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Creative Lesson on the General Course of Physics on the Topic "Compton Effect"

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Annotation: This article provides the content of the creative lesson of the atomic physics section of the general physics course on the topic "Compton effect" for students of higher educational institutions.

Keywords: creativity, creative lesson, Compton effect, J. Gilford, E.P. Torrance, quantum scattering, educational institutions.

In order to improve the methodology for teaching the topic "Compton effect" of the general course of physics in higher educational institutions of the Republic of Uzbekistan, the first task is to organize a creative lesson on this topic. Thanks to such a lesson, students of higher educational institutions can develop their creative thinking and abilities on this topic. What is meant by creative thinking and student abilities? The development of creative thinking and abilities is the guiding principle of learner-centered learning. In this case, the student is an active subject of his self-expression within the framework of professional interests and needs through independent learning activities in the context of specific personal-creative technologies of developing education.

The term "creativity" first appeared in the late 50s in Western psychology and meant the ability of a person to create new concepts and develop new skills. The concept of creativity, universal creativity as a cognitive ability became popular after the publication of the work of J. Gilford. Therefore, creativity, that is, creative thinking and abilities, is rather a collection of different thinking and abilities that a person can acquire at different levels. In a broad sense, creativity is a non-trivial and skillful solution to a problem. Creative abilities of students is a psychological and pedagogical phenomenon. The concept of creativity as a universal cognitive creativity gained popularity after the publication of the works of J. Gilford.

E.P. Torrance continued Guildford's research and developed his own program for the development of students' creative abilities. It included several stages. At the first stage, he developed convergent thinking according to Gilford, and at the second stage, divergent thinking.

E.P. Torrance understands creativity as a person's ability to perceive shortcomings, gaps in knowledge, disharmony, etc. In his opinion, the creative act is divided into the perception of the problem, the search for a solution, the emergence and formulation of hypotheses, their verification, modification and finding the result.

Based on this, he gives the following description of the main criteria of creativity: ease - the speed of performing test tasks, i.e. test norms are similar to the norms of the speed intelligence test; flexibility - the number of switches from one class of objects to another in the course of responses;

originality - the minimum frequency of a given answer to a homogeneous group. Accuracy in Torrance tests is evaluated by analogy with intelligence tests.

The content of a creative lesson on the topic "Compton effect" may be as follows.

Lesson type: repetition and generalization of the topic "Compton effect"(in the form of a fairy tale).

Tasks: 1) to give students an idea of the phenomenon of the Compton effect, the effect of quantum physics; 2) control of students' knowledge on this topic; 3) the formation of the ability to apply the acquired knowledge in a non-standard environment; 4) develop the ability of logical thinking to compare, find common features and differences, systematize, draw conclusions; 5) development of communication skills.

Tasks (Table 1):

Table 1

Educational:	- expansion of theoretical knowledge of students in quantum atomic physics; - creation of the necessary conditions for students to fully master the phenomenon of the Compton effect; - demonstrate the practical application of knowledge about the phenomenon of the Compton effect.
Developing:	students learn to answer oral questions correctly, develop thinking (perform analysis, comparison, generalization, concretization), learn to draw conclusions based on logical thinking, develop flexibility of thinking through the introduction of game elements, develop emotions and motivation when performing practical tasks.
Educative:	- formation of students' scientific outlook; - the formation of life qualities, such as perseverance, accuracy and responsibility.

Decoration: Paradoxes of the Compton effect: 1) From the point of view of classical electrodynamics, the paradoxical scattering quantum change in frequency cannot be explained. 2) From the point of view of quantum mechanics, the concept of elastic collision is a paradox, but it cannot be explained physically. To do this, it is necessary to represent the quantum in corpuscular form. After all, it has an electromagnetic nature from the point of view of classical electrodynamics?

Equipment: screen, projector and computer.

During the classes

This lesson can be carried out in the form of a fairy tale, because any fairy tale is unusual for schoolchildren and children of school age, and they, and even adults, always perceive it with great interest. They sympathize with the heroes of fairy tales. Most importantly, they repeat the learning material on the topic. It develops their creative thinking and imagination.

