

Non-formal education of physics including making devices for demonstration

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The article views non-formal education of physics as an opportunity for upgrading knowledge, acquiring new skills and improving the personal and social qualities of students during their high-school education. The article offers an alternative form of education in the course of which students make their own devices for demonstrating harmonic oscillation in the 9th grade. It summarizes the importance of non-formal education namely as a way of enlarging the scope of students' intellectual properties and increasing their interest in science and engineering, which, in its turn, makes the learning process a desirable challenge.

Keywords: Non-formal education, Physics education, Harmonic oscillation, Devices, Demonstration.

INTRODUCTION

In contemporary pedagogical reality education is efficient provided it is carried out in accordance with the interests of our present-day generation. The last few years have marked an alarming tendency for students to study less. This has become one of the basic problems of Bulgarian education, which rests on the shoulders of every teacher to solve the best way they can think of. That is why, he/she should refer to new and a bit more motivating means and methods to apply at school, so as to boost students' interest and develop their skills. A method which has firmly established itself as fruitful and efficient is incorporating students into the school subject matter through some extracurricular activities, which are part of the so-called non-formal education.

WHAT IS NON-FORMAL EDUCATION ALL ABOUT?

Personally, education is related to the accumulation of knowledge and the development of certain skills, as well as to the acquisition of competences, and socially it has to do with the establishment of the person as a part of society. Education has three forms [1]:

a) The first one known as *formal education* has a levelled structure functioning from primary to university educational institutions. A student who has completed one level or has got qualification in accordance with this educational system gets a certifying document.

b) The second form known as *informal education* centers round education on the basis of life experience and with the participation of people, media, institutions which we happen to come across in our personal bubbles.

c) Particularly innovative has become lately the third form known as *non-formal education* in which, unlike the traditional formal system, activities are outside the structure framework. Non-formal education is achieved in clubs and courses, during seminars, at work, even through sport because of which it has become the object of much deserved interest. R. Valchev *et al.* point out several important characteristics of this education [2]:

- meets the needs of disadvantaged groups;
- sets target groups which include certain categories of people;
- is directed to a strictly defined goal;
- is rather flexible as regards the organization and the methods that are applied.

V. Gyurova dwells on the way non-formal and informal education relate to each other [3]:

a) *non-formal education* has to do primarily with the choice of activities and subjects. It is offered by schools (clubs, study circles, etc.), as well as by other institutions like foundations, associations, societies...;

b) *informal education*, also called parallel, has to do with the development of mass media as a relevant source of information and knowledge, which one way or another, influences the formation of beliefs and values depending on the intellectual properties and culture of different people.

In non-formal education, creative and innovative approaches are applied, together with familiar classical methods, to actively involve trainees in non-formal activities but with an important learning element. From the point of view of the learner, this is conscious learning, considers V. Bozhilova [4].

M. Eraut argues that non-formal education improves some personal qualities like critical thinking, inquisitiveness, creativity, leader skills, etc. They can be successfully combined with some social skills like capacity for communication,

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solidarity, justice, responsibility, etc. The combination of these two types of qualities contributes to the formation of a person of social intelligence capable of coping easily with his/her future educational and other activities [5].

D. Livingston thinks that, alongside formal, non-formal education is increasingly being structured – curricula are being developed, training is being developed within training modules, training is being certified and evaluated. Although these tendencies are different in both systems, they are the two sides of a common movement – integrating formal and informal education into a highly applicable hybrid [6].

In pedagogical practice during the last few years one can see blurring of the boundaries between formal and non-formal education. Nevertheless, G. Straka defines three criteria to differentiate formal from non-formal education [7]:

1) degree of educational planning of external conditions – i.e. to what degree these conditions contribute to the achievement of certain educational goals;

2) certifying – getting a certificate (or a document certifying a degree of education);

3) legalization of certificate.

These criteria manage to overcome the ambiguity of the standards used so far in Europe for differentiating and measuring formal, informal and non-formal learning.

In 2008 the first survey of non-formal education was published in Bulgaria. In it S. Nikolaeva on the one hand differentiates this education in terms of theory and practice, and states her reasons for her differentiation on the other. Non-formal education can hardly be defined only as the ideal, procedural or social anti-thesis of formal education. Actually, it is not so much a matter of anti-theses as of parallel elements, processes and sub-systems of the social system of “education”, which all complete one mission and achieve common global aims often using the same means but in an alternative context [8].

