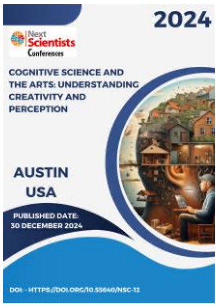

TEACHING THE CONCEPTS OF CIRCLES AND ANGLES IN GALILEAN GEOMETRY

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ABSTRACT

The article provides methodological guidelines for teaching the concepts of circles and angles in Galilean geometry in secondary schools. Methods for increasing students' interest in geometry and consolidating their knowledge using the concepts of circles and angles are presented.

KEYWORDS: Circle, angle, straight line, center of circle, interior angle, Galilean geometry, non-Euclidean geometry.

INTRODUCTION

It should be noted that the definitions of the concepts of "angle" and "circle" are exactly the same in Galilean geometry and in the school geometry textbook. Interestingly, the geometric shape that satisfies the definition of an angle is the same in both geometries. However, the geometric positions of the points that satisfy the definition of a circle are fundamentally different from each other. The reason for this is that the concept of distance is unique in Galilean geometry. Therefore, during the optional exercise, it is necessary to ask students for definitions of concepts and analyze the accuracy of the answers given.

It is necessary to analyze the concept of an angle, its magnitude, and the methods for determining the magnitude of an angle. In this case, it is necessary to analyze the fact that in Euclidean geometry the magnitude of an angle is always finite, while in Galilean geometry the magnitude of an angle is unlimited.

In Galilean geometry, the method for determining the size of any angle should be demonstrated by drawing on the board and using animated diagrams on the electronic board. It is shown that the size of the angle adjacent to a given angle is taken with a negative sign, and that this method follows from the property of the sum of the interior angles of a triangle.

The Main Findings and Results

In Galilean geometry, when a set of points satisfying the definition of a circle is determined, the misconception arises that the points satisfying the second part of the distance are two points lying on a special straight line passing through the center. It is important to note that in this case, it is possible to move to the second part of the distance only if the first part is zero. Therefore, only the first part of the distance formula for a circle is involved, which is definitely not zero, so it does not move to the second part of the distance.

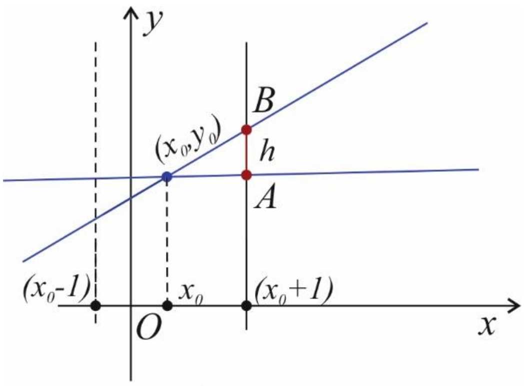
In the cited sources, the angle between two straight lines is given for the case where the straight lines intersect at the origin. However, this equality is also valid if the straight lines intersect at an arbitrary point.

The issue. Two straight lines given by the equation with angular coefficients intersect at the point (x_0, y_0). Calculate the angle between these straight lines.

Solution. Given lines $y = k_1x + l_1$ and $y = k_2x + l_2$ intersect at the point (x_0, y_0). So, $y_0 = k_1x_0 + l_1$ and $y_0 = k_2x_0 + l_2$ will be. We need to calculate the angle between these straight lines. To do this, we draw a circle with center at (x_0, y_0) and radius $r = 1$. It is known that the equation of this circle is $x = x_0 \pm 1$ We find the points of intersection of this circle with the straight line:

$$\begin{cases} y = k_1x + l_1 \\ x = x_0 + 1 \end{cases}, \quad \begin{cases} y = k_2x + l_2 \\ x = x_0 + 1 \end{cases}$$

So, the intersection points from the above are $A(x_0 + 1, k_1(x_0 + 1) + l_1)$ and $B(x_0 + 1, k_2(x_0 + 1) + l_2)$. The distance between these points gives the angle h between the straight lines AB (Figure 1).



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Using the above, we determine the following:

$$h = |k_2(x_0 + 1) + l_2 - (k_1(x_0 + 1) + l_1)| =$$

$$= |k_2 - k_1 + k_2x_0 + l_2 - k_1x_0 - l_1| = |k_2 - k_1|$$

This means that no matter at what point the straight lines intersect, the angle between them is equal to the difference of their slope coefficients.

After showing the method for solving this problem, it will be an interesting problem for students to calculate the interior angles of a triangle, or to solve the following problem, when its vertices $A(x_1, y_1), B(x_2, y_2), C(x_3, y_3)$ are given with their coordinates for an arbitrary triangle:

The issue. Given a triangle with vertices $A(x_1, y_1), B(x_2, y_2), C(x_3, y_3)$. Calculate the interior angles of the triangle and show that $\angle B = \angle A + \angle C$.

This problem and similar problems allow students to test their theoretical knowledge analytically. They also develop problem-solving competencies using a coordinate system on a plane.

It is known from the school mathematics course that in the geometry textbook, students are given a definition of the concept of angle and given examples and problems related to this. However, students are not always taught to apply this knowledge in unusual, unexpected situations. This leads to the fact that the knowledge learned by students is not retained in memory for a long time, and the skills and competence in applying knowledge are not developed. In this case, the following situation can be cited as an example:

Problematic situation. Once students have acquired knowledge about angle size, they will have difficulty solving practical construction problems, such as measuring angles on the ground, and constructing a right rectangle.

In order to solve such problems, it is necessary to develop in students the ability to apply the acquired knowledge in unexpected situations and in solving real-life problems. In this regard, it would be appropriate to teach Galilean geometry to students in optional classes, which we offer.

As we have seen in the above paragraphs, the definition of an angle in Euclidean and Galilean geometries is exactly the same. Only the method of measuring an angle is different in these geometries. Therefore, solving more problems on angle size and angle measurement in optional classes and comparing and reviewing the properties of angles in Euclidean and Galilean geometries will be very useful for students as a way of reinforcing the topic.

The circle of Euclidean geometry is more important to most students than its definition because of the name of this shape. When asked what a circle looks like, most students can draw the shape of a circle without knowing its definition or equation. This leads to some negligence in students' acquisition of knowledge about the definition and equation of a circle. In Galilean geometry, the definition of a circle is accepted as in Euclidean geometry, that is, the definitions given to the circle in these geometries are the same. However, the shape of the circle looks completely different in Galilean geometry. At first, it seems to students to be a very unusual shape, and they accept it with distrust. The reason for this, as mentioned above, is only in the name of the circle.

Galilean geometry is a great way to strengthen students' knowledge of the circle. By comparing and contrasting the common and different aspects of the information about the circle in both geometries, students' knowledge of the circle will be further strengthened.

The most important aspect of this is that by learning the definition of a circle in a geometry lesson at school, and then providing information about the circle in Galilean geometry, and asking students to apply the definition in another unusual situation and draw a new shape of a circle, we can find out how much knowledge students have about the circle. This strengthens students' knowledge of the circle and its elements, develops their imagination, and increases their interest in the subject.

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