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PEDAGOGICAL SOFTWARE USAGE IN FUTURE MATHEMATICS TEACHERS STUDY

Modern educational process in the university is characterized by high intensity. Every year, the total amount and the educational material complexity are increased. It is very important for study of fundamental disciplines in the specialists' training, in particular, future teachers of Mathematics. Quality improving of mathematical education may be achieved by using of new forms and methods of learning organization, educational material structuring, among which pedagogical software use is very important. It combines the features of a textbook, a handbook, a manual and a laboratory practicum.

Geometry is one of the leading disciplines, which is provided by the state educational standard of higher education. The result of the geometric training of the future mathematics teacher should correspond to the mandatory minimum content of the vocational curriculum, requirements for the level of training of graduates. The rapid development of information technologies brings changes to all areas of life; in particular, new educational opportunities are emerging. The development of effective techniques with the use of information technologies in education becomes relevant. At the higher education level, the requirements for the professional training of specialists, the process of forming personal skills change. So, the purposes of informatization of education, which are in rationalizing of intellectual activity through the use of information technologies, increasing of the efficiency and quality of training of specialists, become more important. The main directions and tasks of modernization of education and specialists' training, in particular, pedagogical specialties, include teaching students the use of information and communication technologies in the educational process and the development and implementation of modern models of practical training of students in the university. The article deals with the possibility and expediency of pedagogical software use in "Analytical Geometry" course for future Mathematics teachers in the universities. Practical realization of pedagogical software "Analytical Geometry" use, designed by the developers of Kherson State University, Ukraine is presented.

Key words: *Analytical Geometry, pedagogical software, informational computer technologies (ICT), innovative learning environment, higher education institution (HEI).*

Introduction. The use of new information technologies in education is an important part of modern society informatization. This process develops the preconditions for the widespread use of computer technologies in teaching process. Nowadays, some higher education institutions, such as pedagogical universities, are attempting to involve a personal computer in traditional Mathematics teacher learning system. Despite the interest of researchers in the modernization of teaching, the problem of informational computer technologies (ICT) integration into the vocational education system of future Mathematics teachers needs more attention. ICT in the professional learning of Mathematics students are not used enough; and observation of educational practice shows that, despite the needs of modern society for a more active use of innovative technologies for educational purposes and the relevant recommendations of the Ministry of Education and Science of Ukraine, only certain Mathematics teachers are expedient and effective in ICT using in their professional activity. Therefore, it is important to find and study pedagogically meaningful methodological ways of improving the educational, methodological and informational and educational support of professional learning of future Mathematics teachers using ICT.

The main purpose of the article is to consider the problem of ICT using in Geometric study

of future Mathematics teachers on the example of software "Integrated learning environment "Analytical geometry"". It corresponds to course's curriculum and contains sets of program modules that form a teacher's and students' workplaces. This architecture enables the teacher to teach effectively in a computer classroom with a local or global network.

Related Works. One of the educational tendencies is the guidelines' implementation of the Ministry of Education and Science of Ukraine to develop an innovative learning environment in educational institutions. It is important to modernize the educational services, ensure their quality, and improve the level of educational and methodological support in competent professional training. In particular, the "National Strategy of Education Development in Ukraine for Period up to 2021" defines the strategic directions of state education policy: modernization of the structure, content and organization of education on the basis of a competent approach; improving of the education quality on an innovative basis; improving library and informational support of education and science, etc.

The priority of development of education is modern information and communication technologies introduction that ensure the educational process improvement, accessibility and effectiveness of education, preparation of the young generation for life in the information society [1, p. 7].

In accordance with educational trends in higher education institutions, students should acquire general and professional competences. Among the key competences, adopted by the Council of Europe, are the following:

– connected with deepening of society informatization;

– information technologies mastering;

– understanding of ICT usage in learning process.

