DOI https://doi.org/10.51647/kelm.2021.2.1.4

DOSKONALENIE DZIAŁALNOŚCI SAMOKSZTAŁCENIOWEJ STUDENTÓW KIERUNKÓW TECHNICZNYCH NA ZASADACH INNOWACYJNEGO ROZWOJU SPOŁECZEŃSTWA (NA PRZYKŁADZIE NAUCZANIA FIZYKI)

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Adnotacja. W przepisach artykułu naukowego autorzy rozważają interpretacje pojęć „działalność samokształceniowa" i „kompetencje samokształceniowe" w nauczaniu fizyki w instytucjach technicznych szkolnictwa wyższego. Wyróżniono cechy tego procesu i istniejące wady w kształtowaniu kompetencji samokształceniowych przyszłych specjalistów specjalności technicznych. Uzasadniona jest potrzeba opracowania strategii stopniowego zarządzania działalnością samokształceniową studentów w procesie przygotowania zawodowego i nakreślenia jej możliwych kierunków. Warunki jego skutecznego wdrożenia w procesie edukacyjnym instytucji technicznych szkolnictwa wyższego obejmują: zapewnienie motywacji do prowadzenia działań samokształceniowych na zasadach innowacyjności i cyfrowej ajenty; ujawnianie treści samokształcenia; tworzenie problematycznych sytuacji edukacyjnych, a także promowanie rozwoju refleksji u przyszłych specjalistów specjalności technicznych.

Perspektywy dalszych badań naukowych określają opracowanie metodycznego zapewnienia zarządzania działalnością samokształceniową studentów kierunków technicznych w procesie uzyskiwania specjalności i jej walidacji w rzeczywistych warunkach instytucji szkolnictwa wyższego.

Słowa kluczowe: samokształcenie, kompetencje samokształceniowe, kształcenie specjalistów specjalności technicznych, doskonalenie procesu edukacyjnego; kompetencje zawodowe, fizyka, BHP, innowacje.

IMPROVEMENT OF SELF-EDUCATIONAL ACTIVITY OF STUDENTS OF TECHNICAL SPECIALTIES BASED ON INNOVATIVE SOCIETY DEVELOPMENT (ON THE EXAMPLE OF STUDYING PHYSICS)

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Abstract. In the provisions of the scientific article, the authors consider the interpretation of the concepts of "self-educational activity" and "self-educational competence" in the teaching of physics in technical institutions of higher education. The peculiarities of this process and the existing shortcomings in the formation of the self-educational competence of future specialists in technical specialities are highlighted. The necessity of developing a strategy of step-by-step management of student's self-educational activity in the process of professional training is substantiated and its possible directions are outlined. The conditions of its effective implementation in the educational process of technical institutions of higher education include: motivating to carry out self-educational activities based on innovation and digital agenda; disclosure of the content of self-education; creating problematic learning situations, as well as promoting the development of reflection in future specialists in technical specialities.

Prospects for further scientific research are determined by the development of methodological support for the management of self-educational activities of students of technical specialities in the process of obtaining the speciality and its testing in real conditions of higher education institutions.

Key words: self-education, self-educational competence, training of specialists in technical specialities, improvement of the educational process, professional competence, physics, labour protection, innovations.

УДОСКОНАЛЕННЯ САМООСВІТНЬОЇ ДІЯЛЬНОСТІ СТУДЕНТІВ ТЕХНІЧНИХ СПЕЦІАЛЬНОСТЕЙ НА ЗАСАДАХ ІННОВАЦІЙНОГО РОЗВИТКУ СУСПІЛЬСТВА (НА ПРИКЛАДІ ВИВЧЕННЯ ФІЗИКИ)

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Анотація. У положеннях наукової статті авторами розглянуто трактування понять «самоосвітня діяльність» і «самоосвітня компетентність» у навчанні фізики в технічних закладах вищої освіти. Виокремлено особливості цього процесу та наявні недоліки щодо формування самоосвітньої компетентності майбутніх фахівців технічних спеціальностей. Обґрунтовано необхідність розробки стратегії поетапного управління самоосвітньою діяльністю студентів у процесі професійної підготовки й окреслено її можливі напрями. До умов її ефективного провадження в освітній процес технічних закладів вищої освіти віднесено забезпечення мотивації до здійснення самоосвітньої діяльності на засадах інноваційності й цифрової адженди; розкриття змісту самоосвіти; створення проблемних навчальних ситуацій, а також сприяння розвитку рефлексії в майбутніх фахівців технічних спеціальностей.

Перспективами подальших наукових розвідок визначено розробку методичного забезпечення управління самоосвітньою діяльністю студентів технічних спеціальностей у процесі отримання фаху та її апробацію в реальних умовах закладів вищої освіти.

