



# THEORETICAL FOUNDATIONS OF PEDAGOGY AND EDUCATION

Collective monograph

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**SECTION 8. THEORY, PRACTICE AND TEACHING METHODS**

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**8.1 Application of modern teaching methods in distance education**

The purpose of this work was to study the theory and methods of teaching disciplines in natural sciences and training of health professionals and the development of teaching methodology for students of higher pharmaceutical education in Ukraine in conditions of distance learning.

Today requires special conditions for the training of pharmacists who can work effectively in the dynamic conditions of modern reality [529]. This is due to the progress of world pharmaceutical and medical science, the rapid increase in the number of drugs, increasing requirements for quality control of drugs, as well as changes in the economic, legal and educational space [530].

The modern learning process combines a great variety of didactic techniques and methods. This allows the representative of education to qualitatively increase the effectiveness of students' learning material, visually reveal interdisciplinary links, activate and individualize the learning process, form and develop competencies provided by the objectives of the study profile [531-532].

Information educational resources create convenient and attractive conditions for attracting students of higher education institutions to the educational space and improve the effectiveness of learning the necessary material in disciplines, both training and general. [533].

Teachers of the Department of Analytical, Physical and Colloid Chemistry proposed an algorithm for compiling the structure of the discipline and the working curriculum for academic disciplines, taking into account distance learning.

In general, the working curriculum of academic discipline is a normative document that defines the content, scope, structure of the educational process for studying a particular academic subject, based on the state educational standard and exemplary curriculum on the recommended subject by education authorities. The main



purpose is the planning, organization, correction of the educational process, management of the educational process for the study of the discipline [534].

The authors [535] identify the following subprocesses in compiling the curriculum of academic discipline:

1. Creating a work program passport.
2. Determining the results of mastering the course.
3. Describing the content of the work program.
4. Establishing the conditions for the implementation of the work program.
5. Defining methods for evaluating the results of the course.

In addition, the features of the elective curriculum were considered – it contains a large and significant amount of information in a relatively short period of time, as well as a focus on the basic and most striking concepts of the course. These tasks are especially difficult to perform for a theoretical discipline. This is due to the difficulty of perceiving the basic theoretical materials without practical consolidation. After all, theoretical courses usually consist of lectures and seminar lessons, where students can discuss various issues and solve complex situational problems. Although the practical lesson is a common type of science lessons, which is conducted under the guidance of a teacher and aimed at deepening scientific and theoretical knowledge and mastering certain methods of independent work. Therefore, in the process of such classes are formed practical skills (calculations, use of tables, reference books, etc.). However, the seminar is a lesson in the theoretical discipline, in which students acquire the ability to compose abstracts, learn to take notes on primary sources, orally present material, as well as defend scientific theses and conclusions. Therefore, seminars cannot completely fill the lack of practical skills. Therefore, the curriculum for such a discipline should contain structural blocks based on both case-study methods [536] and game methods [537].

Compilation curriculum of the elective discipline in the context of distance education creates new serious problems, but provides additional opportunities. For example, class discussion will be replaced by online conferencing using various programs (Zoom, Skype, Google Meeting) and information technology. Such a

replacement can lead to a lack of full contact with students for a number of reasons (including poor Internet quality).

Thus, the main problem of distance learning is to create opportunities for the organization of the modern educational process at the full-time level. Distance learning should contain all the necessary factors that shape learning. Yes, the problem of communication with the teacher and students among themselves, conducting discussions, in other words, providing effective feedback is becoming relevant.

One of the most important problems facing the generally accepted model of distance education is the so-called transactional distance, which arises due to the lack of proper communication between student and teacher. Therefore, if there is no connection between the student and the teacher, this gap becomes larger. This factor affects the learning process and its quality. Today, various strategies, techniques and procedures are widely used to increase the interaction between students and teachers. Activities such as personal textbooks and the wider use of information and communication technologies, including teleconferencing and the Internet, are most commonly used [538].

In this paper, we propose certain algorithms to maintain quality and effective communication between student and teacher in distance learning. We offer to consider some classic examples of communication support [539].

1. Lesson - lecture. A modern lecture should be interactive and dynamic. It should not burden students in time. Thus, recording video lectures becomes the optimal choice for distance learning.

You can create discussion posts via social networks or mobile applications to keep in touch with the discussion material.