UNESCO offers a list of skills of teachers, depending on the approach to education system reforming for each of the following six components of the education system: policies and concepts, programs and assessment, pedagogy, ICT, organization and administration, teacher training [2, p. 8]. In this process, the ICT competency of teacher and students is very important, as its obtaining is a prerequisite for effective educational activity in prospective higher education institutions (HEI). One of the advantages of ICT using is the introducing of new opportunities in the educational process organization. It affirms the current level of teacher's pedagogical activity, but there is a correlation between the integration of methods, ICT in traditional teaching methods and increasing of learning motivation and education quality. In order the professional-pedagogical activity of future Mathematics teachers will be on a new high level, it is necessary to train them using the electronic educational resources in Mathematics.

Harmonious combination of fundamental principles of traditional teaching and modern information technologies opens the wide opportunities for qualitative restructuring of the principles and methods of classical mathematical disciplines teaching, including Analytical Geometry. It is made by the effective use of the benefits of computerized tasks and teaching methods. So, the main motives of computer technologies use in "Analytical Geometry" course are: computer methods have recently been increasingly used in Geometry; ICT use in Geometry in Mathematics teacher's study can significantly improve the learning material quality, and it will facilitate ICT using in school Geometry course.

The introduction of pedagogical software (PS) in "Analytical Geometry" contributes to the basic didactic principles implementation, such as the principle of linking theory with practice, systematic character and consistency, continuity of learning, stimulation and motivation, awareness and activity, professional orientation. Educational software has wide possibilities in "Analytical Geometry" teaching, including mathematical concepts, and a wide variety of methods for solving common mathematical, psychological, pedagogical and didactic problems. These tools provide high-quality capabilities to display information on the screen, work in different modes (text, graphic), perform analytical and numerical calculations, and connect additional tools to expand the tasks. That is why the use of pedagogical software in "Analytical Geometry" teaching in combination with classical methods contributes to the qualitative implementation of the basic didactics principles and learning goals [4, p. 14].

However, computer educational software is not always organically integrated with the traditional methodical system of Geometric study of future Mathematics teachers. It is due to the insufficient number of equipped classrooms, and the lack of a methodological system of Geometric study of students of mathematical faculties of universities. So, there are contradictions between the wide usage of computer technologies and the lack of its usage in Geometric courses taught in higher education institutions; between the potentially high didactic capacity of informatization as a means of improving of Geometry learning effectiveness and existing teaching practice which does not take full advantages of these opportunities; between the existing tendencies of pedagogical software development in Geometry, textbooks, computer-oriented methods of specific topics studying, and the lack of a methodological system of Geometric study based on ICT. These contradictions determine the direction of research of theoretical and methodological foundations

of Geometric study of future Mathematics teachers on the ICT basis, which is one of the leading issues of modern education informatization.

Analytical Geometry Learning of Future Mathematics Teachers Using Pedagogical Software. Geometry is very important in the mathematical learning of future Mathematics teachers. The "Analytical Geometry" course should give the scientific ideas and methods of analytical geometry, its place among other mathematical disciplines; promote the mastering of knowledge and skills that enable students to get a qualitative education. In order to eliminate formalism in students' knowledge, lack of skills, the course features should be considered. Thus, the determining factor for the discipline is the method of learning, as well as the need to operate a variety of character and symbolic tools. In addition, there are different approaches to course's structuring, and its basic concepts defining. For better educational material mastering, teacher should form system. Only systemic knowledge allows showing flexibility, critical thinking, ability to evaluate new facts, new ideas, learn a certain Geometric object from different points of view.

It is known the system knowledge comprehended by the student as a non-linear knowledge grouping obtains a compact, expanded form in the completed form. It is revealed that the "Analytical Geometry" knowledge can acquire the qualities of the system if the following are formed: theory structure knowledge, types of connections between its elements; generalized special subject skills; abilities to construct a systematic presentation of material according to a certain scheme; abilities to develop different patterns of presentation. The criteria and levels of students' systematic knowledge formation in "Analytical Geometry" course are distinguished: the first level is a factual systematic system, the second level is a local systematic system, and the third level is a methodological systematic system. There are three main stages of the system knowledge formation in "Analytical Geometry" course. At the first stage, the elements of system knowledge within the educational topic are formed, in the second stage – system knowledge within the content module, and in the third – system knowledge within the "Analytical Geometry" course.

