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METHODOLOGY OF USING COMPUTER EXPERTISE IN THE PROCESS OF TEACHING GEOMETRY IN THE CONTEXT OF DIGITALIZATION OF EDUCATION

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Abstract. The article deals with the problems of teaching Geometry in the context of digitalization of education. Technological tools such as computers are used in teaching, learning, and assessment practices in Geometry.

This study examined integration of some aspects of the computer technology in teaching and learning Geometry. For this purpose, development of a methodology for the application of the programme "The Geometer's Sketchpad", a computer textbook using computer programs (KPUN), demonstration programs at various stages of geometry school education are considered. In addition, the course "Computer learning of geometry in secondary school" was created for students of mathematical faculties of pedagogical universities.

In the research the method of comparative analysis, the system method, the method of categorization and functional-stylistic analysis of media texts, the method of content analysis and an experiment were applied.

The findings of this research demonstrate that using computerization as a basis for changing activities significantly affects students' achievements. It also revealed the pedagogical potentials and limitations of the computer technology in teaching and learning of Geometry. The possibilities of computer training were used in overcoming students' difficulties caused by incorrect or incomplete understanding of the content of the geometric concept; insufficient mastery of mathematical terminology.

Key words: methodology, computer, expertise, teaching, geometry, digitalization, education, automated learning systems

Introduction

The massive introduction of computer technologies in recent years into all spheres of human activity, due to the emergence of a new generation of personal computers with qualitatively new computing and logical capabilities, a perfect interface, the development on this basis of computer learning technologies and the expansion of didactic computer capabilities create prerequisites for a radical change in the learning process using computer technology.

In this regard, it becomes relevant to revise the presentation and determine the role and place of computer technology in the learning process in general, and in school education in particular.

Of particular practical interest is the definition of the role and place of computer technology in teaching geometry due to the fact that the use of computer technology in teaching geometry can not only increase the effectiveness of learning through visual presentation of information that has a positive impact on the

formation and development of flexible geometric thinking (Sh.Zh. Asylbekov, E.V. Baranova, V.V. Gu-zeev, V.A. Dalinger, N.V. Rozov, S.N. Pozdnyakov, A.M. Savin, S.A. Titorenko, I.F. Sharygin, etc.), but also creates an idea of professional activity related to design, designing and other processing of visual information in professionally oriented automated workplaces.

Analysis of existing computer programs for educational purposes in geometry has shown that instrumental geometry-oriented environments, such as Cabri, The Geometry's Sketchpad, have a significant advantage over traditional dialog-training or demonstration programs. Domain-oriented environments allow you to operate with geometric objects of a certain class, implement geometric constructions and transformations. The advantage of using them is that the teacher can independently create on their basis a system of tasks and demonstration materials corresponding to the goals and objectives of a particular lesson. However, the use of subject-oriented environments in the process of learning geometry requires the development of methodological support and training for their use of specialists.

Basic provisions

Important for the modern period of digitalization of education is the awareness of the fact that the use of computer technologies will make the learning process more effective if they are used as a tool of cognition rather than knowledge transfer.

This study considers the didactic possibilities of digital tools and the specifics of improving the process of teaching geometry in modern conditions. Today, many different training programs have been created.

The computer can be used at a variety of stages in geometry instruction, and this application is based primarily on its graphical and computational capabilities. When solving the problem of using a computer in the process of teaching geometry, one should proceed not so much from the functionality of the computer and the desire to use it in the educational process, but from the methodological system of teaching geometry, the analysis of which should show which educational tasks can be solved only by means of a computer, because other didactic means are less effective or not applicable at all [1].

In geometry, the computer acts as an effective means for visually illustrating concepts and demonstrating drawings. The computer's ability to represent the dynamics of graphical images changes the nature of geometry teaching like no other: geometric shapes can be described using procedures, not just equations.