But in our opinion, creation "play modes" will be more effective activities. Interactive modes are best suited for self-study or homework, because it allows your students to work on their own. Teachers can also use this play mode in the classroom if they have a projector: teachers'll elicit responses from students for each question, and input one of them. Such a lecture will be like an interactive game. Where students will have to answer interesting questions right in the middle of the lecture.

## 2. Practical or seminar classes.

This type of activity allows closer contact with the classroom. Such classes can be held in conference programs. Communication should be maintained not only in the classroom, but also in non-class time. Here you can also turn to social networks or mobile applications for communication.

However, the most important thing for these types of classes is to create a learning space for students in non-classes. It is obvious that proper control of students' work and assessment of their knowledge should be created. In this case, it is interesting to create online tests or online quizzes.

Figure 1 illustrates the basic building blocks of effective online learning.

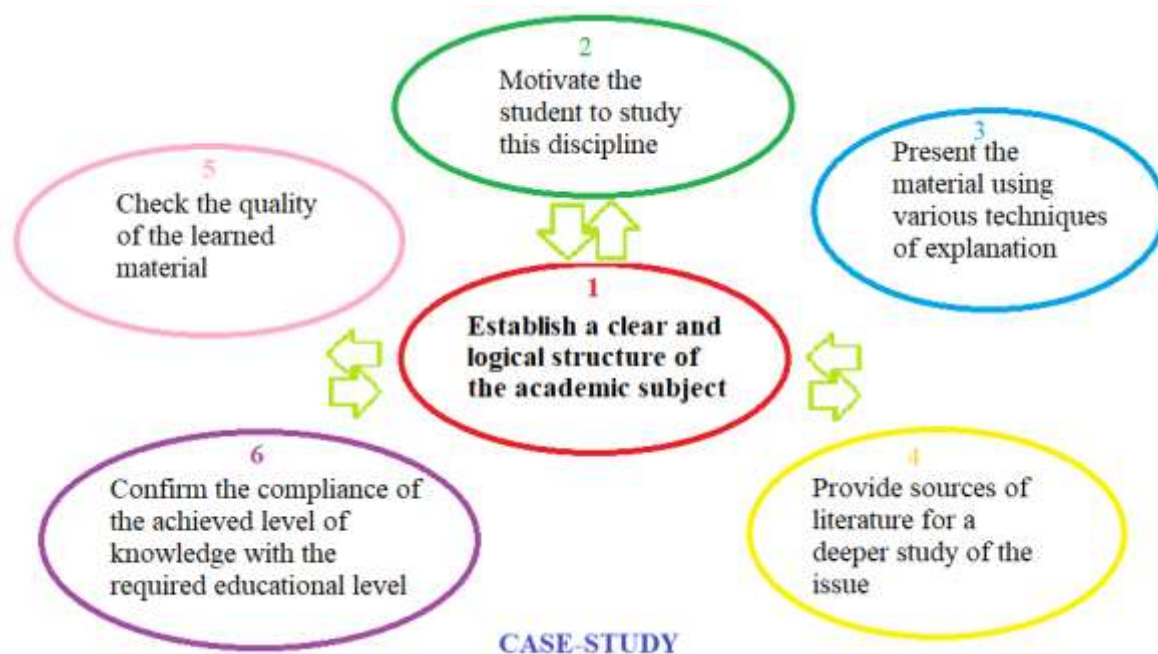


Figure 1. Algorithm for creating effective education [537]

In addition to the listed disadvantages of online classes, it can allow students and teachers to take full advantage of the Internet (interactive tests, games, online video and podcasts, etc.). It should be noted that the successful use of interactive tests created on the Quizzes platform. Figure 2 illustrates the use of interactive tests for teaching disciplines at the Faculty of Pharmacy at the Department of Analytical, Physical and Colloid Chemistry.