The main peculiarity of educational modern system is the clear structuring of learning content. At content constructing of the "Analytical Geometry" course, the following conditions of integration of components of discipline's educational topics should be taken into account: the research objects should be connected; the same research methods should be used at teaching the main topics of the discipline; the study should be based on general theoretical concepts. Learning objectives that provide the formation of necessary knowledge of future Mathematics teachers should be defined at the beginning of each module.

During the course, students develop the specific skills necessary for further professional activities: the ability to think correctly and clearly, to achieve the full value of reasoning, logical thinking, clarity of mathematical reasoning and the ability to make logical and methodological analysis. The modular program of the "Analytical Geometry" course is designed so that the content of module's educational material ensures the didactic goal's achievement. Each module contains components of educational elements. The specific goals of modules provide a clear presentation of final result, the content learning formation, ensuring the mastering of knowledge and skills, as well as feedback. The components of each module are separated and interconnected.

The content or educational module is a part of the course; it has independent significance and contains several similar topics or sections. Each module is distinguished by a set of theoretical and practical tasks of the content, and control forms. At educational module the mastering of material is in the active independent activity. Therefore, in order to ensure the purposeful and organizational independent work of students, it is necessary to carry out the appropriate final classes, tests, etc.

So, it should be noted in the structure of each module there are three main components: theoretical, practical and control-assessed. The theoretical part is directly determined by the content of the lectures, the practical part - by carrying out the practical and advisory classes provided by the curriculum, and the control-assessed includes control of the input, current and final knowledge. The curriculum considers the correspondence of the content and amount of components of the educational material to the relevant plans and discipline's work programs, selected concepts fundamentality, their importance for further professional activity, cross-curricular links in the structure of discipline, availability of educational material for students within the study of one topic. The main attention should be paid to the subject skills formation. It is directly related to students' Geometric skills acquisition, their classification, location and role in Geometry study.

The main purpose of the pedagogical software "Analytical Geometry" is to reveal the theoretical foundations of modern Analytical Geometry on the basis of the unified system of all theoretical and practical material, to form practical skills necessary for analysis, research and the applied problems solving, to assist the teacher in the differentiated approach implementation, to promote more complete and deeper educational material mastering by students. Learning the course using pedagogical software, students master the following knowledge: basic definitions, theorems and practical usage;

basic mathematical methods for solving problems in “Analytical Geometry” course; proof of the important theorems on which the mathematical methods are based.

Traditional learning forms are lectures and practical classes. There is a workplace depending on user’s category to organize the appropriate learning form in pedagogical software. It is determined by the previous personalization procedure after launching the program. According to the category, there is the transition to the workplace of the lecturer or teacher, depending on the type of lesson (lecture or practical) or to student’s workplace. The workplace of each category of users contains the following modules-components: textbook, arithmetic, base notes, analytical tasks, lectures. The shift to the corresponding module is in the main workplace’s window.

Base notes are slides of the brief theoretical information on relevant course issues. There are such base notes: the coordinate method, the line equation, the second order lines, the second order line classification, the lines equation in polar coordinates, the elements of vector algebra, the line equation on plane in space, and the second order surfaces. The method of step-by-step explanation with the ability to go back and go to the current step was chosen as the basis for teaching the material. The lecturer has the possibility to control over the theoretical material teaching and, if necessary, to return to certain aspects that were not well understood by students. In addition, depending on the educational goal, the developed notes are classified by types: note-definition, note-algorithm for solving the problem, note-example of the simplest analytical problem usage, note-graphical construction. The combination of types of notes in the theoretical question teaching gives possibility not only to deepen the teaching material understanding, but also to visualize theoretical geometric concepts. The base note fragment is shown in Fig. 1.

The online textbook contains “Analytical Geometry” educational material; it is relevant to the curriculum. The textbook material is presented in several sections; each one has titles and numbers and contains several paragraphs. The paragraphs also have names and numbers. Thus, the theoretical information for each question is organized in a structure that allows navigating and searching for necessary theoretical question using the software navigation options. The fragment of the textbook is shown in Fig. 2.

