

Features of teaching drug technology *via* distance learning

Oksana Strus

Danylo Halytsky Lviv National Medical University
oxana.strus@ukr.net

Natalia Polovko

National University of Pharmacy in Kharkiv

Marianna Fedorovska

Ivano-Frankivsk National Medical University

ABSTRACT

Modern challenges and the development of Internet technologies have led to a change in the role of education in society and in the training of specialists. Education is no longer a means of mastering ready-made knowledge, but becomes a way of information exchange, which involves the assimilation, transmission and generation of information. Modern higher education demonstrates flexibility and mobility; its characteristics are innovation and interactivity, and the global network is used as an effective learning tool. During the pandemic, distance learning of the educational process requires a set of distance learning courses in all disciplines, which are taught in each educational institution. 'Technology of Drugs' as an academic discipline belongs to the cycle of basic disciplines of professionally oriented training of specialists in the specialty 'Pharmacy, Industrial Pharmacy'. It is designed for graduates of full-time and parttime education, provides theoretical knowledge and develops practical skills on the main stages of formation and development of pharmaceutical technology in Ukraine. 'Technology of Drugs' curriculum is also an entry point to knowledge about modern areas of the pharmaceutical industry and professional activity in Ukraine and abroad, general requirements for the manufacture of drugs of different pharmaceutical groups in pharmacies and industrial pharmaceutical companies. The above-mentioned discipline requires careful mastering of practical skills of manufacturing different groups of drugs, which causes certain features of its teaching in distance learning.

KEYWORDS

technology of drugs, educational process, mastering skills, distance learning

Introduction

In accordance with Resolution No. 211 of the Cabinet of Ministers of Ukraine (11.03.2020) *On prevention of the spread of acute respiratory disease COVID-19 caused by SARS-CoV-2 coronavirus on the territory of Ukraine*, quarantine was introduced in the territory of Ukraine, which made traditional teaching impossible (Resolution No. 211 Of The Cabinet Of Ministers Of Ukraine, 2020; Government Portal Ukraine, 2020). The Ministry of Education and Science of Ukraine developed several regulatory documents with the aim of organising educational processes during quarantine, including Order No. 406 (16.03.2020) *On Organisational Measures to Prevent the Spread of the COVID-19* and obliged the heads of higher pharmaceutical education institutions to develop a quarantine work plan using distance learning, and to provide a flexible work schedule for academic staff (Order of the Ministry of Education and Science of Ukraine, 2020; Nizhenkovska, Kuznetsova, and Narokha 2020).

Distance learning is a process that is increasingly present in the world. The Internet has become the main communication channel for the development of distance learning (Pandza and Masic, 2010).

The pandemic was a challenge for higher education institutions in terms of distance learning, as not all universities had developed and implemented a distance learning system and developed Internet infrastructure, digitised teaching materials and tests, tasks, etc., and faced challenges in teaching applied disciplines that require mastering of practical skills.

Education is no longer a means of mastering ready-made knowledge, but becomes a way of information exchange, which involves the assimilation, transmission and generation of information. Modern higher education has to demonstrate flexibility and mobility; its characteristics are innovation and interactivity, and the global network is used as an effective learning tool (Pandza and Masic, 2010).

Background

‘Technology of Drugs’ belongs to the cycle of basic disciplines of professionally oriented training of specialists in the specialty ‘Pharmacy, Industrial Pharmacy’. Discipline ‘Technology of Drugs’ is designed for graduates of full-time and part-time education, provides theoretical knowledge and develops practical skills on the main stages of formation and development of pharmaceutical technology in

Ukraine, modern areas of the pharmaceutical industry and professional activity in Ukraine and abroad, general requirements for the manufacture of drugs of different pharmaceutical groups in pharmacies and industrial pharmaceutical companies. The above-mentioned discipline requires careful mastering of practical skills of manufacturing different groups of drugs, which causes certain features of its teaching in distance learning (Syllabus, 2021).

The main aim of “Technology of drugs” as an academic discipline is learning by higher education applicants theoretical foundations and practical skills and abilities of drug production in pharmacies and pharmaceutical companies with consideration of the requirements of good pharmacy and manufacturing practice; rules of development and completing the production documents for the manufacture of medicinal products, rules for their storage and packaging; getting knowledge on the characteristics, classification and assortment of dosage forms; studying the influence of excipients on the quality of drugs, enabling realisation of scientific and creative potential of future specialists.