Block 1. Professor-teacher: “Dear students! Today's lesson will be in the form of a fairy tale. I know that we all love stories told or read by our grandparents or parents. This is how we remember our youth. So I will tell you a story. Listen carefully. In the process of listening to a fairy tale, some problems arise in front of its heroes. in solving these problems you will help the heroes of the fairy tale, answer the questions that arise before them. To do this, you need to know the quantum theory of light and the Compton effect. Prepare drawing books, you will need them to solve the problems of fairy-tale characters. If not, then we've started. Thus, there lived a king of a certain country. His

daughter, the princess, who has no equal in beauty, intelligence and hard work, also lived with the king. It is interesting to note that the princess was well versed in physics, especially atomic physics and quantum theory and the related Compton effect. She did some physical experiments in her room and worked on problems related to physics, especially quantum physics. One day the princess was carried away by a black raven. Then the king addressed the people of his country: "Whoever saves my daughter, to him I will give my daughter and half of my wealth." Among the people there was a daredevil to save the princess. His name was Bunyod, and he was the son of a peasant. The king told him that whoever knows physics, especially quantum and atomic physics, should go to save the princess. Bunyod told him: "Let your heart be satisfied, my king, I know physics, especially quantum and atomic physics." After that, the king sent him to search for the princess.

Bunyod went where his head led. He walked, walked a lot, and, finally, on the way he met a hut. An old woman met him at the hut. The old woman asked him in which direction he was going. Bunyod told him everything. The old woman asked Bunyod the question that the king asked. And Bunyod repeated his answer, which answered the king's question. After that, the old woman gave him a ball and said: "If you answer one of my questions, this magic ball will take you to the right place." Bunyod told her: "Ask your question." The old woman asked him the following question: "What do you know about the quantum theory of light?" Bunyod immediately correctly answered this question". The professor turned to the students: "What do you think, dear students, what did Bunyod say to the old woman?" The teacher examines the answers of the students and chooses the correct one from them. Encourages the student who gives this answer. Students who give close to correct answers are also rewarded.

After that, the professor-teacher continued the tale: "The ball rolled. Bunyod ran after him. The ball rolled and carried Bunyod to the trees. Bunyod saw that green ribbons were hanging on them instead of green leaves. Bunyod was about to pass, when he suddenly heard a voice: "Help us, Bunyod!" Correctly hang ribbons on two trees: on the first tree - What is the Compton effect? a tape with the answer to the question, and another tape with the contents of Compton's experiment. Bunyod set to work. After completing the task, green leafy trees appeared in front of him and began to make noise. Then the next voice appeared again: "Thank you for resurrecting us!" The professor-teacher again turned to the students: "Well, which of you students can complete this task?" At will, two students are called to the board. One of them answers the question written on the first ribbon of the tree. The second answers the question written on the second ribbon of the tree. The professor motivates these students based on their answers.

Block 2. The professor-teacher continued the tale: "The ball rolled again. And Bunyod followed him. The ball went and stopped in front of an old man who was sitting on a stool. Bunyod was about to pass in front of him, the old man stopped him and asked: "My son, do not hurry. I know where you're going. You must answer my three questions in order to continue on your path. If you don't answer, you won't make it to your final destination." Bunyod said to the old man: "Ask" and listened to his three questions: "1) What laws did Compton use to derive his formula and what is their role in this process? 2) Write the Compton formula and explain the quantities included in it. 3) How does Compton scattering differ from classical scattering? Bunyod answered all three questions correctly. Here the professor-teacher again addresses the students: "What do you say, how would you answer these questions?". At will, three students are called to the board. One of them answers the first question. The second student answers the second question and the third student answers the 3rd question. Thereafter, the professor-teacher evaluates these students based on their responses. After that, the professor-teacher continued the tale: "The ball rolled so fast that Bunyod ran after it and barely caught it. The ball suddenly stopped in front of a swamp that appeared on the road. There was no way through this quagmire".