Let’s consider the methodological aspects of pedagogical software “Analytical Geometry” use in conducting lectures for future mathematicians. The main didactic purpose of the lecture is to provide an oriented basis for further educational material. Lecture is the leading, main learning form. Lecture is an indispensable learning form because it does not repeat the textbook, but complements it with the latest science data, life facts, personal understanding and attitude towards taught material.

Information computer technologies, in combination with traditional forms of conducting lectures, change the volume, content and information transfer methods qualitatively modify the learning process. The ICT use increases students’ interest, develops creative thinking, forms the integral attitude to information skills, education and self-education. The computer is an electronic mediator between the lecturer

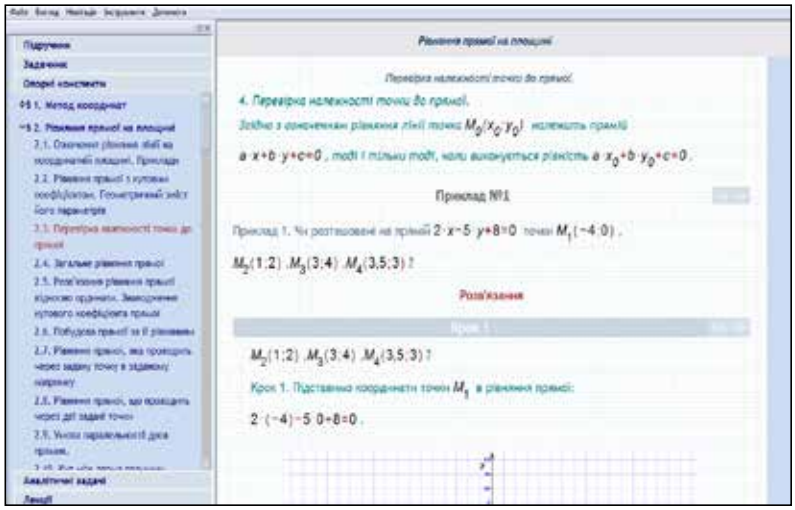

Fig. 1. Base note fragment “Line equation on plane”

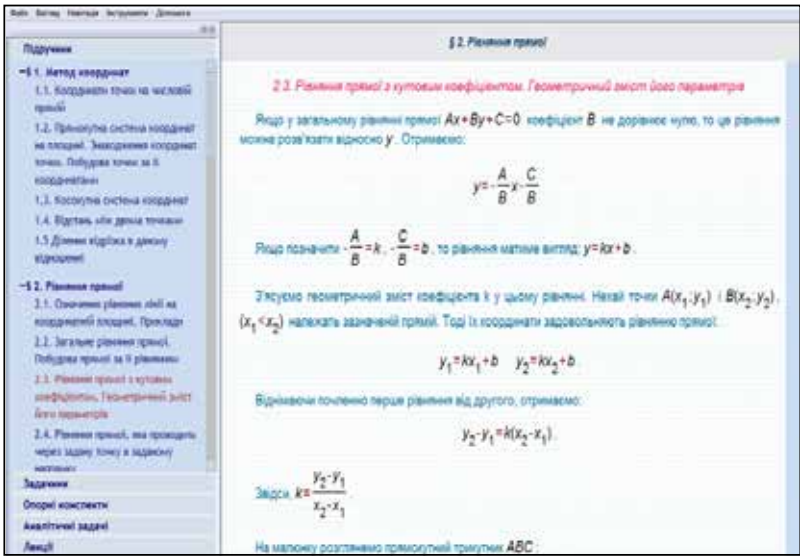

Fig. 2. Fragment of the textbook “Line Equation”

and the students, makes the learning process more vivid and visual, and also allows the teacher to free from a series of routine activities of recording material, practicing elementary skills, knowledge testing. In addition, the ICT use allows students to study educational material in different ways: the student decides how to study the material, how to use interactive opportunities, how to work collaboratively with others. Thus, students can influence the learning process by adjusting it according to their individual abilities and preferences.