To put it in a nutshell, non-formal education has its peculiarities in a systematic, contentional, organizational, technological, subject-oriented, result-driven plan. It lays an emphasis on volunteer work and choice, flexibility and adaptability, multifunctionalism and openness. That is a good enough premise for increasing students’ motivation as well as for developing their organizational, creative, communicative among other skills.

Through informal learning, hard-to-learn science can become surprisingly accessible. For example, creative cognitive tasks develop the ability to better

understand physical phenomena and laws. By "seeing" the practical side of physics, they can clearly realize that it is not only a "dry" matter, but a fundamental and readily understandable science. In this way, students' desire to study nature, technology and space increases, and this has a positive effect on their motivation for future learning and practical realization.

NON-FORMAL EDUCATION OF PHYSICS WITH MAKING DEVICES FOR DEMONSTRATION OF HARMONIC OSCILLATION

A form of non-formal education of physics was implemented in Peyo Yavorov High School, Petrich, in 2012. Four students in the 11th grade, divided into two groups constructed and made two devices for demonstration on the topic of Harmonic Oscillation, part of chapter Mechanical oscillation and waves, which is studied in the 9th grade. All the activities on the project took place in the classroom of physics after regular classes whereas the practice was realized in a carpentry workshop and an automotive repair shop again outside regular school hours. From the very start right to the end of the enterprise both groups worked with enthusiasm sharing ideas, offering constructive ideas. All four students had studied harmonious oscillation in their 9th grade, that is two years previously, and knew what exactly to show and how to do it by making the devices.

The first device, made by one of the groups has a main body unit, which consists of one horizontal basic plank and two other planks mounted vertically on the sides (fig.1). A graduated wooden scale is attached to them; above it a metal stick with a threaded ball is installed; it is fixed to the spring, which in its turn is fixed to the main body unit. With the stretching of the spring the ball starts moving under the force of elasticity, which is proportional to the deviation from its equilibrium point. Thus the device demonstrates harmonic oscillation. Besides, the scale can also measure the deviation of the ball so as the strength of the force and the acceleration typical for that movement to be estimated.

The second device made by the other team is of a wooden body unit and a side wooden plank (fig.2). A metal crank is installed in it with a cardboard disc attached to the front side; a table tennis ball is fixed onto the disc. An L-shaped plate is installed on the vertical plank right above the disc with a tiny lamp powered by battery. The crank makes the disc move steadily with a constant speed. Since the lamp illuminates it from above its shadow starts moving gradually along the horizontal plank. One full circle of the ball round the axis of the disc corresponds to

one full harmonic oscillation. Thus the device demonstrates that the projection of a body that rotates steadily performs harmonic oscillation.



Fig. 1. A device for demonstrating harmonic oscillation and for measuring the deviation of an oscillating body.



Fig. 2. A device establishing the analogy between harmonic oscillation and moving in a circle.

Both devices were displayed in section Demonstration and lab devices and machines for physics classrooms at the student contest **Devices for the classroom of physics**, organized by the Sofia branch of the Union of physicists in Bulgaria at the beginning of April, 2012 (fig. 3). The panel of judges awarded Donika Angelova and Stoyan Yankov **first prize in the category 9-12 class** for the making of the device for establishing the analogy between harmonic oscillations and moving in a circle.

CONCLUSION

Non-formal education is a preferred form of education by students, since it easily changes their attitude towards the educational contents studied at school. It is an object of interest because practically

it can be realized everywhere, it can cover different fields and make use of various means, as well as lead to a targeted motivation.

The basic conclusion the non-formal education of physics leads to is that this type of education enriches students intellectually, develops their skills and boosts their interest in science and technology. Thus studying becomes a yearned for challenge. In pedagogical practice the teacher of physics should deftly combine formal and non-formal education so that students can acquire knowledge better and for longer and give meaning to the studied physical processes and phenomena.



Fig. 3. Students of Peyo Yavorov High School, Petrich, presenting their devices in the foyer of the Faculty of Physics at St. Kliment Ohridski University of Sofia.

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