The distance course on drug technology in universities contains materials of various contents and has a typical structure (see Image 1):

1. general information about the course - presentation, working curriculum, syllabus, learning algorithm, knowledge assessment criteria, list of information sources, glossary;
2. support of the course by a tutor – news, forums;
3. educational and methodical materials on each topic:
 - a) basic information material; lectures
 - b) additional information material;
 - c) practical / seminar classes, laboratory works;
 - d) control tests;
 - e) materials for self-control of studying the topic;
4. materials to prepare for the final certification.

Methods

The information collected from distance learning platforms of the National Pharmaceutical University, Kharkiv, Danylo Halytsky Lviv National Medical University and Ivano-Frankivsk Medical National University as well as from articles in leading professional journals on the issues of distance learning were analysed.

Industrial Technology of Drugs (Module 1)

Home / Courses / каф. Технологій фармацевтичних препаратів / Матеріали для самостійної роботи / Pharmacy / Industrial Technology of Drugs (Module 1)

The screenshot displays the Moodle interface for the course 'Industrial Technology of Drugs (Module 1)'. On the left, there are two main navigation panels: 'Administration' and 'Navigation'. The 'Administration' panel includes options like 'Course administration', 'Edit settings', 'Users', 'Filters', 'Reports', 'Gradebook setup', 'Badges', 'Backup', 'Restore', 'Import', 'Copy course', 'Reset', 'Question bank', and 'Recycle bin'. The 'Navigation' panel includes 'Home', 'Dashboard', 'Site pages', and 'Courses'. The 'Courses' section is expanded to show 'каф. Технологій фармацевтичних препаратів' and 'Дистанційні курси кафедри'. The main content area is divided into several sections: 'Announcements' with links to 'Student-teacher communication', '2. Work Program of a subject', '3. Syllabus 4 year students.docx', '4. Course schedule of practical (lab. sem.) classes Fall semester 2021-2022 (4 year Group 1-11)', and '9. Questions for Final Modular Control'; 'Keys to tasks'; 'Industrial drug technology'; and 'Links for online Zoom classes'. Below this is a section titled '#1 Reference documentation' with a link 'Let's take the test. Reference documentation'. At the bottom, there is a section for 'Alcoholometry' with links for 'Alcoholometry lecture', 'Ethanol dilution', and 'Alcoholemetric table State Ph Ukraine'.

Image 1. Structure of discipline ‘Technology of drugs’

Source: <https://nuph.edu.ua/>

Results

During the first years of the introduction of distance learning in universities, the capacity of Internet connection was significantly increased, academic local networks were improved, and a distance learning server with a 24-hour Internet connection was installed.

The Moodle electronic monitoring platform is widely used for distance learning in pharmacy departments of higher educational institutions in Ukraine. This system is used in National University of Pharmacy, in Lutsk Lesya Ukrainka National University (National University of Pharmacy, Lesya Ukrainka Volyn National University Official websites).

MS Teams platform is used by Ivano-Frankivsk National Medical University, Odessa; (see National Medical University official website); In Kiev Bogomolets National Medical University, distance learning was implemented *via* the Neuron (Bogomolets National Medical University Official website; Nizhenkovska, Kuznetsova, and Narokha, 2020). In addition, web services are also used; Google Classroom is useful for educational institutions; Google Meet, Zoom and Skype for video conferences; and Viber, Telegram messengers, email or telephone

for individual consultations. Online learning has offered an interactive approach to communication between tutors and students, aimed at developing specific professional competencies in students of the Master of Pharmacy programme.

At the Department of Drug Technology and Biopharmaceutics of Lviv National Medical University (LNMU) of the Ministry of Health of Ukraine, distance learning was implemented using the Misa educational and information platform (see Danylo Halytsky Lviv National Medical University official website; available at: <https://new.meduniv.lviv.ua/>). It allowed students to communicate with their tutors, receive online advice, and monitor students' site traffic. A vast array of materials were made available on the Misa platform, including educational and methodological materials such as video clips and lecture presentations; methodological recommendations for the preparation for practical and seminar classes; additional materials for the preparation for practical classes (tables, diagrams and schedules); a list of recommended readings; hyperlinks with external online resources and search engines; and individual assignments for students, etc. (see Images 2 and 3).



