II. ПРОБЛЕМИ МЕТОДИКИ НАВЧАННЯ ФІЗИКИ

NON-STANDARD IMPLEMENTATION AND PHYSICS TOYS AS MOTIVATION STIMULATING EGENTS

Nataliya KAZACHKOVA

У статті запропоновано використання нестандартного обладнання в процесі викладання фізики, розроблено та експериментально перевірено методику його запровадження, розкрито основну мету мотивації розвитку та підвищення рівня знань учнів середніх шкіл в галузі фізики. Описані деякі зразки нестандартного обладнання та рекомендації щодо їх використання на уроках та в позакласній роботі.

The methods of using non-standard equipment in physics teaching process have been proposed, developed and experimentally tested. The main goal of the methods is motivation developing and increasing the secondary school students' knowledge level in physics. Some samples of non-standard equipment have been produced and described. Recommendations how to use them at the lessons and beyond have been given.

1. INTRODUCTION

The problem of physics teaching refinement is a very actual nowadays in Ukraine at all levels (from the secondary to high school level). The approach focused on the using non-standard equipment (often even the household objects and physics toys as models) allows to considerably increase the evidence of physics teaching process particularly for students from 12 to 15.

2. THE ANALYSIS OF PREVIOUS INVESTIGATIONS AND PUBLICATIONS

Modern psychological and pedagogical investigations in Ukraine pay attention on such categories as motivation, an interest to the subject, creative thinking, using of visual methods, which can not be effectively realized in teaching process by using only traditional forms and methods. It should be something a bit different for ordinary school speech day. One of the ways to solve the problem is developing the new educational technologies. There should be methods, which promote teachers' and students' activity by creating situations when the activity of the pupils becomes apparent. That's why the increasing of motivation to learn physics raises the role of motivation and developing the cognitive skills of the secondary school students [2, 9].

Cognitive interest can be determined as an emotional and cognitive attitude towards the subject, which is motivated itself and has a tendency towards growing to a cognitive orientation of the personality. But the interest not always causes of an active learning activity. There are few phases of evolution from its first stage – mere curiosity to the second stage – inquisitiveness (or intellectual curiosity) and after that to the stage of developed cognitive skills and ability to become acquainted with real research work or so called professional interest in physics [8].

The motivation lack problem can be approached from at least two perspectives. Every physics subject matter has got *a structure* and *a content*, therefore, the first perspective is restructuring the way we present the material. The second is broadening the context of the analysis and the perception of the studied subject. Both ways can give us a key to a more successful and motivating teaching strategy.

Increasing secondary students' motivation has always been a challenging task for most physics teachers. Some teachers find it easier, another ones more difficult, but everyone agrees that it takes a lot of time and effort to be able presenting material in a clear, interesting and exciting way for students [7].

The modern conception of physics education in Ukraine bases on the pupils' personality, developing the secondary school students' abilities and creativity. Evolution of motivation of the pupils during the learning process is an actual problem for lots of science teachers in modern schools. But there is a lack of correspondence between a school curriculum and a possibility of learning science in Ukraine. In general, our pupils suffer from an informational overload and it is a reason for decreasing an interest to physics, chemistry, mathematics etc. One of the most effective way of motivation to learn physics properly is non-standard lessons, which based on combination of acting, music, quizzes in format of funny competitions for the secondary school students, where kids can do some entertaining experiments themselves [2, 3].

3. RESEARCH QUESTIONS

The problem described in the article is the effort to find the answer: "How to create the innovative teaching methods at the first stage of physics course to form positive motivation of learning physics in future, how to develop the experimental skills of the students and improve the efficiency of physics teaching process".

The object of our research is the physics teaching process at school and beyond at the early stage of learning (students aged from 12 to 15)

The subject of our research are methods and forms of physics teaching by using non-standard equipment at the early stage physics course.

4. EXAMPLES OF APPLICATION OF THE ELABORATED AND DEVELOPED NON-STANDARD EQUIPMENT.

The analysis of physics teachers' questionnaire forms has shown that falling interest in key physics topic has been linked to the way they are taught from the first steps in physics and the lack of standard teaching implementation in the Ukrainian schools. So we have elaborated some samples of non-standard devices, which can be used instead of the ordinary ones. In this article we are going to describe some of them.

Improved "Cartesian Diver"

The main goal is demonstration the existence of the buoyancy force, the action of Pascal's Law, third Newton's law and jet propulsion of moving stream from the tiny holes of the "diver".

