INTEGRATING DIGITAL TECHNOLOGIES INTO THE TEACHING OF THE SCHOOL GEOMETRY COURSE

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Abstract: *This article examines the scientific and methodological foundations of using digital technologies in teaching school geometry. The study analyzes the role of digital educational resources, interactive graphic software, geometry simulators, virtual laboratories, and dynamic geometry environments (GeoGebra, Desmos, Cabri) in developing students' spatial reasoning. The advantages of digital instruction, mechanisms for integrating technology into the learning process, and its impact on learners' logical and creative thinking are scientifically discussed. The effectiveness of digitalizing geometry education is evaluated through contemporary didactic approaches.*

Keywords: *geometry education, digital technologies, spatial reasoning, GeoGebra, dynamic geometry, interactive learning, STEM, visualization, digital pedagogy.*

ИСПОЛЬЗОВАНИЕ ЦИФРОВЫХ ТЕХНОЛОГИЙ В ОБУЧЕНИИ ШКОЛЬНОМУ КУРСУ ГЕОМЕТРИИ

Аннотация: *В данной статье рассматриваются научно-методические основы использования цифровых технологий в процессе преподавания курса школьной геометрии. Анализируются возможности цифровых образовательных ресурсов, интерактивных графических программ, геометрических симуляторов, виртуальных лабораторий и динамических геометрических сред (GeoGebra, Desmos, Cabri) в развитии пространственного мышления учащихся. Выявлены преимущества цифровых технологий, механизмы их интеграции в учебный процесс, а также влияние на развитие логического и творческого мышления школьников. На основе современных дидактических подходов оценивается эффективность цифровизации геометрического образования.*

Ключевые слова: *геометрическое образование, цифровые технологии, пространственное мышление, GeoGebra, динамическая геометрия, интерактивное обучение, STEM, визуализация, цифровая педагогика.*

O‘QUVCHILARGA MAKTAB GEOMETRIYA KURSINI O‘RGATISHDA RAQAMLI TEXNOLOGIYALARGA ASOSLANISH

Annotatsiya: *Ushbu maqolada umumta’lim maktablarida geometriya kursini o‘qitishda raqamli texnologiyalardan foydalanishning ilmiy-metodik asoslari tahlil qilinadi. Raqamli ta’lim resurslari, interaktiv grafik dasturlar, geometriya simulyatorlari, virtual laboratoriyalar va dinamika geometriya muhitlarining (GeoGebra, Desmos, Cabri) o‘quvchi fazoviy tasavvurini shakllantirishdagi roli yoritiladi. Raqamli texnologiyalar orqali o‘qitishning afzalliklari, o‘quv jarayoniga integratsiyalash mexanizmlari, o‘quvchilarning mantiqiy va ijodiy tafakkurini rivojlantirishga ta’siri ilmiy asosda ko‘rib chiqiladi. Shuningdek, zamonaviy didaktik yondashuvlarga tayangan holda geometriya ta’limini raqamlashtirishning samaradorlik ko‘rsatkichlari baholanadi.*

Kalit so‘zlar: *geometriya ta’limi, raqamli texnologiyalar, fazoviy tasavvur, GeoGebra, dinamika geometriyasi, interaktiv ta’lim, STEM, vizualizatsiya, raqamli pedagogika.*

INTRODUCTION

Today, the use of digital technologies in teaching geometry in comprehensive schools is becoming a priority in modern education. Geometry is a science that studies abstract concepts, spatial figures, their properties, and laws. Effective organization of this process allows students to develop their imagination and analyze complex objects through visual interpretation, modeling, and animation. Geometry lessons organized in a digital environment enhance students' cognitive activity, encourage independent research, and create conditions for individualization of the educational process. Therefore, this article examines the methodological foundations for integrating digital technologies into geometry instruction.