The developing of the lecture is complex work; it requires the teacher's patience, perseverance, creativity and excellent knowledge of the material. To develop a successful lecture the teacher should follow the certain rules and design the lecture consistently, step by step. Teacher should choose a topic and define the purpose of the presentation, then compile the bibliography and select literature, construct a lecture's plan and text, work on the form of presentation. At the lecture, it is especially important to make psychological contact with the audience, capture students' attention and thinking.

However, there are some weaknesses in the lecture that limit its ability to manage students' cognitive activity: relatively less student activity than in other learning forms, the inability of individual approach in the audience, feedback complexity etc... However, these weaknesses are offset by other learning forms. In the integral system of learning forms and teaching methods lectures play the most important role that can be realized only by this learning form. The lecture has a profound educational influence on the students in terms of content and personal communication of lecturer and students.

Let's examine the possibilities of pedagogical software "Analytical Geometry" use in teaching a lecture course. The scheme of using it is based on two important principles -modularity and interconnection. Modularity means the learning system consists of individual blocks, which are subdivided into components and they are part of the general block. These blocks have a clear structure, isolated from each other, but at the same time are interconnected. The main purpose of the construction is to provide opportunities for common system development that can be improved and supplemented. So, adding new elements to an assembled structure is simple and organic, without further functioning blocks modifying. It allows the system to function as a whole, using any system resource during operation. It allows to realize opportunities that are unattainable in traditional forms of educational process construction, and also to orient students for ICT use.

To construct a lecture on the relevant topic of the course, the use of the modules "Library of Base Notes", "Library of Analytical Tasks" and "Library of Lectures" are considered.

There is demonstrates slides collection of mathematical concepts provided by the course's curriculum, examples illustrating these concepts, formulations and step-by-step algorithms for problems solving, graphical illustrations. Each base notes contains only the necessary minimum of textual material, but with the help of the hypertext principle, which is carried out through the content field or through the commands of "Navigation" menu. Theoretical material of the lecture can be logically and consistently presented, considering gradually the concepts and properties and returning to the relevant section of the lecture. The hypertext offers certain advantages to the information transfer process, which include the ability to navigate databases, use a search strategy, and intellectual activity support. The hypertext provides prompt about the connections of each aspect or concept. It provides easier access to information arrays. In addition, the educational hypertext-based material is easy to read and has a positive effect on memorizing information, develops a clear understanding of the studied material structure.

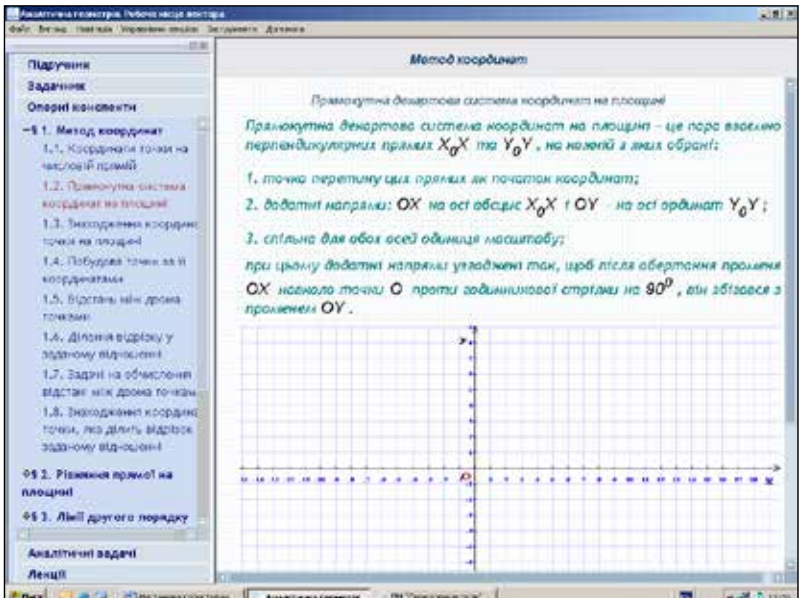

Fig. 3. Base note-definition

The library of base notes contains about 180 demonstration slides that can be classified by the content: note-definition; note-algorithm for problem solving; note-example of the simplest analytical problem usage; note-graphical construction. The example of base note-definition is presented in Fig. 3.