The improvement can be seen in Fig.1. It consists of three main points:

1) the aluminium “cap” which is connected with pear-shaped rubber tube. Pressing the tube we can change the pressure inside the cylinder with dyed distilled water;

2) the shape of the “Diver” change from the ordinary test-tube to the glass octopus with tiny holes in its tentacles (when we press the rubber tube and change the pressure inside the vessel the “diver” rotates due to the jet propulsion of moving stream from the tiny holes of the tentacles);

3) there is a quartz-halogen bulb under the transparent bottom of the cylindrical vessel with water (when the light is switched on the level of liquid in the octopus body is sparkling brightly and can be seen much better)

Fig. 1: *Improved “Cartesian Diver”*

Improved “AstroBlaster”

Lots of physics teachers know the toy which is called “AstroBlaster”. It consists of several rubber balls with different diameter threaded on the plastic pivotal shaft. The toy illustrates the laws of conservation of momentum and can be a model of energy conservation during the creation of a supernova. When the apparatus is dropped straight onto a hard surface, the smallest top rubber ball can rebound to a height equal to five times the original drop. But the main disadvantage of the demonstration is that the process takes too short period of time, so it is difficult to notice the distance which depends on the balls number. So we put the balls on the vertical steel rope (the diameter of the rope is 1,5 – 2 mm, the length is 3-4 m) and attached the small bells on the top of the construction. As soon as the ball arrive the highest point the bell rings and it helps to make the demonstration much more visual and possible to make simple estimations. The lower part of the device can be seen in Fig.2)

Fig. 2: *Improved "AstroBlaster"*

Physics toys allow one to see first hand the different principles of physics in action. They are an easy and inexpensive way to visualize certain concepts which would otherwise be difficult to grasp. A lot of studies of how children learn have shown that the manipulation of concrete objects can assist in the understanding of concepts that would otherwise be quite abstract [8]. We have chosen to use toys for these objects, because they are familiar and interesting to both children and teachers. This familiarity helps them to make connections between school learning and other life experiences. Toys help make the point that physics isn't something that one does some times per week in school with equipment that goes back in the "science cabinet" when the lesson is over, but rather something that permeates everyday life. They are also readily available and relatively inexpensive. In some cases, we use handmade toys, which both have little cost and enable the students to continue to work on the experiment at home. The examples of some children toys which can be used at the lessons demonstrated at Fig.3.

Fig. 3: *Toys used in teaching process*

5. TEACHING METHODS AND RESULTS

Let us give the methodical and technological aspects of the lessons organization, where we proposed to use non-standard equipment and physics toys. Before the event (or the lesson), participants have been divided into group of 4 or 5. The children into each group sit at the desks next to each other's and those group are called teams. Then the teams have been given three coloured index pointers (in our case they were red, blue and green). After that the lecturer demonstrates the phenomenon, paradoxical experiment or physics toys, which accompanied by computer presentation and music, to increase the emotional influence on children. Together with children, they formulate the problem. At the same time, there is an inquiry-based question on the screen and three variants of answers (red, blue and green). The students should discuss the problem into small groups and find out the appropriate variant of answer on the screen (cooperative learning). The captain of the team should pick up the pointer of the definite colour, corresponded to the right coloured answer on the screen. Each correct answer awarded by the score, if the student gives the short correct explanation his team will receive two or three more scores. The winners can be awarded by the good marks at the lessons or by the special prizes (wooden puzzles or interesting physics toys)

Our research has based on the hypothesis that regularly using technologies connected with inquiry based science teaching (IBST) form a strong motivation to learn physics and improve the creative skills of the students aged from 12-15. The first part of our pedagogical experiment has been made at the premises of two Kharkiv schools: Gymnasium # 47 and Lyceum # 116. There non-typical resumptive lessons had been presenting from 2006 to 2009. 302 secondary school students have been involved in the pedagogical experiment. Participants were divided into Control Groups and Experimental Groups. The several tests were proposed to the groups. The results of the tests have demonstrated the effectiveness of our methods. The second part of our experiment has been made at premises of Kharkiv Educational Centre for Gifted Students which is situated at Karazin Kharkiv national University. More than 1580 children aged from 12 to 15 have filled the questionnaire forms after interactive physics competitions which were called "Paradox Show". During the outreach events children were able to use household objects, simple devices and recycled materials (like plastic bottles or paper cans and others). It helps to improve the environmental security as so as simple explanations we have provoked children to make experiments and construct simple devices to understand physics principles and definitions much better.

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ВІДОМОСТІ ПРО АВТОРА

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Коло наукових інтересів: методика використання нестандартного обладнання у навчальному експерименті з фізики.

ПРОБЛЕМНЕ НАВЧАННЯ В ПРОЦЕСІ ФОРМУВАННЯ ФІЗИЧНИХ ПОНЯТЬ

Олеся БУЗЯН

У статті обґрунтовано доцільність використання проблемного методу навчання у вищій школі під час фахової підготовки вчителя фізики. Наведено приклади використання прийомів проблемного навчання у формуванні фізичних понять.

***Ключові слова**: проблемне навчання фізики, вища школа, фахова підготовка.*

In the article the feasibility of using the problem method of teaching in higher education in the professional training of teachers of physics. Examples of the use of problem-based learning techniques in the formation of physical concepts in students.

***Keywords:** problem of teaching physics, high school, professional training.*