The computer can play the role of a means of active dialogue in students' work with models of geometric figures, their developments, a means of developing students' constructive skills, which are one of the types of polytechnic skills. The computer is an effective means of developing graphic design skills in schoolchildren. The computer is of great importance in teaching theorem proving.

Materials and methods

The scientific methods in the research are studying methodological and educational literature, observing the activities of students in the educational process, systematizing and summarizing scientific facts, processing the results of this work,

modeling the use of modern the computer technology in teaching Geometry, setting up and conducting a pedagogical experiment.

The research is based on an interdisciplinary approach synthesizing knowledge of journalism, communication theory, psycholinguistics, cognitive linguistics, linguoculturology, social philosophy.

Thus, the need to revise the content of computer-based geometry teaching taking into account the results of psychological and pedagogical research, the expansion of the didactic capabilities of the computer and the problem of training specialists to use modern computer technologies in school education determined the relevance of the research topic "Methodology for implementing computer-based geometry teaching in secondary school".

The purpose of the study: to determine the principles and methods of integrating computer technologies into geometry teaching and to develop on this basis a methodology for their implementation in the educational process [2].

The object of the study is the process of teaching geometry using computer learning technologies.

The subject of the study is the preparation of specialists for the implementation of computer-based geometry training.

The hypothesis of the study: the study by students of the Faculty of Mathematics of pedagogical universities of the didactic possibilities of a computer in teaching geometry, the psychological and pedagogical foundations of computer learning, the foundations of the design and application of learning software ensures the formation of their level of knowledge and skills, sufficient accurate for the effective use of computer technology in the process of teaching geometry at school.

The objective of the study is to determine the role and place of computer technology in teaching geometry, which includes a number of particular tasks:

1) development and research of the principles of integration of computer technologies into the process of teaching geometry, taking into account modern didactic capabilities of the computer, psychological and didactic requirements for computer training;

2)research of methodological possibilities of computer programs for educational purposes in geometry and development of recommendations for their use in the process of studying a school geometry course;

3) development of a methodology for the application of the subject-oriented instrumental environment “The Geometer's Sketchpad” at various stages of geometry school education;

4) definition of requirements for the level of teacher training for the implementation of computer training and development of methods for the preparation of teachers of mathematics and computer science for the implementation of computer training;

5) development of the course "Computer learning of geometry in secondary school" in the framework of the subject "New information technologies in education" for students of mathematical faculties of pedagogical universities;

6) development of principles for designing computer programs for educational purposes in geometry and an open computer subject-oriented environment in geometry that implements these principles;

7) experimental verification of the effectiveness of the developed techniques.

"Computerization is the introduction of computers into a certain area of activity, accompanied by a noticeable restructuring of this activity under the influence of a computer." (Bokhove, C. 2011). Computerization of education was considered as the first step towards informatization - building an information society. "Informatization as an information process is reduced to the presentation of all socially significant information in a form accessible for storage, processing and transmission by electronic and technical means [3].

In modern conditions, when the computer has become an indispensable attribute of many professions, the formation of computer literacy is no less important than mastering the basics of computer science. Young people, after graduating from school, should have sufficient knowledge and skills to use computer technology in their future activities. The formation of computer technology user skills in all students, regardless of the level and profile of education, is one of the most important tasks of computerization of education.

The problem of preparing the young generation for life in the information world has become relevant for all culturally developed countries. This problem was put up for discussion by a special commission of UNESCO of the International Association for Informatics back in 1981 and was repeatedly discussed in subsequent years, taking on all new aspects. Currently, the world practice of teaching the basics of computer literacy and learning using computers has various approaches to solving this issue. The differences concern both the content of computer education and the forms of its introduction into school. The content of knowledge and skills, as well as educational tasks related to computer work, are determined in each country, taking into account their own characteristics, in accordance with the requirements for a future specialist or use [4].

