

FEATURES OF THE IMPLEMENTATION OF THE PRACTICAL APPLICATION OF SCIENCE EDUCATION IN THE CONTENT OF COURSES SELECTED BY A INSTITUTIONS OF BASIC SECONDARY EDUCATION

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Rezumat: În articol sunt analizate stadiul actual al implementării practice a învățământului științific școlar în conținutul cursurilor opționale pe exemplul predării fizicii în instituțiile de învățământ secundar de bază. S-a constatat că aspectul cheie al aplicării practice a învățământului școlar modern este orientarea conținutului, metodelor, formelor și mijloacelor de învățare a acestuia asupra aplicării cunoștințelor în inginerie și tehnologie, cercetarea științifică și activitatea profesională a unei persoane. S-a ajuns la concluzia că întărirea aplicării practice a fizicii este o condiție didactică importantă pentru formarea competențelor.

S-a stabilit că un instrument important pentru implementarea aplicării practice a conținutului cursurilor opționale de fizică îl constituie sarcinile orientate spre practică, de regulă, cu conținut interdisciplinar, a căror rezolvare contribuie la asimilarea temeinică a cunoștințelor naturale, abilități și abilități, conștientizarea semnificației practice a teoriilor științifice și impactul acestora asupra dezvoltării echipamentelor și tehnologiilor. Completarea sarcinilor unei aplicații practice contribuie atât la formarea competenței subiectului în fizică, cât și a competenței cheie în domeniul științelor naturale, ingineriei și tehnologiei.

Cuvinte-cheie: curs de fizica de bază; competențe cheie; cursuri opționale; aplicație practică; sarcini orientate practic; educația școlară științifică.

Abstract: The article analyzes the current state of the implementation of the practical application of school science education in the content of optional courses on the example of teaching physics in institutions of basic secondary education. It was found that the key aspect of the practical application of modern school education is the orientation of its content, methods, forms and means of learning on the application of knowledge in engineering and technology, scientific research and professional activity of a person. It was concluded that strengthening the practical application of physics is an important didactic condition for the formation of competences.

It has been established that an important tool for implementing of the practical application of the content of elective courses in physics is practice-oriented tasks, as

a rule, of interdisciplinary content, the solution of which contributes to the thorough assimilation of knowledge of the natural world, skills and abilities, awareness of the practical significance of scientific theories and their impact on development of equipment and technologies. Completing tasks of a practical application contributes to both the formation of subject competence in physics and key competence in the field of natural sciences, engineering and technology.

Keywords: *basic physics course; key competencies; optional courses; practical application; practically oriented tasks; school science education.*

The practical application of the basic course of physics in the Concept of basic physical education is the orientation of the content, methods, forms and means to the application of physical knowledge in engineering and technology, scientific research, professional activity of a person and his everyday life. The solution of the practice-oriented tasks which contributes to the students' thorough mastery of physical knowledge, abilities and skills, awareness of the practical importance of physical theories and their impact on the development of science, technology and technology is an important tool for implementing the practical application of the physics course. The practical application is considered as a means that establish a connection between the content and target components of the basic course of physics: the priority of its mastery is the acquisition of the knowledge and skills by students that they will need throughout their lives and therefore necessitates the need to specify and complicate their structure at the appropriate levels of education [2].

A powerful means of effectively solving applied tasks is the creation of an appropriate educational environment, which involves the introduction of subject, interdisciplinary, profile and applied courses of choice into the educational process. The study of such courses plays a particularly important role in the formation of students' competencies, since their content meets the educational needs of schoolchildren as fully as possible and is aimed mainly at independent practical activities. The various forms and methods of organizing educational and cognitive activities in the process of assimilating the content are combined.

Elective courses are competence-oriented courses where the boundaries of science subjects are deepened and expanded and their content is developed, supplemented and integrated. The purpose of the courses is to meet the individual educational interests, needs and inclinations of each student, to form subject and key competencies. The task is to help in choosing a study profile (by studying elective courses at the pre-special level, the student has the opportunity to choose a further study profile mindfully), to deepen knowledge of science subjects; to help graduates of general secondary education institutions in their professional self-determination, to stimulate the development of comprehensive and professional abilities and skills of students, to prepare for external independent evaluation.

