use of various types of questions in tests (not only standard multiple-choice or single-choice questions, but also those with an open answer, matching, dragging in the text or on the image), in our opinion, allows to activate students' attention and make the learning process more interesting for them by diversifying it. Examples of quiz questions of such types, developed by us for the course “Statistical Methods in Pharmacy”, are shown in Figures 5 – 6.



Figure 5. An example of a quiz question (“dragging on the image” type)

На малюнку показано фрагмент таблиці з даними для статистичного аналізу

№	стаж	вік	стать	місто	Чи має аптека власний web-сайт	Чи використовуєте Інтернет для просування послуг?	Чи користуєтесь допомогою рекламних агентств?	Який спосіб реклами фарм.препаратів вважаєте найбільш ефективним?
25	до 5 р.	22-30 р.	жін	Дніпро	немає	не використ.	іноді користуємось	мед(фарм) представники
26	до 5 р.	22-30 р.	жін	Харків	є	використ.	іноді користуємось	мед(фарм) представники
27	до 5 р.	31-45 р.	жін	Харків	немає	іноді використ.	не користуємось	мед(фарм) представники
28	до 5 р.	22-30 р.	чол	Київ	є	використ.	не користуємось	мед(фарм) представники
29	до 5 р.	22-30 р.	жін	Харків	немає	використ.	не користуємось	мед(фарм) представники
30	11-20 р.	46-60 р.	жін	Харків	є	іноді використ.	користуємось регулярно	мед(фарм) представники
31	до 5 р.	22-30 р.	жін	Харків	немає	не використ.	не користуємось	TV- та радіо-реклама
32	до 5 р.	22-30 р.	жін	Київ	є	іноді використ.	користуємось регулярно	мед(фарм) представники
33	до 5 р.	22-30 р.	жін	Київ	є	використ.	користуємось регулярно	TV- та радіо-реклама
34	до 5 р.	22-30 р.	жін	Харків	немає	використ.	не користуємось	TV- та радіо-реклама
35	до 5 р.	22-30 р.	жін	Харків	є	не використ.	користуємось регулярно	TV- та радіо-реклама
36	до 5 р.	22-30 р.	жін	Київ	немає	не використ.	не користуємось	мед(фарм) представники
37	до 5 р.	22-30 р.	жін	Харків	немає	не використ.	користуємось регулярно	мед(фарм) представники
38	5-10 р.	31-45 р.	жін	Київ	є	не використ.	не користуємось	TV- та радіо-реклама
39	до 5 р.	22-30 р.	чол	Дніпро	немає	не використ.	не користуємось	мед(фарм) представники
40	до 5 р.	22-30 р.	жін	Київ	є	використ.	іноді користуємось	тематичні ресурси Інтернет
41	до 5 р.	22-30 р.	жін	Харків	є	використ.	іноді користуємось	тематичні ресурси Інтернет
42	до 5 р.	22-30 р.	жін	Дніпро	немає	інтервальна	не користуємось	мед(фарм) представники
43	5-10 р.	31-45 р.	чол	Дніпро	немає	точкова	не користуємось	тематичні ресурси Інтернет
44	до 5 р.	22-30 р.	жін	Київ	є	номінальна	не користуємось	мед(фарм) представники
45	11-20 р.	46-60 р.	жін	Київ	є	кореляційна	не користуємось	TV- та радіо-реклама
46	до 5 р.	22-30 р.	жін	Київ	немає	нормальна	іноді користуємось	мед(фарм) представники

Вкажіть шкали вимірювання змінних

стать

відповідь на питання "Чи використовуєте Інтернет...?"

Figure 6. An example of a quiz question (“correspondence” type)

The built-in Moodle tool for statistical processing of learning results allowed us to identify the high effectiveness of the developed quiz tasks for the course “Statistical Methods in Pharmacy”, taking into account the indicators of the facility (ease) index (the ratio of the average score to the maximum for a given task, or the mean score of students on the item) and the discrimination efficiency (the correlation coefficient between the response to a given task and the response to all tasks of the test). Figure 7 displays statistical data for one of the tests in the course, which shows that due to the applied teaching methods most of the questions were about right for the average student, and rarely fairly easy, never reaching very difficult or very

easy grades of interpretation, while their discrimination efficiency in most cases was very good (above 50%). Statistical analysis of data for all the quizzes in the developed distance learning course using the built-in Moodle tools allows us to conclude that the proposed quizzes are adequate and well-balanced.