The peculiarity of computerization of education in our country is the inclusion of the basics of computer science and computer technology in the system of school disciplines as a separate academic subject. This decision was dictated by the requirement to organize universal computer education in our country, teaching the basics of computer literacy to all students receiving secondary education. The works of A.P. Ershov, V.M. Monakhov, V.G. Zhitomirsky and others were devoted to the selection of content and the development of a general concept of teaching computer science. It should be noted that the main directions in teaching the course of the basics of computer science and computer technology, in the selection of the content and forms of classes, initially focused on the "machine-less" version of training, therefore, the formation of the basic concepts of computer science and the theoretical foundations of computer use was a priority. Thus, the greatest attention was paid to the consideration of algorithmization and programming issues, familiarity with computer architecture, applied aspects were given much less attention. It was not so much the skills of using a computer to solve practical problems (working with text

and graphics, modeling, etc.) that were formed, as the ideas about the possibility of using a computer for these purposes [5].

Results

One of the types of computer programs for educational purposes (KPUN) is a computer textbook - a software and methodological complex that provides an opportunity to independently master a training course or its large section. KU combines the properties of an ordinary textbook, a reference book, a task book and a laboratory workshop. According to the catalog, software products representing a computer textbook make up the vast majority of software for teaching mathematics developed and registered in Russia. Programs of this kind include: "Study of the behavior of functions", "TEST", "Symmetry», "Functions and their graphs", "Matservice - 5, "Matservice-6", "Mathematics-6", "Functions", "Geometry-7", "Quadratic Equations". There are also foreign developments of this kind on the computer software market. An example of computer textbooks for a geometry course can be "Geometry" and "Mathematics Algebra & Geometry".Computer training systems on geometry of this kind have the following structure [6,7].

Theory Mode is an easy-to-use reference system containing basic definitions, properties of geometric objects, statements and theorems of the training course. Examples and illustrations mode. Any mathematical discipline needs to involve geometric images of mathematical abstractions. Many mathematical statements become clearer, easier and better remembered and assimilated if they receive a graphical interpretation. This mode is the primary stage of training.

Simulator mode. This is the next stage of training. It corresponds to the stage of the simplest questions and exercises, which, as a rule, are accompanied by sections of traditional textbooks.

Task mode. This mode allows the student to solve meaningful tasks independently.

Question mode. This mode implements the final control of the quality of assimilation, as a result of its passage, the level of mastery of the educational material should be revealed.

The role of each element of a specific training computer system depends on its specific goals. For example, in an electronic task book, there may be no theory mode and the mode of examples and illustrations, in geometry control programs, only the mode of questions or tasks may be contained.

The subject-oriented environment (POS) is a new and promising direction in the field of creating software products for training. PIC is a training software package that allows you to operate with objects of a certain class. The environment implements relations between objects, operations on objects and relations corresponding to their definition, and also provides a visual representation of objects and their properties. Examples of subject-oriented environments in geometry can be the programs SAGU and The Geometry's Sketchpad (GSP).

The methodological possibilities of subject-oriented environments in teaching geometry are much wider than computer textbooks or demonstration programs. The main advantage is the possibility of using the tools of a domain-oriented

environment for creating demonstrations, geometric design, and conducting research [8,9].

The idea of creating software that enables teachers and students to use a computer not only as a tool, but also as a teaching tool belongs to programmers from the Center for the Development of Education (The National Assessment of Education Progress) J. Schwartz and M. Yerushalmi, who implemented it in 1985. The Geometric Supposers program they created for Apple computers allowed students to discover geometry on their own by examining drawings and formulating mathematical statements. The study of geometry with this approach is complemented by a series of completed studies of the properties of the figure, the relationships of the elements, while knowledge of the proofs is still mandatory.

Discussion

When starting the experiment, we set ourselves the following goals:

1) to study the state of the problem under consideration in the practice of the school;

2) to correct and implement the developed methodology of GSP application at various stages of geometry training in a systematic course (grade 7-9);

3) to adjust the methodology of teacher training for the use of modern computer technologies in teaching;

4) check the hypothesis put forward.

