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EINSATZ DER TRIZ-TECHNOLOGIE IM UNTERRICHT DER THEORETISCHEN PHYSIK (am Beispiel der Lehre des Kapitels "Quantenmechanik")

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Anmerkung. Die Fragen der Notwendigkeit und Möglichkeit der Entwicklung quantenmechanischer Konzepte bei zukünftigen Physiklehrern der Pädagogischen Hochschule unter Anwendung der TRIZ-Methodik im Physikunterricht werden in diesem Artikel betrachtet.

Schlüsselwörter: Physik, TRIZ, Quantenmechanik, angehende Physiklehrer, Bildung, Forschungstätigkeit, Ausbildung, quantenmechanische Konzepte.

USING TRIZ TECHNOLOGY IN LESSONS OF THEORETICAL PHYSICS (on the example of teaching the chapter "Quantum Mechanics")

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Annotation. The issues of the necessity and possibility of the development of quantum-mechanical concepts in future physics teachers of pedagogical university by using the TRIZ methodology in physics lessons are observed in this article.

Key words: Physics, TRIZ, quantum mechanics, future physics teachers, education, research activity, formation, quantum-mechanical concepts.

According to the international pedagogical experience, the important place in the implementation of new pedagogical projects, the widespread introduction of innovative achievements in practice and raising the quality of education to the new level is occupied by the preparation of future teachers for research activities.

The theoretical bases of the sphere of physical sciences, the problems of developing peculiar methodological aspects of the development of the scientific worldview of students were investigated by scientists of our republic such as B.M. Mirzakhmedov, M. Joraev, O.N. Akhmadjonov, S. K. Kaxxarov, M. Kurbanov, G. E. Karlibaeva and others.

The analysis of the above-mentioned scientific works showed that the processes of organizing and conducting lessons in "Quantum Physics" in the system of higher education in the modern period of information efficiency were not chosen as the object of special research, and gave opportunity to determine the need to improve the

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theoretical and practical bases of methodological support, interactive developments, electronic software in the training of future teachers in the field of physics [3. P. 63].

In teaching theoretical physics, we always solve physical tasks, we select ways to solve them in order to do this, build the algorithm for our actions, connect them with physical laws, namely, we try to solve it as quickly and efficiently as possible, and together with this, to extract benefit and bring to life what something new. Many methods which we use, are included in the "Theory of inventive problem solving" (TRIZ) technology.

The theory of inventive problem solving which was developed by G.S. Altshuller at the end of the 50-years of XX century is considered one of the innovative technologies which can increase the efficiency of education.

TRIZ is considered technology about the development of pedagogical methods and about effective teaching in general, in any area of research activity. TRIZ is also called applied dialectics in pedagogy, and sometimes it is called the general theory of strong scientific-theoretical thinking or the general theory of scientific research. The main difference between TRIZ with other types of activity is considered the conscious management of the process of research activity, it is activity according to algorithms, it is activity according to the laws and rules of pedagogy. If we learn to control our mind, then we will control our everyday life [1. P. 12].

The purpose of using TRIZ in the lessons of physics as the pedagogical technology is as follows [4. P. 139]:

1. Development of quantum-mechanical concepts in future physics teachers.
2. Formation of thinking among future physics teachers on the basis of the laws of quantum mechanics.
3. Formation of the skills of independent scientific research in future physics teachers in order to search for the necessary scientific and methodological information.
4. Formation of knowledge, skills and abilities of processing results and formulation of conclusions.
5. Training the gradual orientation of future physics teachers to the activity of active exchange of information.
6. Development of the scientific worldview of future physics teachers on the basis of quantum-mechanical concepts in the process of observing, presenting and studying phenomena which are related to the chapter "Quantum mechanics".

The analysis of research shows that TRIZ is associated with dialectical views. The improvement of the system of higher education takes place in accordance with the objective laws of the development of pedagogy; components of conscious and controlled technologies of research activities can be improved as a result of specially organized scientific and educational activities.

The essence of the psychological basis of TRIZ is considered to understand quantum-mechanical processes, to apply the acquired information in standard and non-standard situations in educational and life activities; removal of the psychological barrier of fear of the new, the unknown [2. P. 24].

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The main content of the TRIZ technology: methodology for the formation of quantum-mechanical representations; scientific search process, inventive, research activities.

The essence of the TRIZ training form is considered educational process on the basis of "subject-subject" relationship. Therefore, it is advisable to organize the process of development of quantum representations on the basis of such approach as work with information in the course of independent life activity (use information on the basis of memorization and understanding through analysis, synthesis, evaluation). In order to use TRIZ in the educational process requires the active and cognitive position of both future physics teachers and teachers, then only the technology of cooperation is possible at the basis of the relationship between them, [6. P. 40].