Image 2. Screenshot of the lecture

Source: <https://new.meduniv.lviv.ua/>

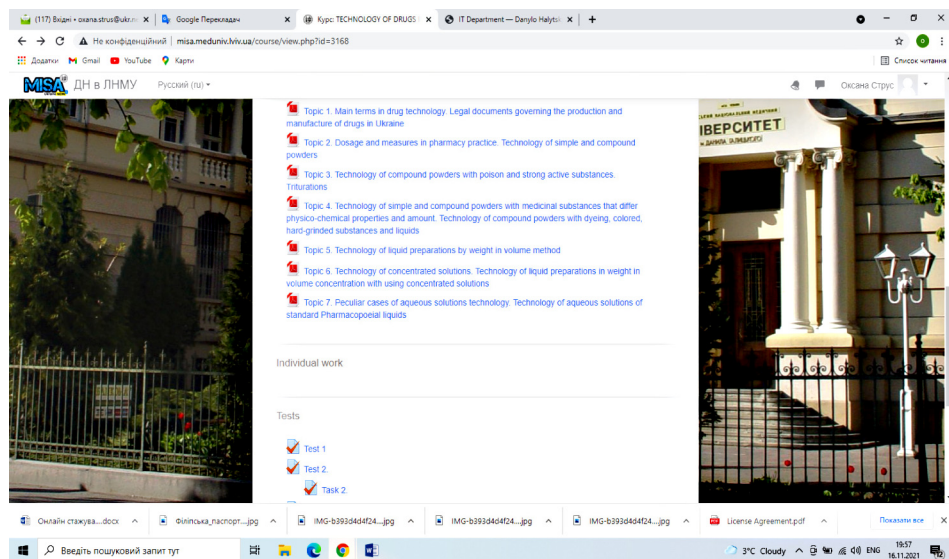


Image 3. Screenshot of the list of seminars and control test

Source: <https://new.meduniv.lviv.ua/>

Using the resources on the MISA platform, the tutors of the Faculty of Pharmacy conducted practical classes and seminars with students, and organised intermediate and final assessments of students' knowledge of the disciplines covered. Based on the results of the students' written assignments, the teachers gave grades to the students in an electronic journal and made comments using a general department email address.

The Misa platform interface was convenient for the students and adaptable to any device, it allowed for viewing of the uploaded materials or testing at a convenient time and place. The Misa educational and information platform is used to prepare 3rd and 5th Year students for a licensed integrated exam 'Krok 2. Pharmacy' for the applicants for Master's degrees in Pharmacy.

Drug technology belongs to the applied disciplines and requires careful acquisition of practical skills, so the teaching of the discipline has a number of features. To illustrate the basic practical skills, videos have been developed that demonstrate the procedure for conducting practical work in laboratories and simulators of virtual laboratories, which allow applicants to simulate the necessary technological operations to perform laboratory work and thus mastering practical skills.

Videos are placed in distance learning courses on relevant topics (see Image 4).

Solution for injection manufacturing**Ampoule Filling and Sealing Machine****Image 4. Video of the sterile preparations' technology**

Source: <https://nuph.edu.ua/>

Review by applicants of the technique of performing the practical part of the lesson helps to visualise the work in the laboratory lesson, provided by the program of the discipline. Such visualisation helps to understand the order of work and techniques of practical tasks during face-to-face classes and to acquire skills and abilities that form the competencies of the future specialist (see Image 5).

**Image 5. Visualisation of the work**

Source: <https://nuph.edu.ua/>

Distance learning involves direct communication between teachers and students during lectures and seminars. Video studios have been set up to give lectures, from which you can broadcast live on the Internet.

During the training, students have the opportunity to attend lectures online and attend practical and seminar classes. Access to video sessions is provided by following the link from the distance course.

Recordings of video lectures are stored on corporate cathedral channels on YouTube, and links to them remain up to date and are available at any time during the study of the discipline.