In accordance with these goals, during the experiment it was necessary to solve the following tasks: 1) choose the method of conducting the experiment;

2) determine the timing of the experiment;

3) conduct an experiment in accordance with the chosen methodology;

4) conduct quantitative processing of the experiment results;

5) to make a qualitative interpretation of the results of the experiment.

The experimental study included ascertaining, searching, training experiments and processing of their results [10,11].

The ascertaining experiment was conducted in schools N 123 in Almaty and in the school of laboratory 597 of the Institute of Productive Learning. The purpose of this experiment was:

1) identification of the main difficulties of students in studying the systematic course of geometry of grades 7 - 9;

2) search for ways to overcome the identified difficulties in studying geometry of grades 7-9, bearing in mind the possibility of using a computer in teaching;

3) determination of the nature and level of computer literacy of teachers, their readiness to use computer technologies in teaching;

4) determination of the nature and level of computer literacy of students of the mathematical faculty of Abai KazNPU, their readiness to implement computer training.

The following methods were used: testing and questionnaires, conversations with teachers.

At this stage, data were obtained that make it possible to find out that the greatest difficulties for students of grades 7-9 in studying geometry are caused by solving proof problems.

Students answered the survey questions to identify opinions on the advisability of using the computer technology in Geometry classes (Table 1). 50 students answered the survey.

Table 1 – The survey on the use of the computer technology in Geometry classes

Survey questions	*Answer options*			
	Strongly agree	*Agree*	*Neither agree nor disagree*	*Disagree*
It is appropriate to use in the classroom the computer technology in learning Geometry.	32	12	6	-
The computer technology is applied timely in Geometry classes.	35	14	1	-
The use of the computer technology is raising the level of mastering the material in Geometry classes.	39	`11	-	-
The use of the computer technology increases emotional background.	35	15	-	-
The use of the computer technology increase motivation in Geometry classes.	38	10	2	-

Students' difficulties are caused by the inability to use deductive reasoning based on the application of theoretical material (definitions, axioms, theorems); incorrect or incomplete understanding of the content of the geometric concept; insufficient mastery of mathematical terminology and mathematical speech. At this stage, the possibilities of computer training in overcoming these difficulties were investigated, as well as the impact of computer training on improving the efficiency of the educational process.

The result of the first stage of the study was the hypothesis about the possibility of using computer technology to form a correct understanding of the introduced geometric concepts, to establish a connection between abstract geometric concepts and visual images and the need to prepare teachers for the use of computer technology in teaching.

The results of the control and experimental groups in order to identify the level of formation of geometric skills are shown in Figure 1.