In the process of applying TRIZ in the educational process, future physics teachers develop the following knowledge, skills and abilities:

➢ Associative-figurative and systems thinking:

- to apply knowledge about quanta, their properties and functions for description in various physical objects;
- to use knowledge of quantum properties and functions to solve inventive problems;
- to establish quantum relationships among different systems;
- to reveal different properties of quantum systems in various interactions;
- to determine changes in the average values of physical quantities over time;
- to determine what and as much as possible to learn about quantum mechanics;
- to work with various types of scientific information.

➢ Development of quantum imagination:

- To get an idea about the physical basis of quantum mechanics with various scientific research ways;
- to learn the properties, functions, structure of quantum systems using quantum mechanics;
- to apply the mathematical apparatus of quantum mechanics for solving inventive problems.

➢ Ways to solve problems of quantum mechanics:

- to highlight and form contradictions in quantum physics;
- to highlight the contradicting properties of particles;
- to find a part of quantum physics which the scientific contradiction has arisen;
- to highlight the interconnections and interactions which cause the contradiction in quantum physics;
- the formulation of the solution of the problems of quantum mechanics;
- to use scientific, methodological and electronic resources;
- to predict the consequences of the proposed solutions;
- to solve inventive problems in quantum physics;
- to select information for research activities;
- to form problems in quantum physics;
- to explain various physical phenomena.

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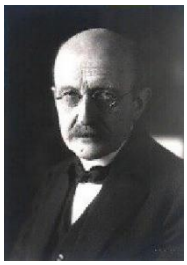
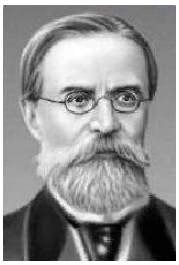
All the methods which are used in TRIZ, allow future physics teachers to find new ideas and already familiar ideas, to find the unusual and unknown things, to make a small scientific discovery, sometimes irregular, standard and non-standard. We give the example of the use of TRIZ technology in the practice of teaching the chapter "Quantum Mechanics".

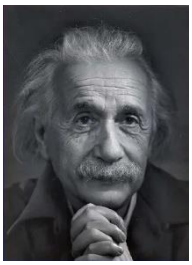
I. Call stage.

Task 1. Make an assumption about the content of the lecture on the basis of pictures.


M.Plank


G.Gerts


A.Stoletov


A.Einstein


E.Schrödinger

II. The comprehension stage.

Task 2. Read the statements in the first column of the table. Express your agreement or disagreement with them in the «Before reading» column. If you agree with it, put a «+» sign, in case of disagreement, put a «-» sign.

Affirmation	Before reading	After reading
1. Any classical system which consists of charged particles cannot be in static equilibrium. And dynamic equilibrium is associated with the movement of particles in a limited area of space, which is always considered acceleration. Accelerated movement is accompanied by radiation [5. P.7].		
2. Two types of collisions were discovered: elastic, without changing the energy of the electron, and inelastic which is accompanied by the loss of strictly defined amount of energy. It followed from this that the atom is always imparted in a collision with the same portion of energy [5. P.10].		
3. The heuristic significance of Bohr's theory consists of the bold assumption of the existence of stationary states and intermittent transitions among them.		

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These provisions were later extended to other microsystems. It was possible to find the energy levels of many simple systems by choosing one or another quantization rule [5. P.12].		
4. De Broglie's hypothesis says nothing about the nature of «matter waves». As will be shown below, de Broglie waves cannot be regarded as waves in some material environment. Their physical meaning should be seen to determine [5. P.13].		
5. The important task of classical mechanics is considered calculation of the motion of material point under the action of given forces, namely, finding the kinematic equation. It is solved by using the basic equation of classical dynamics - the equation of Newton's second law. In a similar way, the state function (and the change in the state function) of microparticle moving in given force field is found using the basic equation of quantum mechanics - the Schrödinger equation [5. P.25].		

Read the text. Re-express your agreement or disagreement with each statement. Fill in the last column of the table.

III. Reflection stage.

Task 3. Summarize the obtained information by filling in the table using the "Cicero's algorithm".

	Quantum mechanics
What?	✍…
Where?	✍…
How?	✍…
When?	✍…
Whereby?	✍…
Why?	✍…
What for?	✍…

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Tasks 4. Summarize the received information by making a didactic syncwine.

1. Quantum mechanics.
2. ✍…
3. ✍…
4. ✍…
5. ✍…

The results of the conducted observation and analysis indicate the need to create an innovative educational environment, the introduction of modern pedagogical technologies in the physics lessons and the improvement of this support.

In conclusion, we can say that in physics lessons we have introduced into educational practice interactive development like TRIZ which is created on the basis of the priority of the quantum-mechanical features of objects: consistency, discreteness, probably static. Using TRIZ technology is considered a necessary condition for the development of students' scientific ideas while mastering the laws of "Quantum Physics". This development is focused on expanding the scientific worldview of students, awareness or achievements of modern science, perception of the theory of the structure of matter, and served as a deep assimilation by future physicists of the laws of quantum physics, the development of their professional competence.

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