Image 6. Video of powders technology

Source: <https://www.youtube.com/watch?v=PZS2TSnx1Wg>



Image 7. Virtual imitators of technics

Source: <https://nuph.edu.ua/>

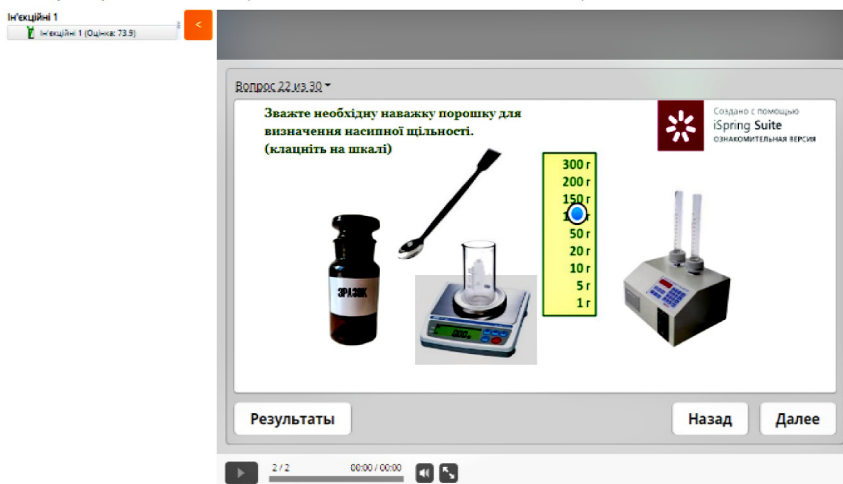


Image 8.

Source: <https://nuph.edu.ua/>

In order to ensure the proper level of applicants' integration and for constant communication with the teacher in distance learning courses, forums of mutual assistance and assistance of the teacher have been launched (as a blog). The forums are used for discussions about interesting academic issues, provide assistance in difficult situations in learning the material.

To support the motivation of students to learn, constant and prompt feedback from the teacher is necessary. Therefore, when communicating *via* forums, teachers must adhere to the time period (not more than 24 hours), during which the applicant must receive an answer to a question or assessment for the work done.

During the learning process, the teacher has an online hour in his schedule for daily communication on forums and to check the tasks performed by applicants. Using Moodle for distance learning, Misa allows students and teachers to use different resources to place information materials, practical tasks, materials for self-monitoring and control.

Gamification (crossword puzzles, cards, photo tasks, etc.) is widely used for creating practical tasks to check the assimilation of theoretical material.

Тема 2. Рецепт 7
от Стужук Софія Валентинівна Фс18(4,5дз)-01а дз - Thursday, 10 September 2020, 12:00

Доброго дня! Підкажіть, будь ласка, в рецепті розчин Люголя для зовнішнього виписаний в об'ємі 20 мл. В якій частині води тоді розчинити калію йодид, якщо по розрахунках його виходить 0,4 ?

Постоянная ссылка | Редактировать | Удалить | Ответить

Re: Тема 2. Рецепт 7
от Герасимова (Білошицька) Ірина Вікторівна #РДК_2014 - Thursday, 10 September 2020, 15:26

Доброго дня! Калію йодид необхідно розчинювати в рівній кількості води, тобто в 0,4 мл (тобто 8 крапель). Але в ППК (л.б.) Ви маєте написати загальну кількість води, яка використовується, а саме 20 мл.

Постоянная ссылка | Показать сообщение-родителя | Редактировать | Отделить | Удалить | Ответить

Re: Тема 2. Рецепт 7
от Стужук Софія Валентинівна Фс18(4,5дз)-01а дз - Thursday, 10 September 2020, 17:38

Дякую!

Постоянная ссылка | Показать сообщение-родителя | Редактировать | Отделить | Удалить | Ответить

◀ Строки виконання завдань тема 4 (4,2) ▶

Image 9. Forum in the form of blogs

Source: <https://nuph.edu.ua/>

The image displays a gamified learning interface with three main components:

- Crossword Puzzle:** A crossword puzzle titled "Вопрос 8 (По вертикали):" with the question "явление разрушения эритроцитов под действием плотных средин". The answer field is empty, and the puzzle grid shows some letters filled in.
- Photo Task:** A task titled "Оберечь кожу лица..." with a list of ingredients: "Рр: Нейтральный оксид Fe3O4 0,2; Олиевое масло 0,2; Lanolin anhydric 1,6; Vaselina 8,0; M.D.S. Закладать за повязку." Below the list are six numbered cards (1-6) with photos of various steps in a procedure, such as "Подобрать нужные дозы", "Смешать ингредиенты", "Сформировать шарик", "Взвесить нужные дозы", "Заложить до застывания", and "Положить шарик в емкость".
- Task Diagram:** A diagram titled "Задание" with the instruction "оберечь соответствующий вид контроля до каждого технологического этапа". It features a central "ОК" button and several interconnected nodes: "стерильность", "чистота", "качество", "важность и контроль", and "использование". A hand icon is shown interacting with the diagram.