The module "Library of Analytical Tasks" is a complement to the previous module "Library of Base Notes".

The library is formed by a lecturer using the module “Solution Environment”. It enables the lecturer to formulate, solve, and save a typical task and then include it in the lecture’s content. The “Library of Lectures” module contains a list of lectures formed by lecturer. The lecturer uses demo slides from the previous two modules as a component of each lecture. The operation of content forming of a new lecture is carried out with the help of the command “Add to the lecture”. The selected base note or analytical task is added to the lecture’s content (the example of lecture’s forming and demonstrating is shown in Fig. 4).

Thus, each lecture consists of several base notes and analytical tasks, selected by the lecturer; it ensures the individuality of theoretical material. In addition, the sequence of formed lectures determines the structure of topics of the “Analytical Geometry” course, i.e. the learning process using pedagogical software is personalized depending on the lecturer. In order to develop the author’s sequence of teaching, it is necessary to plan the thematic distribution of educational material and design a structure of lectures in the logical sequence according to the plan.

Development, correction, formation of the lecture’s content is carried out using main menu commands of the “Lecturer’s Workplace” module. Thus, with the help of the commands “New lecture”, “Save lecture”, “Print”, “Preview”, “Lecture” the creation, saving, print, viewing of the content structure, editing of theoretical material is being made. In addition, the commands of “Lecture Management” menu allow it to be conducted in three demonstration modes: group, individual, and mixed. Group mode is for lecturing from the teacher’s workplace. In this mode, the lecturer explains the new material, demonstrating the notes (educational materials). Students listen to the lecture and watch synchronized materials. The individual mode is intended for students to learn independently educational materials at their workplaces. Mixed mode is for a lecture with a group of students.

However, the lectures are designed to be used in the class equipped with a local area network (LAN). There is no possibility to transfer a separate lecture or lectures library to a student’s home computer in this pedagogical software version. Students have the opportunity to use a textbook and a library of base notes at home to consolidate the theoretical material of the lecture, didactic materials of arithmetic at home practical tasks.

The module “Arithmetic” is used for organizing practical classes and independent work of students at home. It is designed to store tasks, which can be solved either orally or in a solution environment. The tasks are grouped into several sections with titles and numbers. The sections contain tasks to solve on practical works, self-study, or exams. Tasks can be divided into two groups - tasks with a given mathematical model and tasks with mathematical model constructed by the user. The practical tasks have the basic tasks in “Analytical Geometry” and provide a transition from the students’ self-cognitive activity to the qualitative mastering of educational material, increase and realize the activity and independence. Tasks are solved with the help of the solution environment and the module “Handbook”; it contains mathematical models of the basic typical tasks in the “Analytical Geometry” course.

The available list of tasks fully corresponds to the course’s curriculum for future Mathematics teachers and provides the opportunity to work out the skills of solving basic tasks in Analytical Geometry on practical classes and independent work of students outside the classroom.

Conclusions and Perspectives. The ICT implementation in the life can not affect the development of new foundations in educational activities. The ICT use in educational process organization, in particular, at conducting lectures and practical classes, allows to overcome the main shortcomings of the traditional educational system (integration of students’ individual characteristics, learning passivity, focus on memorization, but not on understanding of educational material), as well as intensify presentation of the material and its perception through the use of different types of information and perception channels. At using of pedagogical software in geometric problems solving, knowledge of general scientific methods of cognition and research is formed; the ability to interpret and analyze the results independently increases; cognitive abilities developing through the conscious