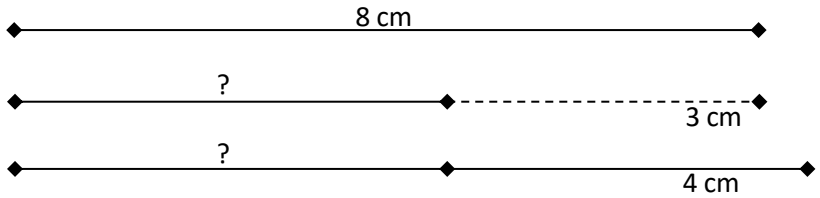
RESEARCH MATERIALS AND METHODOLOGY

Computational problems-problems in geometry include comparison of sections, finding the perimeter of a polygon, finding the edge of a figure, as well as problems with practical content.

When completing tasks involving measuring segments, constructing a segment of a given length, finding the length of a segment that is longer or shorter than a given length, and comparing segments, students must perform arithmetic

13.00.00. – PEDAGOGIKA FANLARI
JOURNAL.NAMSPI.UZ
ISSN: 2992-9008; UDK: 37

operations on the numerical values of the segment lengths. In other words, arithmetic operations are used when solving geometric problems. Consider the following problem: "The length of the first segment is 8 cm, the second segment is 3 cm shorter, and the third segment is 4 cm longer than the second. Find the length of the third segment." Here is a graphical representation of this problem:



Solution:

1. $8 - 3 = 5$ (cm) – length of the second section;

2. $5 + 4 = 9$ (cm) - length of the third section.

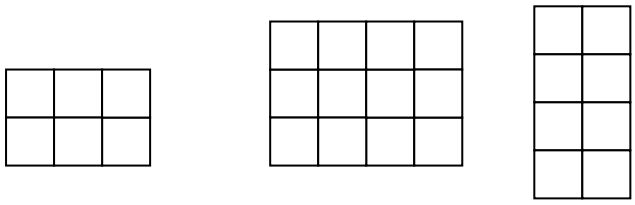
RESEARCH RESULTS AND DISCUSSION

Answer: 9 cm.

Students study the topic "Perimeter" and complete tasks to find the perimeter of polygons, specifically, right-angled quadrilaterals, squares, and triangles. When completing these tasks, students are first asked to draw a geometric figure, such as a triangle, in their notebook. The sides of the drawn figure are measured with a ruler, and its perimeter is found. This reinforces geometric drawing skills, improves measurement skills, and develops counting skills. It should be noted that students use arithmetic operations and their properties to solve geometric computational problems, and also use graphic representations to solve some word-based arithmetic problems. This demonstrates the sequence of learning arithmetic and geometric concepts.

Students will study the topic "Surfaces of Shapes," learning that shapes have surfaces, how they are measured in square units (the unit of surface area is the square centimeter (cm^2)), and the rule for finding the area of a rectangle. They will then complete tasks to calculate the area of a rectangle and a square.

A task of a calculation nature: “Find the perimeter and side of any rectangle.”



In completing this task, the student operates with two types of numbers: units of length and units of area. The student reasoning is as follows: Figure 1 is a rectangle 2 units wide and 3 units high. Its perimeter can be calculated in three ways:

Method 1: (2+3)·2=5·2=10 (unit)

Method 2: 2·2+3·2=4+6=10 (unit)

Method 3: 2+2+3+3=4+6=10 (unit)

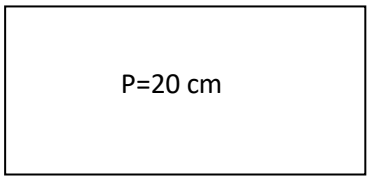
To find the area of the regular quadrilateral in Figure 1, multiply the width (2 units) by the height (3 units). S = 2·3 = 6 (square units).

The perimeter and surface area of the remaining shapes are calculated taking these considerations into account.

It should be noted that geometric computational problems are much more complex. Indeed, modern mathematics textbooks contain a fair number of such problems.