Image 10. Gamification of the learning process: crossword puzzles, cards, photo tasks

Source: <https://nuph.edu.ua/>

Quite common among Moodle resources is the 'Lesson', which is used by teachers both to teach information material and to perform practical tasks. - an example of using the resource 'Lesson' for lecture material: an example of using the resource 'Lesson' for a practical task.

To assess the current and final control of knowledge, students are tested in the MS Teams program, which helps to record the percentage of correct answers, testing time, cheated points and cheated time.

Tasks developed by teachers of Ukrainian universities for distance learning courses have a variety of formats: applied tasks, essays, project development, computational problems, case studies, etc.

Control tests are compiled using most of the possible options provided by Moodle. In addition to tests such as multiple choice, actively used tests for compliance, missing words, short answer, dragging in the text, numerical and calculation, which allows to diversify approaches to control the knowledge of applicants and to form a bank of questions of varying difficulty.

The final part of each course provides information on the content and format of the final control of the discipline, which allows applicants to prepare for the control activities.

An important component of the learning process is the self-preparation of applicants, which is 40%, so in distance learning courses there are tasks for independent work on each topic in the form of tasks / tasks and tests, which are evaluated automatically. Tests for self-preparation are configured in the format of checking the correct answer, which allows you to adjust the answer if necessary for better mastering of the course materials.

Printed and Internet resources are intended for independent work of applicants with theoretical material. Most of the main sources have active links to the electronic library. As a result, applicants can download textbooks or other literature to their devices or work with them online. There are also links to specialised sites, the information of which is necessary for the work of applicants to master the material of various disciplines being studied.

Applicants can at any convenient time use electronic presentations of lectures, recordings of video lectures, hypertext textbooks, tests for self-control and other educational and methodical materials on disciplines placed in the educational environment. All these opportunities significantly improve the quality of knowledge.

Distance learning also provides for the possibility of conducting control events in a distance format, so universities had every opportunities to conduct in connection with quarantine measures in 2020 in the format of video confer-

ences (with mandatory personal authentication) final exams and defence of final qualifying works full-time education in all specialties (sometimes in a mixed offline/online mode)..

Task 1. A pharmacy received the prescription for the extemporaneous dosage form compounding of the following composition:

Rp.: *Ephedrini hydrochloridi* 0,4

Kalii iodidi 3,0

Natrii benzoatis 4,0

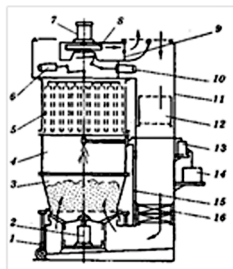
Aquae purificatae ad 180 ml

Misce. Da. Signa: 1 tablespoon 4 times a day orally after meals.

According to the received prescription it is necessary:

- to indicate the type of dosage form and check the compatibility of ingredients, single and daily doses of poisonous, narcotic and potent substances;
- to calculate the quantities of active pharmaceutical and auxiliary ingredients;
- to substantiate the optimal technology according to the compounding stages;
- to indicate packaging and sealing materials, utensils and types of labels for dispensing of the compounded dosage form;
- to draw up a passport of written control.

Task 2. Indicate the name of the equipment shown in the figure, explain its function, design features and principle of operation.



Task 3. Calculate the quantity of plant raw material and the extraction agent for 150 ml of the Belladonna tincture manufacturing with the alcohol adsorption coefficient of 1.4. Specify this dosage form quality indicators.

Image 11. Sample of exam test from drug technology

Source: <https://ifnmu.edu.ua/uk/>

Distance learning technologies and system solutions teachers' and applicants' e-education are also extremely important. Informagion materials, e-libraries and Internet links to specialised sites are available on university websites. The University has also developed distance learning courses for teachers, so that distance learning teachers have a clear idea of the relationship and interdependence of technological components included in the distance learning course and allow you to implement and establish all learning procedures and improve your knowledge.

