EUROPEAN INTERNATIONAL JOURNAL OF PEDAGOGICS

VOLUME04 ISSUE11
DOI: https://doi.org/10.55640/eijp-04-11-46 Pages:226-230

LEARNING TO SOLVE PROBLEMS USING MODELING METHODS FOR TECHNICAL SPECIALIZATION REQUIREMENTS

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ABOUT ARTICLE

Key words: Future professional activity, modeling, engineer, designer, constructor, personality activity approach, etc.

Received: 19.11.2024
Accepted: 24.11.2024
Published: 29.11.2024

Abstract: Modeling is the study of cognitive objects (physical phenomena and processes) using their models, the creation and study of models of existing objects and phenomena. The modeling method is widely used in modern science. It simplifies the process of scientific research, and in some cases becomes the only means of studying complex objects. The importance of modeling in the study of abstract objects, distant objects, and very small objects is great. The use of physical and logical modeling plays a significant role in the theoretical and practical development of physics.

INTRODUCTION

Physical modeling is being successfully applied in solving various practical problems in exact sciences. The modeling method allows for quantitative expression of one or more variables that characterize the problem, and then enables the study of their relationships. The execution of large-scale calculations related to complex systems, such as spacecraft trajectory, creation of complex engineering structures, design of transport routes, and others, confirms the effectiveness of modeling. Typically, computational experiments on models are conducted in cases where it is impossible or economically impractical to experimentally investigate a real object.

Solving physics problems is one of the essential elements of educational work. Problem-solving helps students deeply understand the relationships between physical phenomena and laws, further develops their logical thinking and research abilities, and forms skills to achieve goals. It teaches them to apply theoretical knowledge in various situations and establish connections between theory and practice.

Knowledge of physics laws is determined not only by defining them but also by solving related problems. Therefore, solving problems in physics studies not only occupies an important place but also presents certain difficulties.

When analyzing a problem and formulating a system of equations representing a phenomenon, the main attention should be focused on the nature of frequently encountered physical quantities.

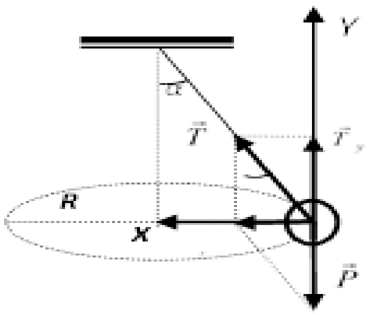
First, it is necessary to better understand the physical phenomenon mentioned in the problem, recall the physical laws underlying this phenomenon, and try to clearly imagine the mechanism of its occurrence.
Regarding problem-solving skills, we would like to present the following opinion of Professor D.Sh. Shodiev: "The derivation of physical formulas never allows students to become familiar with natural phenomena...." The second level of derivation and memorization of formulas is that the main thing is to understand the essence and meaning of the physical phenomenon being studied in the educational process. The main purpose of using this idea as an example is that the general secondary education system and academic lyceums have been mathematicized at a higher level than necessary. In teaching the content of physics education, often focusing on simple mathematical structures and calculations limits the ability to understand the physical essence of a specific phenomenon being studied, as mathematics is not the content of physics, but rather a tool. It is necessary to use this weapon in the necessary situations.
It is known that knowledge of physical laws is not enough to solve problems. In some cases, it is necessary to know and apply general special methods and techniques, while in other cases, such methods and techniques may not be available. In this case, in addition to knowledge of theory, the formation of logical thinking is of great importance.
Higher educational institutions for developing problems in physics courses require the following:
- Explain the reason, essence, and content of the methods used:
- deeper knowledge and a broader understanding of physical laws;
- Developing students' thinking skills.

The types and methods of working with problems vary depending on their content and didactic purpose. They can be divided into classes according to the following characteristics:
• according to the information provided on the problem;
• according to the method of working with the problem;

Adjective problems are problems whose solution does not require calculations, but rather requires explaining a particular phenomenon, choosing the conditions for the occurrence of the phenomenon, and revealing the qualitative classifications of different points of view. In these, numerical expressions are not given exactly.
Calculation problems are problems in which the answer to the question is found through calculations. To solve such problems, they are first analyzed qualitatively. As a result, calculation methods and possible solutions are determined, and arithmetic, algebraic, geometric and graphical methods are used for calculation.
When solving a problem arithmetically, mainly arithmetic operations are used, while when solving it algebraically, formulas and equations are used. When solving a problem geometrically, geometric theorems are used, while when solving a problem graphically, methods of drawing a graph or analyzing a given graph are used.
When solving problems, the analysis of the phenomenon being studied based on modeling allows for a systematic understanding of the process. When solving physical problems, the study of phenomena and processes using modeling is carried out in four stages.
The first stage is the expression of the laws that determine the main objects of the model.
The second stage is the analysis of the physical problem, verification and selection of the model.
The third stage is to determine whether the selected model satisfies the accepted operational criteria. In other words, to determine whether the results obtained correspond to theoretical data.
The fourth stage is to conduct a further analysis of the model and develop and refine it by collecting data on the phenomenon under study.