When teaching students to solve computational problems, it's important for teachers to carefully select and implement learning tasks to develop independent thinking and creative inquiry skills. One of the learning tasks for a student is: "Draw two right-angled quadrilaterals with different sides, the sum of the lengths of each equaling 20 cm."

This is a multiple-choice question. To begin, the student first draws a rectangle on a piece of paper and presents the following reasoning.



The sum of the width and height of a rectangle with a perimeter of 20 cm is 10 cm. Thus, the previous task leads to the next one, which will be familiar to the

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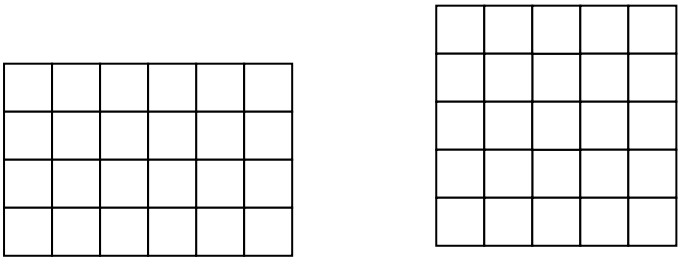
ISSN: 2992-9008; UDK: 37

reader. This is the task outline.□+□=10. That is, you need to find two numbers whose sum is 10. Solution options for this problem:

5 + 5 = 10	7 + 3 = 10	2 + 8 = 10
6 + 4 = 10	3 + 7 = 10	9 + 1 = 10
4 + 6 = 10	8 + 2 = 10	1 + 9 = 10

You can draw a right-angled quadrilateral by choosing any two options. For example, draw a right-angled quadrilateral with sides of 4 cm and 6 cm and a right-angled quadrilateral with sides of 5 cm and 5 cm:



After the rectangles are drawn, they are divided into squares, measuring the area in square centimeters. The teacher, in addition to this task completed by the students, gives the following task, which brings tears to the eyes of the students: "Look carefully at the two figures drawn and say what they have in common and what is different." Such students reason as follows: "Figure 1 has 4 rows of 6 squares each, therefore, in figure 1 $6 \cdot 4 = 24$ (ta) has a square unit (cm²). In form 2 there are 5 rows of squares with 5 in each row, where $5 \cdot 5 = 25$ (ta) has a square unit (cm²). The area of figure 2 is greater than the area of figure 1. The similarity lies in the fact that the sum of the lengths of their sides (the perimeter) is equal to each other, that is, 20 units (cm).

As a result of completing such work on educational assignments, the student develops logical thinking, creative and intellectual activity, and learns to discuss each educational task in detail.

Students learned to solve problems involving calculating the side of a rectangle and how to solve the inverse problem, that is, finding the side of a rectangle and the other side if one side is known, using equation solving methods. In the future, when completing a problem involving calculating the side of a given figure, looking

at the diagram, they will see how to divide figures into rectangles and find a solution to the problem.

Among geometric computational problems, those encountered in real life and practice, in which the student is directly involved, are of great importance. These include problems involving determining the perimeter of a schoolyard or garden; problems involving calculating the area of the floor, ceiling, doors, and windows during a classroom renovation; and problems involving determining paint consumption and the amount of paint needed. Students engage in such problems with interest.

In general, the scope of application of computational problems is extremely broad, and by completing them, students develop their imagination about geometric figures, improve their computational skills, and also increase the possibility of applying educational problems to real problems and finding correct solutions.

CONCLUSION

The findings indicate that the use of digital technologies in geometry lessons significantly strengthens students' spatial thinking, logical reasoning, and visual problem-solving skills. Interactive geometry software simplifies the comprehension of abstract topics and encourages independent and creative thinking. Digital technologies serve as powerful didactic tools that greatly enhance the effectiveness of the teaching–learning process. Further development requires expanding digital resource availability and improving teachers' digital competence.

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