Ключові слова: самоосвіта, самоосвітня компетентність, підготовка фахівців технічних спеціальностей, удосконалення освітнього процесу, професійна компетентність, фізика, охорона праці, інновації.

Introduction. Modern scientific research in higher school pedagogy emphasizes the urgency of the problem of training a competent technical specialist who can effectively perform their production functions, systematically improving their professional level throughout life. The ways of intensification of educational and cognitive activity of students of technical specialities in teaching physics and labour protection for purposeful development of professional competence are considered.

However, it is impossible to solve this task within the framework of only professional training in technical institutions of higher education (HEI). For its maximum solution, it is necessary to pay attention to the management of students' self-educational activities, which complements the educational process in universities based on innovation (use of 3D modelling, STEM-education technologies, artificial intelligence, augmented and virtual reality, etc.).

The need to develop self-educational competence is determined by the Council of Europe, which in the list of key competencies of the individual identified the need for soft skills that realize the ability and desire to learn all life as a basis for continuing training in professional, personal and public life.

The problem of self-educational activity is covered in the works of S. Arkhanhelyskoho, V. Andrieieva, A. Hromtsevoi, M. Piskunova, B. Raiskoho and other scientists. The development of the self-educational competence of technical specialists is considered in the publications of L. Honcharenko, N. Dovmantovych, I. Zymnoi, N. Kovalenko, V. Ivaniutinoi, G. Lebed and others.

Problems of innovation are revealed in the works of prominent scientists:

– relevance of the development of the concepts of innovation and innovation (L. Tondla, H. Frimen, J. Shumpeter, etc.);

– introduction of elements of STEM-education in modern educational institutions, namely in the new Ukrainian school (I. Vasylashko, N. Honcharova, I. Savchenko, etc.);

– transdisciplinarity and ontological approach in the study of fundamental and professionally-oriented disciplines, in particular in the aspect of teaching physics and labour protection with the separation of components of STEM-education (Stryzhak, Prychodniuk, Podlipaiev, 2019; Rostoka, Guraliuk, Kuzmenko, Bondarenko, Petryshyn, 2021; Дем'яненко В.Б., Дем'яненко В.М., 2017).

Each of these researchers reveals some aspects of the implementation of self-education on innovative trends that need to be developed in terms of Industry 4.0, but the management of the process of self-education and psychological mechanisms of motivation to self-education students of technical HEI (which is the study of physics and mathematics and engineering sciences) remain open.

The purpose of the article is to analyze the features of self-educational activities of students of technical specialities and find ways to form self-educational competence in the process of professional training in the context of innovative development of society; disclosure of methods of teaching physics and labour protections based on STEM-education technologies, which will determine and stimulate the independent cognitive-search activity of subjects of study.

To solve this goal, the following tasks were formulated:

– analyze scientific publications on the research problem and clarify the basic concepts of research;

– identify existing problems in the formation of self-educational competence;

– outline ways to improve the formation of self-educational competence in the process of professional training;

– outline some methodological aspects of teaching physics and occupational safety based on STEM-education technologies, taking into account the innovative demands of society;

– identify prospects for further research.

Materials and methods of research. In order to study the peculiarities of the implementation of self-educational activities of students of technical education, scientific and methodological publications on the research problem were analyzed, the available practical experience and own pedagogical experience were summarized. The problems that arise in the process of self-educational activities at Vinnytsia National Technical University and the Flight Academy of the National Aviation University were analyzed by surveying research and teaching staff, students/cadets. To achieve this goal, use the following general research methods: abstraction, generalization, comparison and systematization. Methods of mathematical statistics were used to process the survey results.

Results and discussion. Self-education is one of the most complex types of educational activities, as it is managed by the specialist's resources.

According to A. Markovoi, independent work can grow into self-education, as the independence of the student's educational work arises as a consequence of mastering the means and methods of building their educational activities. However, if the results of the independent work of the student/cadet are controlled and evaluated by the teacher, then he manages self-education himself, focusing on his own goals. Evaluation and control of self-educational activities are not provided.

In the context of reforming higher education at the present stage of development of society, the role and task of the teacher in transferring knowledge to the organization of his educational activities is changing, the importance of self-educational competence as one of the indicators of professional activity of future professionals. A student from a passive listener becomes an active participant in the educational process, which determines his educational trajectory. In such conditions, the task arises to teach students to learn independently, i.e. to form skills of self-educational activities.

Analysis of scientific sources shows that although this phenomenon is actively studied by scientists, the interpretation of the concept of "self-education" is quite different.

In particular, M. Kasianenko defines self-educational activity as a process of independent mastering of a certain system of knowledge and skills, views and beliefs, as well as progressive experience in a certain field of activity under the influence of personal and public interests (Касьяненко, 1988: 42). In turn, O. Klochko sees in self-educational activity such a process of development of intellectual qualities and mental abilities, which ensures the improvement of personality through independent and research activities (Клочко, 2005: 268).