Bunyod's head froze, and he sat down on a stone in front of the swamp. At that moment, it was as if someone called him. He looked up and saw a small bird perched on a tree branch opposite. “Pick up the stone you are sitting on. Below it is the letter you need. It contains several tasks related to the Compton effect. If you find their answer, an invisible path through the swamp will open for you, otherwise you will not be able to pass through the swamp and you will not be able to find the princess” said the bird. Bunyod pushed the stone and saw that there really was a letter with a written task under it. He began to read these tasks: 1) If the energy of a quantum (photon) incident on a substance is less than the rest energy of an electron entering this substance, then ..... happens. 2) If the energy of a quantum (photon) entering a substance is greater than the rest energy of an electron entering this substance, but less than twice the rest energy of an electron, then ..... it happens. 3) If the energy of a quantum (photon) incident on a substance is more than twice the rest energy of an electron entering this substance, then ..... happens. 4) In classical scattering, the photon frequency ..... 5) In quantum scattering, the photon frequency .....

As soon as Bunyod completed these tasks correctly, he saw a path through the swamp. In this way he quickly crossed the swamp. Again, the professor-teacher addresses the students: “How do you think you would complete these tasks?” Students are called to the board at will. They tell the answers to these tasks. The professor-teacher then evaluates these students based on their responses.

Block 3. Several photos related to the topic of the lesson are shown to slightly distract students from the topic and relax them. These pictures depicting scientists who carried out scientific research in the field of quantum theory (N. Bohr, M. Planck, Compton, G. Hertz and others) will be needed. In this, too, the professor-teacher evaluates active students.

Block 4. The professor-teacher continued the story: “The ball rolled along the road, which ended up in a swamp. Bunyod hurriedly followed him. The ball suddenly stopped. Bunyod took a closer look and saw that there was a deep ditch in front of him. This ditch cannot be bypassed, it is impossible to jump off it. Bunyod thought, not knowing what to do. His gaze fell on a large stone lying at the far end of the ditch. The following words were written on the stone: “If you find physical errors in the audio text that will now be given, a bridge will appear over the ditch and you will cross it, otherwise you will not be able to cross the ditch and reach your goal.” Again the professor-teacher addresses the students: "Attention, students! Now we are listening to an audio text. Listen to it and find physical errors in the text."

After that, the professor-teacher played the audio text previously recorded on the computer. Voice text turned on and off. This allows students to listen to the text again and makes it easier to find physical errors in the text. The content of the text is as follows: “Two friends met, Dilshod and Ulugbek, who had not seen each other for a long time. After the greeting, Ulugbek boasted to Dilshod that "I know physics, its branch of atomic physics, especially the Compton effect." Dilshod did not come empty-handed: "I also know atomic physics and the Compton effect well." After that, they began to show their knowledge. Ulugbek said: "The Compton effect is formed as a result of an elastic collision of a particle with the electrons of an atom of matter." Dilshod answered him: "The Compton effect is formed as a result of the inelastic collision of a photon with the electrons of an atom of matter." Ulugbek asked again: “Do you know that the Compton effect can be directly observed with the eyes?”

Dilshod answered him: “Of course, this can be observed with the ordinary eye, because everything can be seen with a telescope, but did you know that the Compton effect occurs when a particle of arbitrary energy collides inelastically with an electron?” Ulugbek replied: "Don't you know that everyone knows this." "Dilshod, have you heard that the crystal acts as a body in Compton's experiment?" Dilshod smiled and said, “Of course I heard. I even know the properties of the crystal

used in this experiment. It will have a certain volume, but will not have a constant crystal lattice. And the particle that dissipates in it has a certain mass." Ulugbek told him: "Hey, wait, I think you got everything mixed up." "Okay, then answer my other question: "Does the frequency of a photon change during Compton scattering? Think first." "What should I think? I say without hesitation that the frequency will not change." write down the questions and answers given in it in their notebooks, since these questions and answers may be lost from their memory. Again, the professor-teacher addresses the students: “What do you say, how would you answer these questions?” Students are called to the board at will. They will answer these questions. The teacher-professor then evaluates these students based on their responses.