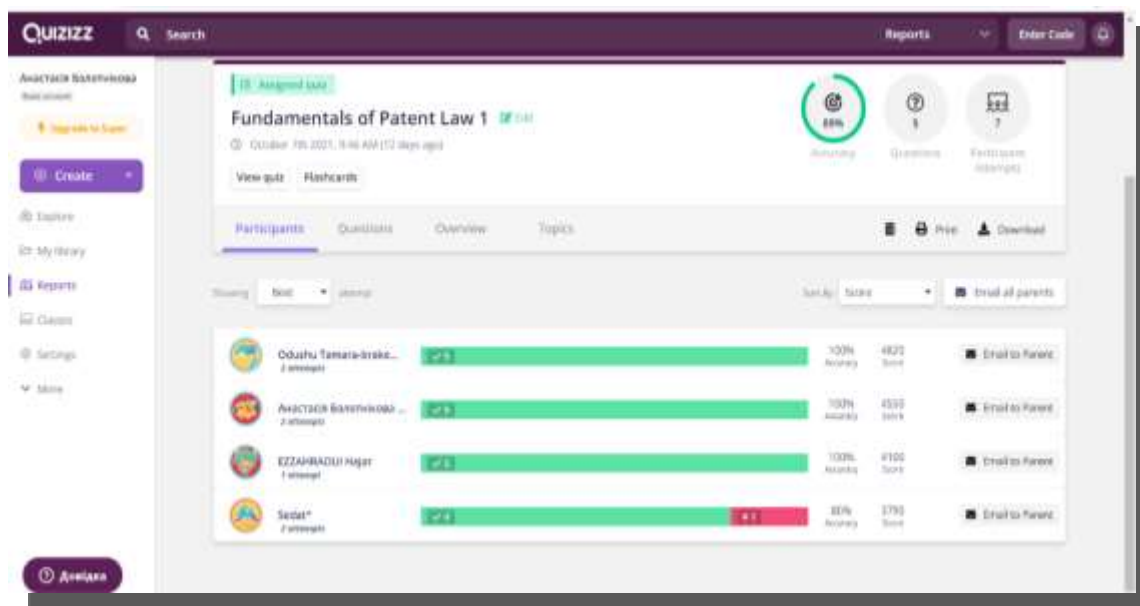


Figure 2. Fragment of interactive testing on the Quizizz platform (elective course "Fundamentals of Patent Law").

The solution to many of the problems associated with distance or blended learning is to conduct “flipped” lessons. Therefore, “flipped” lessons are very relevant today. This term is no longer new [540], but has gained the most popularity over the past few years. So, the description of motivation and cognitive load in an inverted classroom [541], how we flipped the medical classroom [542], flipped physics [543], quantitative and qualitative evaluation of transforming to flipped-classroom [544] – all this the actual topics of today's flipped lesson.

Flipped classroom is an instructional strategy and type of blended learning that aims to increase student engagement and learning by completing reading at home and working on problem solving in real time during class [545]. In the “flipped” lesson, the focus is on the student and his brain activity. The teacher no longer gives him ready-made answers to his own questions. Students work actively and ask questions themselves, and in the learning process they themselves answer them. Students can conduct data analysis or even entire research at home, and in the classroom only establish certain concepts and goals of the work. Conversely, what students in traditional teaching did at home, they can now do in class. For example, they can watch

online lectures and discuss them in class, conduct various creative projects in groups or in the whole class. To plan such lessons, it is necessary to develop methodological materials of different levels and purposes, the so-called didactic support. These materials should provide for the possibility of control by both the student and the teacher.

Such classes form certain positive aspects in the student's life:

- Presence of real motivation
- Curiosity
- Using a systems approach
- Attentiveness
- Hard work, hard overcoming of their own laziness
- Gradual formation of the habit of self-learning
- Positive competitiveness
- Analytical thinking
- Independence

In addition, the inverted lesson is extremely convenient. Conversely, the student chooses a convenient time to study. After all, the main idea of such an approach to classes is the possibility of conducting them on the Internet. In this way, the main elements of the lesson can be viewed online at any convenient time. The model of such a lesson is aimed at obtaining a proper effective education and in-depth knowledge. In this way, the teacher solves another serious problem. Namely, training to obtain a final grade. After all, “flipped” lesson encourages students to understand the material, not just memorize it. So to speak, the student is experiencing the discipline, he (she) is interested and fascinated by it. The knowledge gained in this way remains extremely deep in human memory [546].

We offer our own model of a “flipped” lesson. This model can be applied to technical, mathematical, natural and even humanitarian disciplines.

1. Basis of your flipped lesson.

An online lecture can form the basis of our inverted lesson. In this lecture, the teacher only outlines the main points and principles of the topic, but does not cover all

issues. Such lectures can usually last from 5 to 30 minutes. They are usually recorded. So students can listen to the lecture at any convenient time. The teacher should intend to present the material in such a way that the student can formulate specific questions. That is, it was not the teacher who directly asked the student questions and gave answers to them, but the student himself asked certain questions. This encourages the student to gain deeper knowledge, to show creativity.

