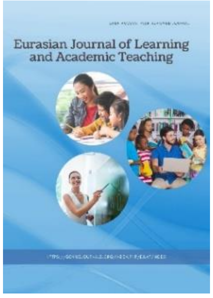

Formation of sustainable motivation to study the subject "Differential Equations"

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ABSTRACT

The article reveals the methodological foundations of teaching students to solve differential equations, which contribute to overcoming the difficulties that arise when determining the type of a differential equation and when compiling a differential equation of the process presented in the condition of the problem.

Keywords: Formation Of Scientific Views, Methodological Basis, Increment Of An Independent Variable, Differential Equation.

Elementary knowledge of mathematics, an understanding of its capabilities becomes as necessary an element of general culture as knowledge of one's own history. Mathematical methods are increasingly penetrating into the most diverse spheres of socially useful human activity. Many areas have received a boost to development thanks to mathematics. Mathematics plays an important role both in the development of intelligence and in the formation of character. It is advisable to start the analysis of the features of mathematical education among students with a characteristic of the process of mathematization of knowledge characteristic of the modern era. Teaching differential equations is aimed at the continuous development of scientific, mathematical and methodological aspects. The role of differential equations is great because, in places of change, their speed, acceleration and other characteristics are interrelated. And their mathematical equivalent is a function, their derivatives, their relations with each other, i.e. differential equations, are widely used in such fields of science as physics, chemistry, economics, biology. In this regard, the use of various problems with differential equations gives students the opportunity to develop their thinking abilities. Teaching mathematics carries a professional context: solving applied problems by means of mathematics, there is an integration of mathematical knowledge. To form the foundations of students' scientific views, it is correct to explain the real reasons for the results of solving differential equations, as well as the place of this course among other disciplines and in life situations. Solving practical problems related to differential equations plays an important role in the formation of a worldview, raising the level of mathematical culture, developing knowledge that makes it possible to implement interdisciplinary connections. Differential equations are also used as a universal method of cognition of the world. In addition to the system of teaching the subject of differential equations, a system of methods is being created that contribute to the development of cognitive abilities. The specifics of the credit training system consists in developing the knowledge of self-study of students, increases the volume of independent work, thereby makes it possible to develop creative abilities, work with teaching aids. The solution of physical and mechanical problems usually begins with the construction of a mathematical model, which in turn is solved by mathematical methods. Most of the problems studied by students of technical specialties are reduced to solving linear differential equations with constant coefficients and the right part of a special form. It should be noted that when solving such equations, students use the knowledge gained while studying linear algebra, which demonstrates the inextricable connection of various branches of mathematics and the universality of the laws established by it. The main factors for the formation of a positive stable motivation to study the subject "Differential equations" in accordance with the theory of E.P. Ilyin [3] are:

1) The content of the educational material (theoretical and practical);
2) The organization of students' educational activities includes: motivational, operational-cognitive and reflexive-evaluative;
3) Collective forms of educational activity;
4) Means of evaluating educational activities;
5) The style of pedagogical activity;
6) Individual characteristics of students;

The main functions, thanks to which it is possible to effectively form motives for students' learning activities: these are

1) organize the process of studying the subject in a visual, interactive, more effective way;
2) the possibility of implementing a large number of tasks (different values of the initial conditions, different solutions);
3) the opportunity to create project work, activate research activities, diversify classroom and extracurricular activities;

Practice shows that students have difficulties when studying the topic "Differential equations". The first difficulty is connected with the definition of the form of a first-order differential equation. One of the reasons for this difficulty is that in textbooks all types of equations are given by general formulas, a verbal description of the signs of each type of equation is not given, and as is known from psychology, if the signs are not verbally formulated, it makes it difficult to form the appropriate skill. Another reason is the lack of a common "instruction" for all types of first-order differential equations, following which students would be able to determine the type of differential equation. Therefore, it is necessary to create methodological foundations (guidelines), using which students would be able to determine the type of differential equation.

These guidelines should have a generalized character and be applicable in determining the form of any first-order differential equation. The implementation of such methodological foundations is the developed scheme for clarifying the form of a first-order differential equation. [7] It is based on the following: first you need to express the derivative, and then, in a certain sequence of actions, analyze the right part of the resulting equality.

Since there are differential equations that belong to more than one kind (for example, the equation $\frac{y}{x}$ can be considered an equation with separable variables, since its right part can be represented as a product of two functions, each of which depends only on one variable $y' = \frac{1}{x}y$, and also this equation can be considered homogeneous, since its right part is a function that depends only on $\frac{y}{x}$). We show how to determine the form of the differential equation

$$x^2 + y^2 + y + (2\mathrm{xy} + \mathrm{x} + e^y)\mathrm{y}' = 0. \ [5]$$

First we express the derivative

$$y' = -\frac{x^2 + y^2 + y}{2xy + x + e^y}$$

Next, we analyze the right side of the resulting equality. It is not possible to represent it as a product of two functions, each of which depends only on one variable, so next we try to represent it in a function that depends only on $\frac{y}{x}$, but this also fails. Represent the right part as a sum

$$P(x)y + Q(x)\, y^n, where\ n \neq 1$$

also failed. Therefore, it is necessary to check the feasibility of the following condition: the derivative of the numerator in y is equal to the derivative of the denominator in x taken with the opposite sign. We calculate the specified partial derivatives $:(x^2+y^2+y)'_y=(2y+1)$, $(2xy+x+e^y)'_x=2y+1$.

So, we see that the condition being checked is satisfied, so we conclude that the differential equation in question is an equation in full differentials.

The results of students who were trained to determine the type of a first-order differential equation using rules are significantly higher than the results of students who were trained traditionally. The following difficulty arises when solving applied problems that are reduced to a differential equation associated with the formulation of a differential equation.[7] The process of composing a differential equation depends on the type of problem (physical, geometric), each of which has its own characteristics. Therefore, for applied physical and geometric problems, schemes for their solution are constructed, where the actions that must be performed in order to make a differential equation of the process presented in the problem condition are indicated.
Let's consider a scheme for solving applied physical problems [6]. This scheme is based on a model approach and includes the following steps: 1) drawing up a differential equation. 2) working with a differential equation: 3) interpretation of the results. Let's consider the stages of composing a differential equation. [7]
To implement this stage, you need to perform the following intermediate steps: 1) determine whether there is a physical law governing the process presented in the problem condition. Further, the sequence of actions depends on the answer to the first question. If the answer is positive (we call such tasks applied physical tasks of the first type), then you need to perform the following sequence of actions: 2) write down the equality corresponding to the physical law; 3) determine which of the values of the process under consideration is an independent variable; 4) express the changing values through an independent variable and the task data.
To do this: a) express one changing quantity from the compiled equality through the given tasks; b) express the remaining changing quantities from the compiled equality using the physical meaning of the derivative. If the answer to the first question is negative (we call such tasks applied physical tasks of the second type), then the sequence of actions will be as follows: 2) select quantities, one of which will be an independent variable and the other a desired function, and enter notation for them; 3) express the change in the desired function, which will correspond to the increment of the independent variable.
To do this, you need to: a) find the "positive" increment of the desired function; b) find the "negative" increment of the desired function; c) record the "full" increment of the desired function.
Solving applied physical problems usually does not cause difficulties.[6] The solution of applied problems can be divided into two types: materials used during classroom classes and materials for independent work of students at home. Both types of materials are designed according to the following requirements: the material must be educational (reveal the composition of mathematical activity, help overcome mathematical difficulties); and the material must be comprehensive. [5]

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