Block 5. The tale continued: “Bunyod clearly pointed out all the errors in the text. After that, a bridge appeared across the stream, and Bunyod crossed it and continued on his way, walking for a long time. Finally he reached the castle where the princess was hiding. He saw with his own eyes that all the surroundings of the castle were empty, and the walls were built so high that they were impenetrable. He tried to bring down the walls, but their strength did not allow. Bunyod was delighted to see a small door in these walls. But his joy did not last long, because there was a large padlock on the closed door. He again fell into depression, but this process did not last long. Suddenly a voice was heard: “Don’t be so sad. If you answer the following questions correctly, the door will open by itself and you will achieve your goal, otherwise you will not see the princess again: 1) What is the reverse Compton effect? 2) Where is the Compton effect used? 3) What phenomenon occurs when the energy of the incident quantum is greater than the energy of an electron at rest, but less than twice the energy of an electron at rest? 4) Why was a calcium carbonate crystal used in Compton's experiment? Here again, the professor-teacher addresses the students: “What do you say, how would you answer these questions?”. Students are called to the board at will. They will answer these questions. The professor-teacher then evaluates these students based on their responses.

Block 6. In this block, a system of complex tasks is organized, aimed at developing students' motivation, diverse and logical thinking, and creative abilities. The appearance of this block for the Compton effect theme can be as follows.

The professor-teacher continued the tale: “With the last words of Bunyod, the lock on the castle door opened and fell to the ground, and the door opened. The princess was standing in front of him. She said: "Good Bunyod!" You overcame all the difficulties and trials that preceded you and arrived here. But I can't go with you because my spell hasn't been broken yet. In order for it to be removed, you must correctly answer the following questions, otherwise my spell will not be solved and I will not be able to go with you: 1) Derive Compton's formula; 2) formulate the conclusions following from this formula; 3) give a physical definition of the effective scattering cross section and explain this definition; 4) Explain the Klein-Nishima-Tamm formula. Bunyod fulfilled this task. The evil spell has been broken. The abandoned castle is gone. Bunyod and the princess appeared in the king's palace. He was very happy to see his daughter. He gave Bunyod the promised half of the wealth and a daughter. Here the tale ends. "Blessed is he who listened to him and repeated atomic physics and the Compton effect." Here again, the professor-teacher addresses the students: “What do you say, how would you answer these questions?”. Students are called to the board at will. They will answer these questions. The teacher-professor then evaluates these students based on their responses.

Block 7. This block provides feedback to the students in the lesson and gives a qualitative and emotional assessment of the lesson itself to the students. The appearance of this block for the Compton Effect theme can be as follows.

Creation of syncwine on the theme "Compton effect". Syncwine is a unique non-rhyming poem, consisting of five lines, which contains information about the concept (event, event, topic) being studied, expressed in the words of the reader in different versions and from different points of view. Syncwine is an important skill for expressing complex ideas, intuitions and feelings in just a few words. The process of creating a syncwine helps to better understand the topic. The rule for compiling a syncwine: 1) In the first line, the subject (task) is depicted in one word (usually with a noun); 2) The second line consists of two words, and these words must consist of adjectives. Words should reveal the main theme. 3) In the third line, the actions within the subject are expressed in three words. 4) In the fourth line, an opinion (intuition) is written, consisting of four words, which means attitude to the subject. 5) In the last line, write one word that repeats the essence of the topic and is close to it in meaning.

The syncwine for the Compton Effect theme looks like this:

Compton Effect

quantum scattering quantum effect

dissipates collides elastically gives energy

electron formula effective cross section reverse effect

photon scattering

Students who have compiled a syncwine are called to the board at their own request. They will read and explain their syncwines. The teacher-professor then evaluates these students based on their responses. At the end of the lesson, the professor-teacher summarizes and announces the final grades of the encouraged students.

Summing up this lesson, we can say with confidence that pedagogical optimism has a strong influence on the upbringing of a creative personality, and confidence in a student is manifested not only in his abilities, but also in his moral qualities. Pedagogical optimism is expressed in the problematic nature of teaching the formation of the educational process, in the constant complication of cognitive (a theoretical approach aimed at comprehending the way of thinking and understanding the psyche) tasks, in the development of students' creative abilities in rather difficult conditions. than simple education. If the student's reputation with other students and in his own evaluation increases, communication between professor and student will increase the effectiveness of the promotion described above.

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