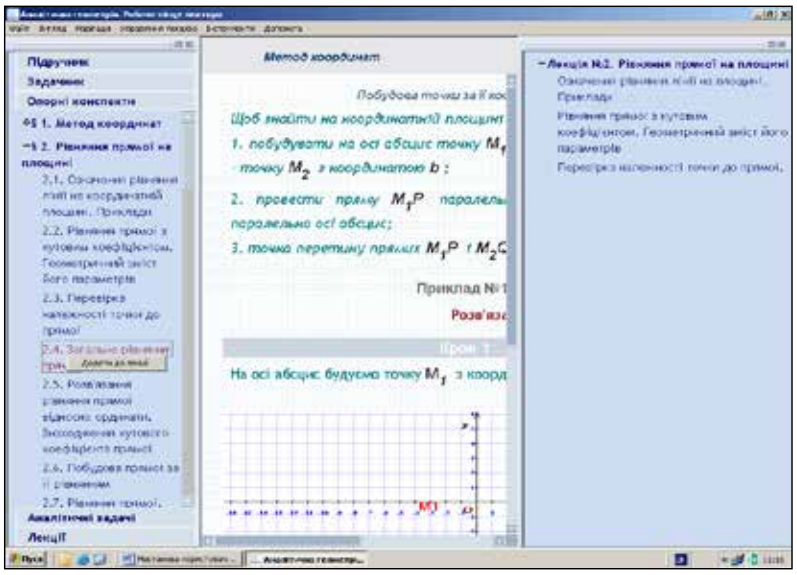

Fig. 4. Lecture’s forming and demonstrating from “Library of Lectures”

use of cross-curricular communication; new material is assimilated; a knowledge system is formed in the minds of students, it ensures the system principle realization. Increased students' interest in information technologies, the ability to self-manage software options stimulates cognitive interest and forms a positive attitude to the learning process. The geometric concepts visualization implements the principle of visualization, reveals links between the theoretical concepts and the geometric interpretation. Students develop qualitatively new professionally skills needed for successful professional teacher's activity.

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Котова О. В., Гнєдкова О. О., Григор'єва В. Б. Можливість застосування педагогічних програмних засобів у процесі підготовки майбутніх вчителів математики

Сучасний навчальний процес у вузі характеризується високою інтенсивністю. З кожним роком зростає загальний обсяг та складність навчального матеріалу, що повинен засвоїти випускник. Особливо це стосується вивчення фундаментальних дисциплін під час підготовки фахівців, зокрема, майбутніх вчителів математики. Підвищення якості математичної освіти може бути досягнуто шляхом застосування нових форм та методів організації навчання, структуризації матеріалу, серед яких певне місце займають педагогічні програмні засоби, які поєднують у собі особливості підручника, довідника, задачника та лабораторного практикуму та звільняють навчальний процес від громіздких розрахунків, дозволяють як викладачу, так і студенту, сконцентрувати основні зусилля на постановці задачі, виборі методів її розв'язування та інтерпретації результатів розв'язання. Геометрія виступає однією з провідних дисциплін предметного блоку, що передбачені державним освітнім стандартом вищої освіти. Результат геометричної підготовки майбутнього вчителя математики повинен відповідати обов'язковому мінімуму змісту професійної освітньої програми, відповідати вимогам рівня підготовки випускників. Стрімкий розвиток інформаційних технологій привносить зміни в усі галузі життя, зокрема, з'являються і нові можливості в освіті. Актуальності набуває розробка ефективних методик із застосуванням інформаційних технологій у навчанні. На рівні вищої освіти змінюються вимоги до професійної підготовки спеціалістів, до процесу формування вмінь та навичок особистості. З огляду на ці зміни набувають значення цілі інформатизації освіти, які полягають у раціоналізації інтелектуальної діяльності шляхом використання інформаційних технологій, підвищенні ефективності та якості підготовки спеціалістів. І до основних напрямів та задач модернізації освіти та підготовки фахівців, зокрема педагогічних спеціальностей, належать навчання студентів використанню інформаційних та комунікаційних технологій в освітньому процесі та розробка і впровадження в процес викладання у вузі сучасних моделей практичної підготовки студентів. У статті розглядається можливість та доцільність використання педагогічних програмних засобів під час викладання курсу аналітичної геометрії майбутнім вчителям математики у вищих навчальних закладах на прикладі педагогічного програмного засобу «Аналітична геометрія», розробленого колективом науково-дослідного інституту інформаційних технологій Херсонського державного університету.

Ключові слова: *математична підготовка майбутніх вчителів математики, аналітична геометрія, педагогічний програмний засіб.*