The above-mentioned courses are divided into subject-oriented ones, which enable students to realize their own cognitive interests in the chosen educational field and along with it form skills and methods of solving practically oriented tasks (educational practice, project technology, research activity); interdisciplinary, the task of which is to create conditions for the formation of students' competencies and motivation to study.

The content of subject-oriented courses involves in-depth study of individual topics of the basic school physics course, ensures a higher level of assimilation of the content of the subject, the formation of key and subject competencies. They are divided into advanced level courses aimed at thorough study of the subject. Such a course makes it possible to learn the educational material more detailed, to study individual sections thoroughly, the purpose of which is to get acquainted with important ways of applying knowledge, developing interest in modern technology and production, mastering the methods of learning about the natural world, studying the history of the subject, composing and solving applied problems on based on the results of physical, chemical and biological experiments [1].

The purpose of the course is the formation of competencies, specialized and initial professional training of institutions of basic secondary education students in accordance with their interests, inclinations and personal abilities, improvement of general scientific culture, deepening of the system of applied knowledge required for the practical application of physical theories, laws, regularities, formation of skills and abilities for solving applied problems, performing laboratory and practical work.

The main tasks of the courses are to satisfy the cognitive interests of the students, the formation of key and subject competencies based on the assimilation of applied knowledge about physical laws and regularities, the most important theories and concepts, the implementation of measurements of physical quantities, the formulation of generalizations and conclusions, the acquisition of algorithmic and heuristic techniques for solving applied physical problems, justification and generalization of results based on systemic connections between the components of the problem, expansion of the condition by increasing the number of unknowns, a drawing up of tasks in compliance with the requirements of the principle of consistency, ensuring the competence training of students, familiarizing them with the practical application of the laws of physics, the scientific foundations of modern production, leading trends in its development, deepening of pre-professional training, acquisition of a specialty relating to the use of applied knowledge, development of intellectual, creative, moral and social qualities, striving for self-development and self-education.

The content of the educational material is compiled in accordance with the principles of deepening, consistency, integration and functionality of theoretical knowledge, strengthening their applied nature, methodological and practical

orientation. It is based on the following general didactic principles: integrity; scientific and accessible (the simplest tasks are the basis for building more complex ones); consistency (formation of physical knowledge and skills is carried out systematically and purposefully); creative activity and independence (independent acquisition of knowledge and solving individual tasks); the connection between theory and practice (awareness of the vital need for physical knowledge, development of a child's mental potential).

We will give an example of the optional course "Development of Physics and Technology in Ukraine" (9th grade).

Purpose: formation of informational, innovative competence in the field of natural sciences, engineering and technology, environmental etc. students' competencies.

Tasks: teaching physics as a theoretical and experimental basis of technology, familiarization with the history and prospects of the development of physics and technology in Ukraine, the application of fundamental laws in practice (on the example of technology and production), the formation of interest in science and technology, a valuable attitude to the created technical objects, taking into account their practical and ecological characteristics, acquiring the skills to navigate in a modern production environment and developing practical skills for working with technical devices, applying physical knowledge during the performance of practical tasks relating to technical equipment and mechanisms (home experimental tasks using household appliances), solving technical problems etc.

The proposed course is designed for 12 hours and includes: lectures (2 hours), practical classes (6 hours) and excursions (4 hours). It is appropriate to consider in its theoretical part the role of physics in the development of technology and production, the contribution of domestic scientists to the development of world science and technology, and environmental problems related to the development of production. The approximate topics of the lectures may be as follows:

1. Modern technology and production of Ukraine (Naftogaz, Ukrzaliznytsia, DTEK Elektroenergetika, Ukrtatnafta, NAEK Energoatom etc.).

2. Technology and the environment (the impact of emissions of harmful substances by metallurgical enterprises, exhaust gases on the environment, power plants on the ecology of the region, technical devices for protecting and cleaning the environment, positive and negative aspects of the impact of technology on people).

The purpose of the procedural module of the course is to deepen the knowledge gained at the lectures and to apply them while solving practical problems. Since it consists of independent tasks, so it'd be advisable to organize it in the form of seminars where the students will present the results of their own activities. It is recommended to use part of the course hours for excursions with the purpose of direct observation and familiarization with the application of physical knowledge in real life,

Let's consider another optional course for students of the 9th grade, the purpose of which is the formation of environmental competence - "Physical pollution of the environment and its impact on humans".

