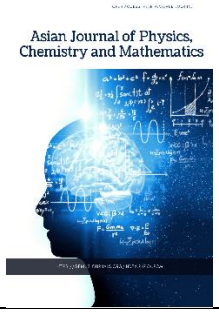

Significance and Application of Pedagogical Innovations in Physics Teaching

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ABSTRACT

This article describes the essence and application of pedagogical innovations in the teaching of "Oscillations and Waves" in physics. In particular, the advantages of the method of teaching vibrational motion and waves on the basis of double-contrast examples, the method of teaching the department of vibrations on the basis of integrative technologies and the use of analog technologies in teaching mechanical and electromagnetic oscillations were given.

Keywords: Vibration, wave, pedagogical innovation, method, double-contrast, integrative technology, analogy.

One of the important requirements for the organization of modern education is the formation of certain skills and competencies based on the delivery of certain knowledge to students in a short time, a new approach to the educational process to more effectively increase the level of theoretical and practical knowledge. The essence and application of pedagogical innovations in teaching physics are given below.

Teaching oscillating motion and waves on the basis of double-contrast examples: generalization of didactic units of double-contrast knowledge and tasks is one of the main parts of the theory of magnification, which is widely used in all stages of education.

The theory of generalization of didactic units is based on the combination of contrasting knowledge, change of concepts - generalizations of substitutions, theorems, functions. Of these, the double-contrast knowledge method is the most widely used. But this method is almost never used in the teaching of physics, including other sciences. This leads to a weakening of students' ability to remember given and generalized knowledge as well as their logical thinking.

In the system of generalization of didactic units, teaching materials are presented in large blocks and concepts, ratios, relationships, actions, events, processes are paired in contrast.

Double-contrast examples, graphs, diagrams, and relationships are presented on one page, side-by-side, in one drawing. This allows them to analyze, compare, and memorize information according to the law of contradiction and unity of philosophy. This method also leads to the use of students' psychological characteristics: word, science, picture, numbers, symbols, activating memory. It should also be noted that double-

contrast examples allow physical problems to be suddenly illuminated without long descriptions in words.
and helps you understand the problem faster.

One of the didactic principles of teaching physics is the principle of demonstration. This principle serves to fully master the learning material. The ability of a person to see and remember information is almost 7.5 times higher in percentage than in hearing.

Therefore, examples of double-contrast allow students to analyze, memorize, and draw conclusions about the laws of motion from the diagrams shown when teaching the "Vibration and Waves" section of physics. Examples include the presence of double-contrast processes in mechanical vibrations and waves, as well as in the comparison of electromagnetic vibrations and waves.

Double-contrast examples, graphs, diagrams, and relationships are presented on one page, side-by-side, in one drawing.

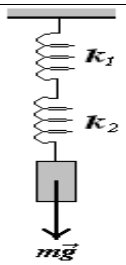
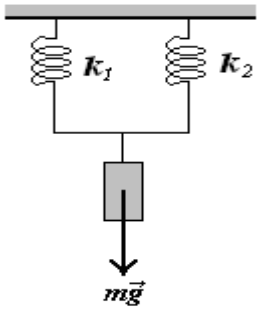
in series	Parallel
	
$mg = -k_1 x_1 \Rightarrow x_1 = -\frac{mg}{k_1};$ $mg = -k_2 x_2 \Rightarrow x_2 = -\frac{mg}{k_2}$ $k_{ум} = \frac{k_1 \cdot k_2}{k_1 + k_2}$ $\quad T = 2\pi \cdot \sqrt{\frac{m}{k_{ум}}}$	$x_1 = x_2 = x;\ mg = F_1 + F_2$ $kx = k_1 x + k_2 x;\ k = k_1 + k_2$ $T = 2\pi \sqrt{\frac{m}{k_1 + k_2}}$

Figure 1. Vibrational motion of a load suspended on springs connected in series and in parallel.

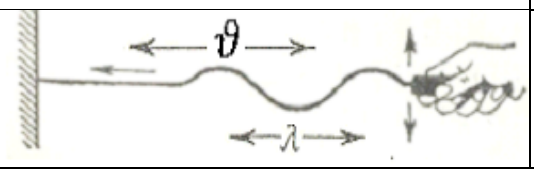
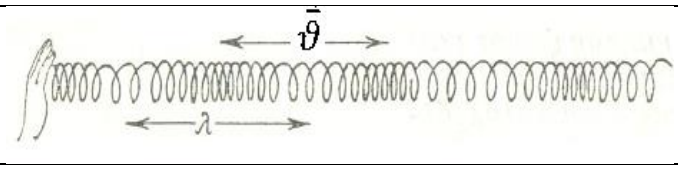
Transverse wave	**Longitudinal wave**
	
$\lambda = \vartheta T \rightarrow \vartheta = \frac{\lambda}{T};\quad T = \frac{1}{\nu}$ дан $\lambda = \frac{\vartheta}{\nu} \rightarrow \vartheta = \lambda\nu$	

Figure 2. Double-contrast processes occurring in the propagation of transverse and longitudinal waves.