0. Preliminary preparation

This stage exists for preliminary preparation of students for the lesson. It can include different types of assignments that will help expand the topic of the lesson. For example, a teacher may only sketch out a preliminary outline of an online lecture, while a student, in turn, may prepare a short message, a short summary, or a presentation on these theses. This active learning encourages students to think critically [546].

1. Information tool

By information tool, we mean some supporting materials for obtaining information.

So, after the main lecture, the student has a few questions. However, you must be able to answer them remotely. How? You must provide him with a complete list of trustworthy resources where the student can get answers. It doesn't have to be resources with superficial answers. The student must do some analytical work. However, if the mentor does not provide him with reliable resources, he may find unverified sources. So, the student can make a mistake and remember the wrong information.

2. Task which reinforces interest in the topic of the lesson

After the lecture, the teacher must formulate the task for the student. This task does not have to have a clear framework in terms of the form of presentation of the material or its volume. However, the answer to the assignment must clearly correspond to the content of the assignment and fully disclose it. At the same time, this task should be, as it were, a stimulus for answering the questions formulated after the lecture. So even uninterested students will be forced to delve deeper into the material. Examples of such assignments include:

- Creation of various projects.

- Writing abstracts, messages, articles.
- Creation of presentation and report on it.
- Solving problems of increased complexity.

#### 4. Testing yourself

At each stage of self-study and preparation for the lesson, the student must test himself. He (she) must understand whether he is doing everything correctly, whether he makes mistakes. Usually, this stage is quite difficult to achieve. However, the teacher can use some tricks to complete this step. For example:

- Online testing at the preparation stage.

This testing should not be created to evaluate students by teachers, but to test students themselves. This is an exclusively computerized test, where each question is formulated in such a way as to calculate possible mistakes and problems of students. The teacher creating this type of activity should try to predict all possible difficulties for students.

- Online discussions between students of one group or several groups.

This type of activity does not involve a teacher. However, it helps to improve mutual understanding between students and increase the level of knowledge on the subject.

- Online discussions between students and the teacher. This discussion is not a scheduled seminar required for all students. This is something like a consultation for those in need.

#### 5. Closing the topic. Demonstration of completed tasks

This is the last, but not the last, part of our flipped class model. This part of the lesson can be conducted as a workshop, seminar or conference. It all depends only on the imagination of the teacher and students.

#### 6. Teacher control

This is the last stage of the lesson. You can choose any type of control, depending on the topic of the lesson, the discipline itself, etc. It may be:

- answer to control or test questions;
- checking the abstract;

- checking abstracts;
- verification of solved problems;
- verification of calculations;
- check of the executed graphic exercises and tasks;
- verification of completed individual tasks

“Flipped” classrooms will provide an opportunity for active learning and student engagement in a variety of hands-on activities such as individual assignments, discussion, debate, workshops, problem solving, and critical thinking. Through the proposed lesson model, the teacher can offer more personalized guidance and interaction with each student. This method helps prevent lacks in the material, provides a better understanding of the subject and, accordingly, higher productivity.

The curriculum of the optional theoretical course in distance learning in accordance with these aspects may have approximately the following educational components:

1. Lectures using the program for online meetings or recording video lectures.
2. Seminars that can be combined with different methods of studying specific cases (using different Internet resources) [547].

In addition, a detailed lesson plan is a crucial element of a successful and effective course.

Creating a reliable lesson plan is an important part of classroom management. This requires the ability to apply effective strategies for student learning. There are many different types of lesson plans and ways to create them. Teachers can encourage critical thinking in the group by creating plans in which all students participate. Visual strategies are another component of lesson plans that help with classroom management. The lesson is usually better if the teacher has planned it correctly, because it provides a lesson structure and discipline for students [548].

Summing up, it should be noted that the preparation of working curricula of the elective course for the theoretical discipline is based on several key points:



1. Determining the amount of educational materials in accordance with the main objectives of the discipline and the interval of study of this subject, as well as research of relevant literature and reliable Internet sources.