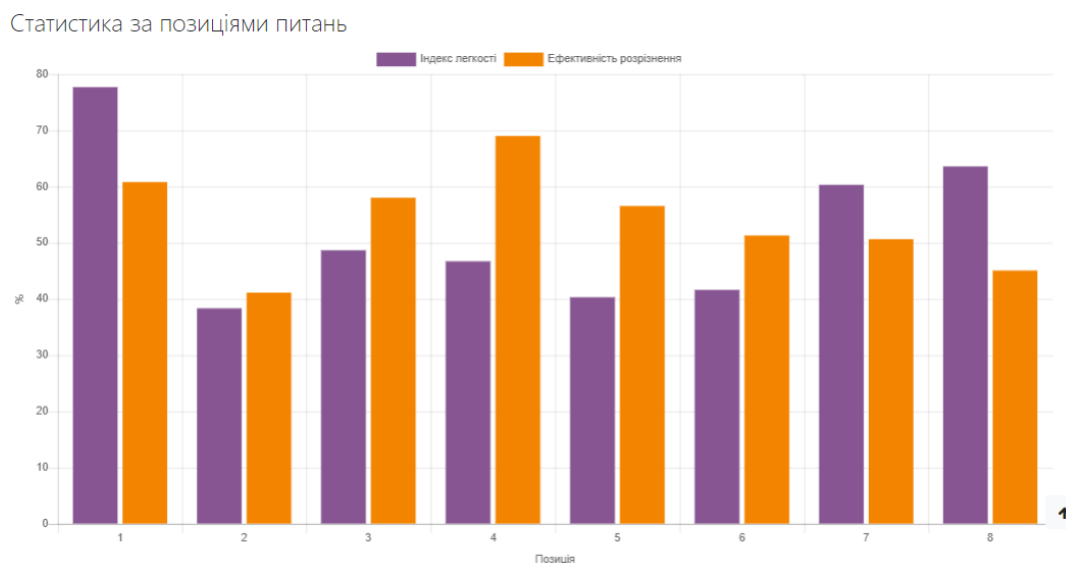


Figure 7. Statistical data for the control quiz on the topic “Parametrical and Non-parametrical methods for Comparative Analysis of Two Pharmaceuticals by Quantitative Features. Testing Statistical Hypotheses”

Analyzing the activity of the course participants since its certification and the results of their educational activities in completing quizzes (both training and control quizzes) and practical assignments, it can be concluded that the course users successfully grasp the theoretical material and demonstrate high proficiency in applying it in practice.

2.4. Authors’ personal contribution

Iryna Zhovtonizhko – the article concept, review of recent publications, introduction, general overview and characteristic of distance learning and LMS Moodle; developer of the distance learning course “Statistical Methods in Pharmacy” (mainly the first content module topics), the course tutor experience (2020 – 2021 academic year), and results analysis; formulations of conclusions and prospects for further researches.

Maryna Nessonova – analysis of the current state of implementing distance learning technologies in medical and pharmaceutical education; formulation of the research problem regarding finding ways to increase education seekers’ motivation to study educational components of a mathematical profile; developer of the distance learning course “Statistical Methods in Pharmacy” (mainly the second content module topics), the course tutor experience (2020 – 2021 and 2021 – 2022 academic years), and its analysis; formulating of conclusions and defining prospects for further researches; overall editing of the article and preparation for publication.

Mariana Barannyk – review of recent publications on the research topic, including the implementation of distance learning technologies in higher pharmaceutical education, justification of the relevance of the research topic; analysis of experience supporting the distance course “Statistical Methods in Pharmacy” as a tutor (2022 – 2023 and 2023 – 2024 academic years) and the effectiveness of course implementation; overall editing of the article and preparation for publication.

Nadiia Sheykina – analysis of experience supporting the distance course “Statistical Methods in Pharmacy” as a tutor (2022 – 2023 and 2023 – 2024 academic years) and the effectiveness of course implementation; overall editing of the article and preparation for publication.

Olga Marchenko – methodological support at the stage of development of the distance course “Statistical Methods in Pharmacy”, justification of psycho-pedagogical approaches to presenting the course materials; analysis of the prospects for implementing distance and online learning in the training of future pharmacists.

3. CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

Thus, the implementation of distance and online learning in the practice of higher pharmaceutical and medical education is an urgent necessity in today's conditions. A well-structured distance course, where educational materials are presented based on a competency approach using appropriate and diverse tools of modern LMSs, contributes to the growth of cognitive activity among learners in higher pharmaceutical education. It fosters their autonomy, independence, initiative, responsibility, freedom of choice in building their educational trajectory, formation of self-control skills, motivation, and interest in acquiring new knowledge. It allows for individualization and differentiation of the volume and sequence of presenting educational material, initiates the development of students' communicative abilities, nurtures information literacy, the ability to interact and collaborate in the digital environment, and, among other things, develops time management skills.

Nevertheless, the issue of motivating higher education seekers in medical and pharmaceutical specialties to study the educational components of the mathematical profile remains relevant. We see the solution to this problem as promising by shifting the focus in teaching similar disciplines to this group of students. Instead of solely teaching fundamental higher mathematics principles, the emphasis should be placed on solving real-life problems that mirror certain aspects of students' future professional activities. This allows increasing motivation by forming impression of studying pure pharmacy rather than mathematics, while the use of IT tools to perform the necessary calculations, avoiding the need to use complex math formulae, supports this effect. These approaches were applied by us in the development of the distance course “Statistical Methods in Pharmacy”, which is oriented towards the professional needs of future pharmacists in quantitative analysis and statistical data processing, as well as in documenting and reporting the results of chemical-pharmaceutical experiments. The use of a wide range of Moodle's technical tools for developing components of the distance course has allowed students to construct their own educational trajectories while mastering the course. It also has contributed to their interest in the subject matter of the discipline and increased overall success.

Further scientific investigations into this multifaceted problem could be an extension of the research on the effectiveness of implementing distance technologies in medical and pharmaceutical higher education. Additionally, exploring new approaches to motivating students to study educational components of a mathematical nature could be an area of future research.

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ДОСВІД УПРОВАДЖЕННЯ ДИСТАНЦІЙНОГО КУРСУ «СТАТИСТИЧНІ МЕТОДИ У ФАРМАЦІЇ» В МАТЕМАТИЧНУ ПІДГОТОВКУ МАЙБУТНІХ ФАХІВЦІВ ФАРМАЦЕВТИЧНИХ СПЕЦІАЛЬНОСТЕЙ

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Анотація. Стаття присвячена актуальній проблемі дистанційного та онлайн-навчання під час здобуття вищої освіти майбутніми фахівцями фармацевтичної галузі. У даній статті розкрито сутність поняття дистанційного навчання, визначено основні його принципи, окреслено характерні риси, вказано основні переваги та недоліки використання дистанційної форми навчання у вищій фармацевтичній і медичній освіті. Значна увага приділена використанню дистанційних технологій навчання у процесі фізико-математичної підготовки здобувачів вищої освіти фармацевтичного профілю. Окрім технічних засобів і структурно-методичної складової процесу розробки дистанційних курсів особлива увага приділена психолого-педагогічним аспектам, зокрема спрямованим на підвищення мотивації даного контингенту здобувачів освіти до опанування дисциплін, пов'язаних з точними науками.

На прикладі розробленого авторами з використанням LMS Moodle дистанційного курсу «Статистичні методи у фармації», який було апробовано, сертифіковано і впроваджено у фундаментальну підготовку майбутніх фахівців фармацевтичної галузі в Національному фармацевтичному університеті, показано, що вдале поєднання методичних підходів, інноваційних методів навчання, спрямованих на реалізацію компетентісного підходу в освіті, із сучасними інформаційними технологіями забезпечення онлайн-доступу до навчального контенту, включно з засобами підтримки зворотного зв'язку, відпрацювання практичних навичок і автоматизованого самоконтролю, забезпечує ефективність досягнення здобувачами освіти навчальних цілей і формування професійних компетентностей, визначених освітньою програмою.

Зроблено висновок, що впровадження дистанційних технологій навчання в практику української вищої фармацевтичної та медичної освіти є необхідним не лише за неможливості організації повноцінного офлайн-навчання сьогодні, але й за рахунок ефективності цих технологій, у першу чергу, для організації самостійної роботи, що забезпечує формування автономності здобувачів освіти, сприяє розвитку інформаційної культури, загальної цифрової компетентності та низки soft-skills, зокрема навички цифрової комунікації, взаємодію та співпрацю в цифровому середовищі та раціональне використання навчального часу.

Ключові слова: дистанційне навчання; онлайн-навчання; електронні навчальні курси; Moodle; статистичний аналіз; фармацевтична освіта



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