Thus, the main content of modeling is formed by theoretical analysis of the model based on the preliminary study of the object, obtaining results through practical calculations, and comparing the results with theoretical data about the object, correcting (improving), etc. In the process of solving physical problems, the problem is initially formalized to create a model. The necessary notations are introduced in accordance with the content of the problem. Then, a functional relationship is formed between the quantities, written in the form of a formula or algorithm.

Problem: A mass suspended from a string of length l moves in a straight line and circles in a horizontal plane. What is the velocity of the mass if the string around which the mass is moving makes an angle α with the vertical?



Solution: The load is acted upon by the force of gravity and the tension of the string. We write Newton's Second Law for these forces:

$$m\vec{a} = \vec{P} + \vec{T}$$

Each physical problem is based on a special case or manifestation of general physical laws. Therefore, before working on problems related to a section of the physics course, it is recommended to thoroughly study the theory related to these problems, because without a solid knowledge of the theory, it is impossible to solve and analyze even simple problems, let alone more complex ones.

In solving physical problems, there is also a technology for modeling processes on a computer, the purpose of which is to accelerate the process of understanding and understanding the nature surrounding us, the phenomena occurring in it, events and changes in society using modern methods. Computer models can solve various dynamic problems. This leads to a deeper and broader understanding of the essence of the processes taking place, to a more realistic assessment of the results obtained and to an expansion of ideas about the possibilities of computer modeling.

The theoretical foundations of modeling are divided into five stages and are implemented.

At the first stage, the process is analyzed qualitatively, the purpose of the problem is studied, and relevant information is collected. The essence of the process is studied theoretically, its necessary parameters are determined, which forms the basis of modeling.

The second stage is the calculation of the optimality criterion of the process, in which all operations are brought to a single unit of measurement, and the criterion is expressed in the form of a mathematical function, at certain values of which there is a single solution.

In the third stage, the model is expressed in the form of mathematical expressions (a system of equations and inequalities), which can be written in linear, quadratic, nonlinear, hyperbolic, and other mathematical expressions. In the fourth stage, a method is selected that determines the quantitative solution of the formulated model. Modeling methods are used to solve a problem expressed in a mathematical expression using a model. Programming or other methods can be used to determine the optimal solution to the problem. At the fifth stage of modeling, the unique (optimal) solution to the problem is analyzed in terms of quantity and quality, and the relative position between them is obtained.

Modeling laws and processes that are studied in the process of solving problems in physics can be divided into several types:

- modeling of various forms of motion (flat, uneven, with uniform acceleration, etc.);
- modeling of processes with functional connections;
- modeling of processes that cannot be directly observed by humans (for example, Brownian motion of gas molecules, diffusion phenomena, etc.).

The form of data models should strictly adhere to the following requirements:

1. Simplicity. The data model should have a minimum of relational structures.
2. Clarity. The data model should be visual (visible, depicted).
3. Decomposability. The data model should be easily replaceable in the data warehouse.
4. Interchangeability. The data model should be interchangeable with similar models.
5. Freedom. The data model should not be limited to specific details. Even the above requirements cannot ensure the ideality of the created models. Because modeling involves some important features of the real object.

CONCLUSION

In conclusion, we can say that practical experience shows that we propose to use the following stages in determining the solution to problems.

Stage 1 - Determining the purpose of the problem; At this stage, an attempt is made to clearly and accurately define the purpose of the problem through time, understanding, and writing.

Stage 2 - Selecting a model to solve the problem; In this case, if the problem is clearly stated, then a ready-made model is selected, and if a clear model does not exist, then a model suitable for solving this problem is developed. Models can be of any type: physical, analogical, mathematical, deterministic (deterministic), stochastic, etc.

In the 3rd stage, the necessary initial information is searched and prepared to determine the solution, specific variables are selected and adapted based on the verbal model.

Stage 4 - testing the solution - in this case, the solution is tested and the closest solution is studied.

The solution of many problems of a computational nature is reduced to the formulation of mathematical equations, which are considered to be expressions of the physical laws underlying the phenomenon under consideration. As a result, one or more equations are obtained, one of the unknowns in which is the desired quantity. Then the solution of the problem is reduced to performing purely mathematical operations. The main difficulty in solving almost all physical problems is to construct a system of equations that fully describe the physical process under consideration.

Students studying in technical specialties were shown the importance of teaching them to solve physics problems using the method of creating and modeling models of real objects, as well as developing their skills in modeling various objects.

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