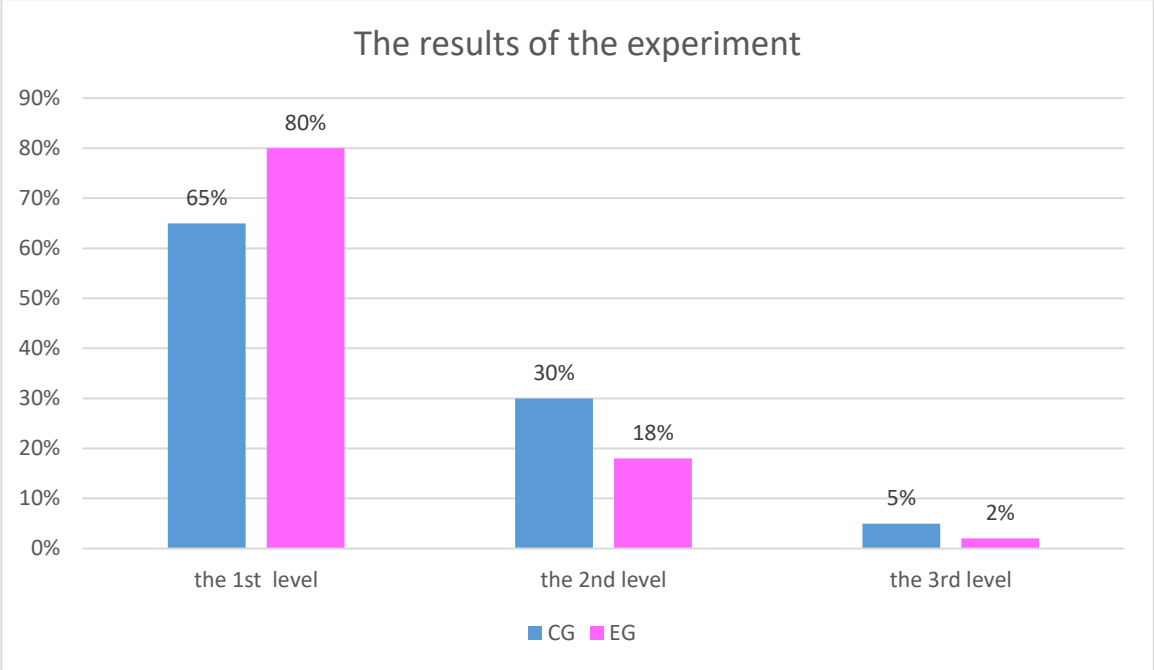

Figure 1 - The results of the experiment

These results allow us to draw a conclusion about the formal assimilation of the theoretical content of the geometry course.

At this stage of the experimental work, it was possible to identify a tendency to increase the motivation for studying geometry in the conditions of computer training, which in turn contributed to the formation and development of experimental and research skills. However, quantitative characteristics of the effectiveness of computer training were not revealed at this stage.

Conclusion

In the course of the study, we used the following methods: analysis of psychological and pedagogical, methodological and educational literature on the problem of research, methods of system analysis, psychological and pedagogical analysis of the educational process and educational and cognitive activity, pedagogical observations, conversations, questioning of teachers and students, organization and conduct of experiments (ascertaining, searching and forming), quantitative processing and qualitative interpretation of experimental data.

The need to equip modern society with new information technologies makes it necessary to informatize education in general and secondary education in particular. Informatization and computerization affect all aspects of the educational process in modern conditions. The concepts of "informatization" and "computerization" are sometimes mistakenly considered synonymous, referring to the fact that a computer is an obligatory means of collecting, processing and storing information. Computerization as a basis for changing activities is indeed a satellite of informatization, but unlike computerization, which consists in the use of computer technology in a particular activity, computerization consists in "identifying

algorithms intrinsic to a certain area and constituting its information side" Computerization is usually understood as the use of computer technology in a particular activity.

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БІЛІМ БЕРУДІ ЦИФРЛАНДЫРУ ЖАҒДАЙЫНДА ГЕОМЕТРИЯНЫ ОҚЫТУ ҮДЕРІСІНДЕ КОМПЬЮТЕРЛІК САРАПТАМАНЫ ҚОЛДАНУ ӘДІСТЕМЕСІ

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Аңдатпа. Мақалада білім беруді цифрландыру жағдайында геометрияны оқыту мәселелері қарастырылған. Геометрия бойынша оқыту, оқу және бағалау тәжірибесінде компьютерлер сияқты технологиялық құралдар қолданылады.

Бұл зерттеу геометрияны оқыту мен оқудағы компьютерлік технологияның кейбір аспектілерін интеграциялауды қарастырды. Осы мақсатта «The Geometer's Sketchpad» бағдарламасын қолдану әдістемесін, компьютерлік бағдарламаларды (KPUN) пайдалана отырып, компьютерлік оқулықты, мектеп геометриясын оқытудың әртүрлі кезеңдерінде демонстрациялық бағдарламаларды әзірлеу қарастырылған. Сонымен қатар, педагогикалық жоғары оқу орындарының математика факультеттерінің студенттері үшін «Орта мектепте геометрияны компьютерлік оқыту» курсы құрылды.