Conclusions and recommendations for practice

Ukraine has not yet fully formed a system of distance learning and is now at the stage of rapid development, so in our opinion we should develop the Internet, develop new approaches to learning practical skills, and share experiences of distance learning with colleagues, including from abroad.

Intermediate results of this active transition of the pharmaceutical faculties within Ukrainian universities to distance learning show that the self-discipline and self-organisation of the students (i.e. those who can independently choose a curriculum, draw up an individual class schedule, study anywhere with a device connected to the Internet and contact professors online) are very important aspects of this form of education.

Although it is still not fully consistent with European standards, the last decade has seen positive changes to the educational systems in Ukraine. Despite the difficulties and problems in the educational environment that arose during the transition to distance learning in Ukrainian institutions, it should be noted that the development of distance learning technologies in Ukraine will make pharmaceutical education better, more competitive, more flexible and more attractive to students.

The future of higher pharmaceutical education in Ukraine depends on how quickly some issues of distance support will be resolved. These issues include the creation of software products such as online course resources for distance learning platforms; integration with cloud technologies; online student's identification standards; the issue of academic staff load; advanced training for academic teachers; and professional burnout amongst others. Distance learning is a prerequisite and a condition for the academic mobility of both students and professors, which will assist with the integration of the Ukrainian system of pharmaceutical education into the European educational environment.

References

- Government Portal Ukraine. Retrieved November 9, 2021 from [https:// www.kmu.gov.ua/npas/pro-zapobigannya-poshim110320rennyuna-teritoriyi-ukrayini-koronavirusu-covid-19](https://www.kmu.gov.ua/npas/pro-zapobigannya-poshim110320rennyuna-teritoriyi-ukrayini-koronavirusu-covid-19).
- Pandza, H., and Masic, I. (2010). Distance learning perspectives. *Acta Informatica Medica*, 18(4), 229–232.
- Nizhenkovska I., O. Kuznetsova, and Narokha V. (2020). Organising distance learning for Master's in Pharmacy in Ukraine during COVID-19 quarantine. *Pharmacy Education*, 20(2) 59–60.

- Official site Bogomolets National Medical University. Retrieved November 9, 2021 from <http://nmuofficial.com/en/>.
- Official site Danylo Halytsky Lviv National Medical University. Retrieved November 8, 2021 from <https://new.meduniv.lviv.ua/>.
- Official site Ivano-Frankivsk National Medical University. Retrieved November 9, 2021 from <https://ifnmu.edu.ua/uk/>
- Official site Odessa National Medical University. Retrieved November 8, 2021 from <https://onmedu.edu.ua/>.
- Official site Lesya Ukrainka Volyn National University. Retrieved November 9, 2021 from <https://vnu.edu.ua/en>
- Official site National University Of Pharmacy. Retrieved November 7, 2021 from <https://nuph.edu.ua/>.
- Order of the Ministry of Education and Science of Ukraine. On organisational measures to prevent the spread of coronavirus COVID-19 dated 16.03.2020 No. 406. Retrieved November 5, 2021 from <https://mon.gov.ua/ua/npa/pro-organizacijni-zahodi-dlya-zapobigannya-poshirennyu-koronavirusu-Covid-19>.
- Resolution No. 211 Of The Cabinet Of Ministers Of Ukraine. On prevention of the spread of COVID-19 acute respiratory disease caused by the SARS-CoV-2 coronavirus in Ukraine” dated 11.03.2020. Retrieved November 5, 2021 from <https://www.kmu.gov.ua/npas/pro-zapobigannya-poshim110320rennyu-na-teritoriyi-ukrayini-koronavirusu-covid-19>.
- Syllabus on the discipline «Technology of drugs». For speciality 226 Pharmacy, industrial pharmacy, 2nd Master’s degree of Higher education, full-time for 2021-2022 years. 34 p. Retrieved November 5, 2021 from https://new.meduniv.lviv.ua/uploads/repository/kaf/kaf_biopharm/00.%20Foreing_students/3.Syllabus/01.TECHNOLOGY%20OF%20DRUGS%20III-IV%20course%20.pdf.