One of the most urgent problems of our time is the problem of environmental protection. First of all there are associations with various chemical factors when it comes to environmental pollution, (air pollution with carbon dioxide, water and soil with poisonous chemicals etc.). And such phenomena as noise, vibration, light seem to be harmless at once, although in truth, they are also environmental pollutants, with their electromagnetic radiation, radiation, and have a significant negative impact on human health.

The goal of the course is the formation of environmental competence that consists of relevant value orientations, knowledge, skills and practical experience. After completing its study, the student should **know**: 1) physical parameters of the environment and standards of a person's comfortable state; 2) types of pollution (chemical, physical, biological) and their impact on humans; 3) physical indicators characterizing the capabilities of the human body and methods of their determination; 4) methods of assessing the state of the environment and its protection; **to be able to**: 1) assess the environmental situation; 2) determine the physical characteristics and capabilities of their own body; 3) to effectively use the limited resources of nature and the human body; to have the following **value orientations**: 1) responsible, respectful attitude towards family, society, environment, careful attitude towards health; 2) awareness of the importance of caring for the environment.

The course program is designed for 10 hours (Table 1).

*Table 1. Thematic plan of the optional course
„Physical pollution of the environment and their impact on humans”*

No	Type of lesson	Summary (covering the issue)
1.	Lecture „Nature and Man”	Relationship between man and nature. Environmental pollution as a result of its activities. Types of physical pollution.
2.	Seminar „Noise and vibrations”	The role of vibrations in technology. Their harmful effect on the human body. Development and application of anti-vibration devices. Mechanical fluctuations and the greenhouse effect. Noise as an environmental factor. The negative impact of sound waves on the human body and other biological objects. Permissible noise standards. The role of green spaces in the fight against it.
3.	Seminar „Electromagnetic types of radiation”	Biological effect of ultra-high frequency electromagnetic waves, ultraviolet, infrared and X-ray radiation and protection against them.

4.	Seminar „Radiation”	Radioactive contamination of the biosphere by products of nuclear explosions. Atomic energy production. Problems of burial of nuclear power plant radioactive waste. Safety techniques at nuclear installations. The effect of radioactive pollution on the human body.
5.	Final conference	Student reports, prepared on the basis of completing homework assignments and filling in the summary table (Table 2).

Table 2. Types of physical pollution

Type of physical pollution	Sources of pollution	Impact on people	Ways and methods of protection
Noisy			
Vibrating			
Electromagnetic			
Radiation			
Warm			

Let’s consider examples of practical homework.

“Electromagnetic radiation”.

Using a compass, investigate the presence of electromagnetic fields around household appliances (refrigerator, TV, computer, microwave oven, washing machine, mobile phone, light bulb etc.). According to the deviation of its arrow, compare the electromagnetic fields created by different devices.

“Measurement of the radiation background”.

The equipment is a dosimeter. Schoolchildren carry out either a radiation study of the city area: they examine various objects (shops, schools, residential buildings, roadways etc.), compare them and draw a conclusion as to area where is safer to live in, or they study the radiation of household appliances and suggest ways to reduce its harmful effects.

Also, within the scope of the optional course, the practical work “Evaluation of your own workplace” can be offered as homework. Its implementation is relevant given the fact that the organization of the workplace is an important component of a person’s further professional activity. Students need to be given certain recommendations on the use of appropriate devices.

Stages of work performance:

1. Study of workplace lighting. Lux meters can be used in order to determine the illumination created by various sources (electric lamps, natural light etc.) that are arbitrarily spatially located. The principle of their operation consists in the conversion of radiation into an electrical signal by the photo-receiving device, followed by the indication of numerical values of illumination.

A number of modern means of monitoring the physical parameters of the environment are used to measure illumination, brightness, temperature, humidity etc. Students independently study the instructions attached to the device, perform measurements and compare them with ergonomic standards, formulate conclusions, and provide recommendations.

2. Determining the noise level at the workplace. In order to determine the noise level, a sound meter is used or a table of noise level indicators of various sources is used.

In the process of studying elective courses based on the assimilation of applied knowledge of physical laws and regularities, the most important theories and concepts, subject and key competences are formed, profile and in-depth pre-professional training of students is provided, skills and problem-solving skills are developed, familiarization with the scientific foundations of modern production, leading trends in its development, highlighting the humanistic orientation of physics, its role in human life.

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