2. Selection of a list of topics for the creation of this discipline.

3. Selection of optimal types of classes (lectures, seminars, practical classes).

4. Drawing up a rich thematic plan for all types of classes.

5. Creating exciting tasks and situational tasks using case studies methods (case method) and game methods.

6. Strengthening tasks and exercises for students with various opportunities of Internet resources and modern IT. Students should keep in mind that they need to prepare carefully for the seminar: read the seminar plan, study the recommended literature, make a short plan of presentation for each question. In preparation for the seminar, you usually need to review one or more literature sources: books, brochures, articles. Of course, acquiring the skills of summarizing while working with a book is extremely important, but the implementation of various creative projects in preparation for the seminar not only develops analytical thinking, but also strengthens the functions of memorization, which increases learning productivity.

7. Establishing clear provisions and criteria for assessing student responses.

8. Compilation of guidelines and special manuals for students.

9. Forming a thorough plan for each lesson to achieve effective learning outcomes [546].

Curriculum is a dynamic process. Development means changes which are systematic. A change for the better means any adjustment, revision or improvement of existing condition. To produce positive changes, development should be purposeful, planned and progressive. It will take years to evaluate if the curriculum is effective and attuned to the needs of the learners and the society [549].

Simultaneously with the development of the curriculum, teachers systematize and supplement the existing teaching material, as well as create new teaching resources. Educators should rely on a number of fundamental principles. The traditional components of the curriculum are: goals, objectives, learning strategies,

topics of study, types of work, assessment, sources of material and number of hours [546].

On the basis of the created working curricula of the course the peculiarities of teaching elective courses were studied. Consider the following features on the example of the elective course "Fundamentals of Chemical Metrology", which is studied by students of the Faculty of Pharmacy by correspondence in the 2nd year in the 3rd semester. This discipline is studied by students of the Faculty of Pharmacy by correspondence 5.5 years of study and 4.5 years of study ("Medicine", "Pharmacy", second higher education); total students in 2020-2021 academic year - 399. 90 hours of full-time study are devoted to the course "Fundamentals of Chemical Metrology", of which: 3 hours - lectures (Table 1), 6 hours - seminars (Table 2) and 81 hours - independent work. The form of control of learning success is a differential test [550].

Table 1.

## Thematic Plan of Lectures

№	Title of the lecture	Number of hours
1	Chemical metrology as a science. Subject of chemical metrology, purpose, tasks, methods. Specifics of chemical analysis as a metrological discipline.	1
2	General metrological characteristics of the analysis. Errors in chemical analysis, their classification.	1
3	The main stages and sources of errors in chemical analysis. Statistical analysis of a chemical experiment.	1

Table 2.

## Thematic Plan of Seminars

№	Title of the seminar	Number of hours
1	Statistical processing and presentation of quantitative analysis results (calculation of metrological parameters).	1
2	Estimation of permissible discrepancy of results of parallel determinations (estimation of convergence).	1
3	The main concepts of probability theory.	1

Due to the COVID-19 coronavirus pandemic, the educational process in the autumn-winter semester of 2020-2021 in the Bogomolets National Medical University was organized by a mixed (classroom-distance) form of education (NMU order № 439 of 19.08.2020). On the web resource [neuron.nmuofficial.com](http://neuron.nmuofficial.com), structured educational content was created to study the elective course "Fundamentals of Chemical Metrology" by students of the Faculty of Pharmacy by correspondence and its current assessment. Seminars were conducted with students online using Zoom technology according to the class schedule [551].

The content of the online course on the Neuron platform includes the necessary learning materials that allow students to master the main points of the content of the discipline, namely:

- 1) working curriculum;
- 2) methodical manual for seminars and independent work on the course "Fundamentals of Chemical Metrology";
- 3) methodical recommendations for independent work of students in preparation for seminars;
- 4) video content of lectures;
- 5) testing to assess the current activities of students.

In addition, an instructional and methodical map is proposed for each seminar, which specifies the sequence of actions of students to achieve the goal of the lesson.

Figure 3 illustrates excerpts from the Fundamentals of Chemical Metrology course on the Neuron distance learning platform.

The screenshot displays the course interface on the Neuron platform. It is divided into two main sections: 'Lectures' and 'Seminars'.