Thus, the double-contrast method is an innovative technology of education, which allows the student to acquire independent knowledge, logically combine themes and units over time, activating the processing of information faster and more consciously.

The method of teaching the department of vibrations on the basis of integrative technologies: the topic is described in sequence in terms of structural and physical nature. The cyclic frequency and their oscillation cycles in the conventional and non-conventional methods for the four pendulums are given below. They can be applied to a number of complex vibrating systems and pendulums. The parameters of the systems are shown in Table 1.

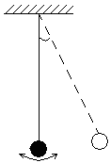
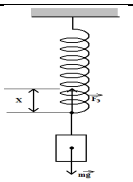
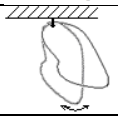
As can be seen from the table, the cyclic frequency and oscillation period for complex systems are determined relatively quickly and easily by this method.

If tables are given for each group with one column empty, they can solve it in a short time in the audience using the mini case method.

If the information in the column (or multiple cells in a row) in the table is not provided, then it can be resolved by separate groups through a general discussion, such as a short case.

Given one or two rows of data in the table, and without the rest, that complete case method can be solved individually or collectively within a few days. Assessment of students' knowledge is done by the teacher.

Table 1. Parameters of oscillating systems and pendulums

Type of corpses	Schematic view	Vibration period	Cycle frequency	Potential energy	α	Kinetic energy	β
Mathematician		$2\pi\sqrt{\frac{l}{g}}$	$\sqrt{\frac{g}{l}}$	$\frac{1}{2}mgl\varphi^2$	mgl	$\frac{1}{2}mgl^2\varphi'^2$	mgl^2
springy		$2\pi\sqrt{\frac{m}{k}}$	$\sqrt{\frac{k}{m}}$	$\frac{1}{2}kx^2$	k	$\frac{1}{2}kx'^2$	m
Physics		$2\pi\sqrt{\frac{I}{mga}}$	$\sqrt{\frac{mga}{I}}$	$\frac{1}{2}mga\varphi^2$	mga	$\frac{1}{2}I\varphi'^2$	I
The liquid in the U-shaped container		$2\pi\sqrt{\frac{l}{2g}}$	$\sqrt{\frac{2g}{l}}$	$2\rho g\ell x^2$	$\rho g\ell$	$\frac{1}{2}\rho slx'^2$	ρsl

Such integrated universal cases serve as both practical, educational and research cases.

The method of using analog technology in the teaching of mechanical and electromagnetic oscillations: logical concepts such as idealization and modeling, induction and deduction, analogy, intellectual experiment, hypothesis physics are widely used in the teaching of general physics. Analogy has a special place among these methods. Similarities with the same laws also occur in phenomena of different physical nature. In such cases it is possible to speak of physical analogy.

The word analogue comes from Latin, which means similarity. Using this method, it is possible to obtain accurate information about another branch of science by teaching one branch. The application of the analogy method in the teaching of physics and its importance are described in a number of works.

Experiences in teaching physics show that teaching the topic of "Electromagnetic Vibrations" is effective if the problems of electromagnetic and mechanical vibrations are analyzed using an analogy between them. This greatly simplifies the solution of the problem of determining the commonality between vibrational processes of different nature.

Using the analogy method, it is possible to determine the oscillation cycles of a mechanical oscillator and 2 coil systems connected in parallel, the oscillations of different frequencies, in opposite phases (or in the same phase), and the relative magnitudes for equivalent electrical systems.

When the springs shown in Figure 3 are connected in series and the m-mass load is moved to a distance x, the elongation of each spring is x1 and x2, while the elongation of the oscillator is x = x1 + x2.

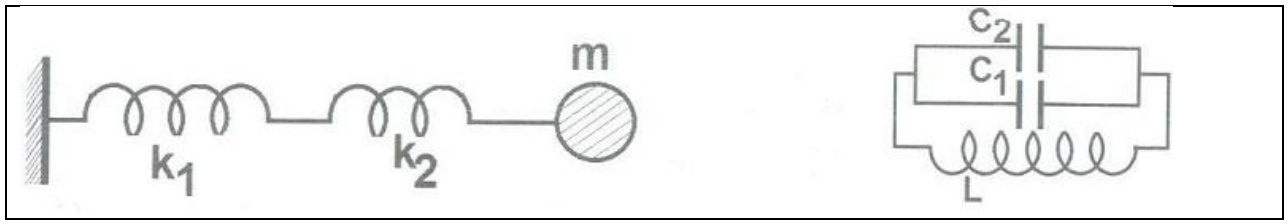


Figure 3. Serially connected spring and parallel connected capacitor oscillator.

In an electrical system, q = q1 + q2, the capacitors are connected in parallel, and the period of electrical oscillations is determined using the following expression: $T = 2\pi\sqrt{LC_{um}}$; where Cum = C1 + C2. Using the analogy, it is possible to record the oscillation period of a mechanical oscillator. $T = 2\pi\sqrt{m(1/k_1 + 1/k_2)}$

The importance of analogy in teaching the properties of physical phenomena and learning more about them is immeasurable. The analogy method also simplifies the problem-solving process and allows students to easily remember the processes and laws of physics.

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