Зерттеуде салыстырмалы талдау әдісі, жүйелік әдіс, медиамәтіндерді санаттау және функционалдық-стилистикалық талдау әдісі, контент-талдау әдісі және эксперимент қолданылды.

Компьютерлік оқытудың әртүрлі аспектілеріне арналған көптеген зерттеулерде компьютер бағдарламаланған оқыту идеяларын жүзеге асыратын автоматтандырылған оқыту жүйесінің (АОЖ) техникалық негізі ретінде қарастырылады. Әртүрлі АОЖ функцияларын орындайтын оқу бағдарламаларын пайдалану тәжірибесі бағдарламаланған оқыту идеялары негізінде компьютерлік оқытуға тән бірқатар кемшіліктерді анықталды: компьютер қарапайым материалды ғана оқытуға мүмкіндік береді; компьютерлік оқыту оқушының бастамасын дамытуға ықпал етпейді; жауапты бекіту арқылы оқыту интеллектуалдық жаттығуларға негізделген оқудан нашар.

Бұл зерттеудің нәтижелері компьютерлендіруді әрекетті өзгерту үшін негіз ретінде пайдалану оқушылардың жетістіктеріне айтарлықтай әсер ететінін көрсетеді. Сондай-ақ геометрияны оқыту мен оқудағы компьютерлік технологияның педагогикалық мүмкіндіктері мен шектеулері ашылды. Оқушылардың геометриялық ұғымның мазмұнын дұрыс немесе толық түсінбеуінен, математикалық терминологияны жеткіліксіз меңгергеннен туындаған қиындықтарды жеңуде компьютерлік оқытудың мүмкіндіктері пайдаланылды.

Тірек сөздер: Әдістеме, компьютер, сараптама, оқыту, геометрия, цифрландыру, білім беру, автоматтандылырған оқыту жүйесі

МЕТОДИКА ИСПОЛЬЗОВАНИЯ КОМПЬЮТЕРНОЙ ЭКСПЕРТИЗЫ В ПРОЦЕССЕ ОБУЧЕНИЯ ГЕОМЕТРИИ В УСЛОВИЯХ ЦИФРОВИЗАЦИИ ОБРАЗОВАНИЯ

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Аннотация. В статье рассматриваются проблемы преподавания геометрии в условиях цифровизации образования. Технологические инструменты, такие как компьютеры, используются в преподавании, обучении и оценивании геометрии.

В этом исследовании изучалась интеграция некоторых аспектов компьютерных технологий в преподавание и изучение геометрии. С этой целью рассмотрена разработка методики применения программы «The Geometer's Sketchpad», компьютерного учебника с использованием компьютерных программ (KPUN), демонстрационных программ на различных этапах школьного обучения геометрии. Кроме того, для студентов математических факультетов педагогических вузов создан курс «Компьютерное обучение геометрии в средней школе».

Во многих исследованиях, посвященных различным аспектам компьютерного обучения, компьютер рассматривается как техническая основа автоматизированной

системы обучения, реализующей идеи программированного обучения. Опыт использования образовательных программ выявил ряд недостатков компьютерного образования: компьютер позволяет преподавать только простой материал; компьютерное обучение не способствует развитию инициативы ученика; обучение посредством подкрепления реакции хуже, чем обучение, основанное на интеллектуальных упражнениях.

В исследовании были применены метод сравнительного анализа, системный метод, метод категоризации и функционально-стилистического анализа медиатекстов, метод контент-анализа и эксперимента.

Результаты данного исследования показывают, что использование компьютеризации как основы изменения деятельности существенно влияет на успеваемость учащихся. Он также выявил педагогический потенциал и ограничения компьютерных технологий в преподавании и изучении геометрии. Возможности компьютерного обучения использовались в преодолении трудностей учащихся, вызванных неверным или неполным пониманием содержания геометрического понятия; недостаточным владением математической терминологией.

Ключевые слова: методология, компьютер, экспертиза, преподавание, геометрия, цифровизация, образования, автоматизированных систем обучения

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