**Lectures Section:** The header is 'Лекції - Lectures'. Below it, a message reads: 'Шановні студенти, до Вашої уваги лекції у форматі pdf та у форматі mp4 (із коментарями лектора)'. The list includes:
 

- Лекція 1 Lecture 1
- Лекція 2 Lecture 2
- Лекція 3 Lecture 3
- Лекція 1 (з коментарями) Video-lecture\_1
- Лекція 2 (з коментарями) Video-lecture\_2
- Лекція 3 (з коментарями) Video-lecture\_3

**Seminars Section:** The header is 'Семінарське заняття 1. Статистична обробка та представлення результатів кількісного аналізу (розрахунок метрологічних параметрів) - Seminars'. The list includes:
 

- Інструкція до заняття 1 Instruction for the seminar 1
- Семінарське заняття 1. Методичні рекомендації Guidelines for the seminar 1
- Поточний контроль до заняття 1 Current control\_1

 Below the 'Current control\_1' item, there is a detailed instruction: 'Шановні студенти, до Вашої уваги 10 тестових питань до заняття № 1. Час проходження тесту - 45 хвилин. Правильна відповідь лише одна. Проходження тесту передбачає виконання деяких математичних розрахунків. Підготуйте, будь-ласка, аркуш паперу, ручку та калькулятор.'

Figure 3. Fragments of the course "Fundamentals of Chemical Metrology" on the Neuron platform for distance learning.

After analyzing the indicators of student test results, we obtained a chart (Figure 4), which shows that 76 students gave the correct answer to less than 60% of questions; 171 students gave 60–80% correct answers; 152 students gave the correct answer to more than 80% of the questions [550].

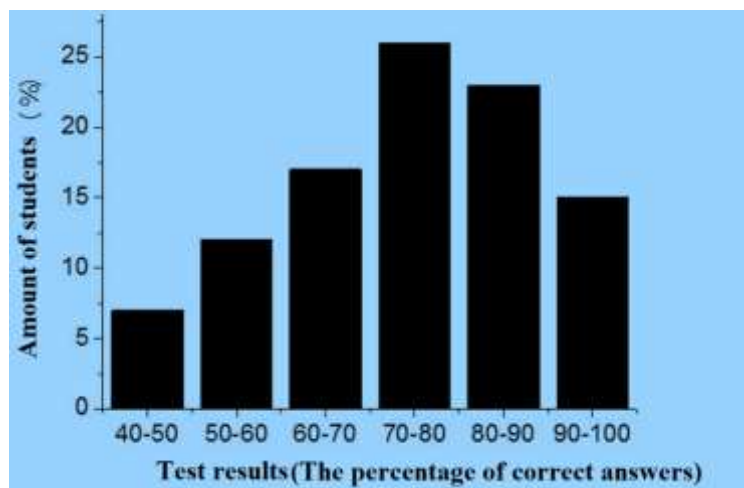


Figure 4. Test results of students of the Faculty of Pharmacy of distance learning

Employees of the Department of Analytical, Physical and Colloid Chemistry of the Bogomolets National Medical University is developing methodological support for teaching students of chemical disciplines. In the format of the content of the Internet platform methodical recommendations for independent work of students, materials for test control, electronic versions of lecture material for students, educational videos, electronic support of practical and laboratory classes are created. Methodical recommendations for students' independent work, control materials, electronic versions of lecture material, educational videos, electronic support of practical and laboratory classes are created and displayed on the educational platform on the Internet. Teaching technologies and methods, especially the experimental-demonstration base of chemical disciplines in higher pharmaceutical education in Ukraine, are improved through the process of further work with educational materials, modernization of innovative teaching methods for disciplines and disciplines of natural science training in health care [552].

Our research shows that feedback is the primary channel for communicating information about student performance and learning, so it is imperative that feedback constantly adapts to the ever-changing needs of students. It goes without saying that students must have a great responsibility to their mentors in order to take full advantage of the benefits of constructive communication [539]. Thus, this study provides a clear

structure for organizing feedback. Moreover, “flipped” classrooms have been proposed as a solution to many problems associated with distance learning or blended learning. Indeed, this type of lessons will provide an opportunity for active learning and student participation in a variety of practical activities such as individual assignments, discussions, debates, workshops and problem solving. Through the proposed lesson model, the teacher can offer more personalized guidance and interaction with each student. This method helps to prevent gaps in the material, provides a better understanding of the subject and, accordingly, higher productivity. Furthermore, the structure of the elective course is presented, which optimally ensures the effectiveness of education of students. The example of teaching the elective course "Fundamentals of Chemical Metrology" for students of the Faculty of Pharmacy distance learning shows that distance learning, as a forced measure in the pandemic COVID-19, is an effective tool, as evidenced by the results of the session.