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STUDY OF SECOND-ORDER LINES AND SURFACES USING THE GENERAL EQUATION

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Abstract
The role of geometry in the development of students' thinking and their education, as well as in the practical application of the knowledge acquired in mathematics, in the formation of skills and qualifications, is incomparable. The study of geometric objects and the correct visualization are of great importance in the formation of students' mathematical knowledge, skills and abilities at a high level. It is known that the content of the science of geometry is made up of a system of axioms, theorems, definitions and problems, and all of them together form the concepts of the science of geometry. The logical connection between the students' geometric training and their professional pedagogical training is reflected in the acquisition of mathematical knowledge by the future student of mathematics. For this reason, the parameters for determining the student's geometric readiness have been specified. Since lining is of great importance, attention was paid to the subject of second-order lines and surfaces.

Keywords: Second-order lines, characteristic equation, center of a line, invariants of a second-order line, second-order surface, ellipsoid, hyperboloid, paraboloid.

Introduction

In modern conditions, possible pedagogical ideas are the ideas of humanization, humanitarization and democratization, which form the basis of new educational priorities.
Modern teaching experience shows that most children are physiologically and psychologically not ready to perceive geometry in an axiomatic presentation. Many of them do not understand the true purpose of axioms, and to overload a textbook with axioms, as well as cumbersome theorems, so that children memorize without understanding them, means scaring students away from mathematics, destroying their positive curiosity caused by external effects. Of course, in a school geometry course there should be some axioms and theorems, but their presentation should be accessible to all students. Some theorems can be proven, others just need to be formulated and taught to schoolchildren to apply them to solving problems. But the most important thing is that a school geometry course should initially be spatial; its construction should take into account all the pedagogical experience accumulated by humanity over many centuries [3].
The role of geometry is incomparable in the development of students' thinking and in their education, as well as in the formation of the skills and abilities to apply the knowledge acquired in mathematics. The study of geometric objects and the correct visualization are of great

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importance in the formation of students' mathematical knowledge, skills and abilities at a high level.

The geometric capabilities of the future mathematics teacher is the basis of his professional pedagogical competencies. It is known that the content of the science of geometry is made up of a system of axioms, theorems, definitions and problems, and all of them together form the concepts of the science of geometry.

Materials and Research Methods

For this reason, the logical connection between geometric capabilities and professional pedagogical competencies is manifested in the acquisition of mathematical knowledge by the future teacher of mathematics. Geometric capability plays an important role in the professional competencies of future mathematics teachers. Geometric competencies of students was determined as follows:

- knowledge of geometric concepts;
- ability to apply theoretical materials appropriately in practice;
- ability to describe geometric figures correctly and demonstratively;
- developed spatial imagination;
- understanding the role of geometry in the study of other subjects;
- being able to draw general conclusions when studying topics;

The article discusses the methods of simplifying general equations of the second order line, and analyzes the advantages and disadvantages of these methods. In particular, in the simplification of the second-order line equation, the method of simplification using line invariants and the methods of simplifying the general equation of the line using the principal directions of the line were used.

Examples of determining the type of line as a result of simplifying the general equation of the second order line are given.

Let it be, a line of the second order in the Cartesian coordinate system (Descarte's system) in the plane is given by the following equation [6]:

$$a_{11}x^2 + 2a_{12}xy + a_{33}y^2 + 2a_{13}x + 2a_{23}y + a_{33} = 0 \quad (1)$$

As a result of simplifying the equation of this line in the Cartesian coordinate system (Descarte's system), it can be brought to one of the following forms.

$$a_{11}x^2 + a_{22}y^2 + a_{33} = 0 \quad (2) \quad a_{22}y^2 + 2a_{13}x = 0 \quad (3) \quad a_{22}y^2 + a_{33} = 0 \quad (4)$$

The first method of simplifying the second-order line equation is based on some algebraic results without introducing a new coordinate system. In this way, the quantities S, δ, Δ which are called invariants of the line, and the expression K, which is called the semi-invariant of the line, are used to simplify the equation of the second order line.

Using these quantities, it is easy to write down the following equation, which is called the characteristic equation for the line

$$\lambda^2 - S\lambda + \delta = 0$$

The roots of the characteristic equation can be found and using them, the linear equation can be brought to the canonical view as follows

$$\lambda_1 x^2 + \lambda_2 y^2 + \frac{\Delta}{\delta} = 0$$

When $\delta = 0$, it can be shown that the line equation can be reduced to the following canonical equation

$$sy^2 + 2\sqrt{-\frac{\Delta}{S}x} = 0$$

When checking the lines of the form (4), we use the quantity K. In this case, the line equation can be written in the following form.

$$Sy^2 + \frac{K}{S} = 0$$

In addition, the general equation of a second-order surface includes brief information about ellipsoid, hyperboloid, and paraboloid types of surfaces.

The discussion of the results

A set of points defined by the following second-order algebraic equation in an affine coordinate system is called a second-order surface.

$$a_{11}x^2 + a_{22}y^2 + a_{33}z^2 + 2a_{12}xy + 2a_{13}xz + 2a_{23}yz + 2a_{14}x + 2a_{24}y + 2a_{34}z + a_{44=0} \quad (5)$$

Eigenvalues of second-order surfaces are briefly mentioned.

It is recommended to study the second-order line as a section of a plane with a given surface in space.

To conclude, in every lesson, it is necessary not only to give students knowledge, but also to direct them to thinking, to generalize, analyze, and systematize the acquired knowledge. There are ample opportunities for developing students' thinking skills in geometry classes, especially in the process of studying analytical geometry.

For this reason, it is one of the urgent issues to develop effective methods of further development of students' thinking ability in the teaching process and to explain them with an innovative approach. In addition, the innovative approach to teaching the analytical geometry course is an effective method for imparting new knowledge to the students of mathematics and computer science education during the teaching process of the analytical geometry course.

Research results

Students' interests in geometry, the study of mastery levels, results of analysis, bringing together the elements of analytic geometry in plane and space in the course of teaching analytical geometry, involving modern tools in lectures and practical training classes organization of the educational process takes an important place in the development of students' geometric competencies, which is a part of methodical competency.

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