O. Lavrinenko's approach is interesting, according to which self-educational activity is a specific form of educational and cognitive activity, which is characterized by activity, independence, voluntariness, focus on forming a culture of mental work, as well as the development of potential opportunities and abilities (Лавриненко, 2013: 124).

Despite the different interpretations of the concept of «self-education», scientists agree that self-education is always associated with internal factors of personality development, such as self-knowledge, self-management, self-education, self-learning and self-activity.

However, we believe that the problem of self-education of specialists in technical specialities is multifaceted and its study requires systematization of various aspects of self-improvement of the specialist as a whole.

The teacher's participation in the self-educational activities of students of technical specialities in scientific publications is not stipulated. It can be carried out either with the participation of the head or outside it, for example, during the performance of independent work. However, at the stage of training, self-educational activities require mandatory management by the teacher to form the readiness of the future specialist for self-educational activities.

The self-educational activity involves improvement in both professional and cultural development. The purpose of self-educational activities can be to compensate for the shortcomings of basic education, adaptation to new knowledge, professional culture, development of creative potential and so on.

The difference between self-education and independent work is that in the course of self-educational activity a person acts as a subject of his activity in the process of achieving self-determined goals, which are the motive of self-educational activity. In addition, the self-educational activities of students of technical specialities require mandatory diagnosis and should become an integral part of the educational process, to promote the active formation of the personality of the future specialist.

We agree with the results of V. Kozakov's research and believe that the peculiarities of student's self-educational activity are:

– the main ways of methodological influence on student's self-education are the improvement of the educational process, its intensification, various activities to increase the professional orientation of training future professionals;

– student's self-education depends on the stability of cognitive interests and practical activities in which they want to succeed. In this regard, there is a need to use collective forms and methods of pedagogical guidance of student's self-educational activities;

– self-education of students contributes to the consolidation and deepening of learning outcomes, the satisfaction of cognitive interests, is a means of preparation for future professions;

– difficulties that arise in the case of insufficient culture of mental work and weak general preparation of student's for independent activity, associated with the inability of students to work independently (Козаков, 1990: 52).

From the standpoint of the competence approach, the ability to conduct self-educational activities is expressed by the appropriate level of formation of self-educational competence. However, there is also no ambiguity in the interpretation of this term.

For example, M. Marina and O. Tadeush interpret it as a certain integrated quality of personality, which is manifested by certain structured and organized knowledge, skills, self-educational motives, aspirations and interest in self-improvement, the experience of independent activity, focus on education during life, value orientations that contribute to the successful solution of their self-realization, self-development and self-education (Маріна, Тадеуш, 2015).

S. Kasiiants considers self-educational competence as a qualitative characteristic of personality, an indicator of which is a set of professional skills that determine the ability to independently conduct cognitive research activities aimed at improving theoretical knowledge and practical skills in the field to respond to modern socio-economic transformations society (Касіянц, 2017).

In general, we agree with this interpretation and in the context of further research, we will interpret self-competence as a formed ability of a specialist to independently conduct cognitive and exploratory activities to acquire theoretical knowledge in a particular field, improve desired skills and practical skills to improve professional level and timely response. requirements of employers in the labour market.

Based on the analysis of scientific publications and our own pedagogical experience, which is covered in several publications (Дембіцька, 2021; Дембіцька, Кобилянська, Пугач, 2020; Дембіцька, Кобилянська, Пугач, 2021; Дембіцька, Кобилянський, 2018), we have identified some requirements to the organization of self-educational activity of students of technical specialities, in particular:

1) ensuring the motivation of students for self-development. To this end, it is advisable to demonstrate to future specialists in technical specialities modern achievements in their field, to give examples of people who have achieved professional success in the same speciality;

2) disclosure of the essence of self-education and the principles of its implementation. It is necessary to teach students to learn independently. Unfortunately, we have that students in most cases carry out training under duress (fear of not passing exams, not receiving a scholarship, being expelled from the university), and not guided by an inner need and desire for self-development;

3) creating problematic learning situations to develop motivation for self-education;

4) promoting the development of reflection in future specialists in technical specialities.

To implement these requirements, it is advisable to provide current and future planning of self-educational activities of the student, to determine the individual educational trajectory, to select rational forms and methods of assimilation and analysis of information.

The program of self-educational activities of the student should include both the acquisition and improvement of professional knowledge and the improvement of knowledge about the cultural and social life of the state and the world.

It is mandatory to have tangible results of self-educational activities, as the future specialist must understand the purpose for which he carries out a particular job. The results of self-educational activities can be presented in

the form of publication of scientific articles, abstracts, face-to-face participation in scientific conferences and competitions, creation of certain products (software or technical), etc.

Criteria for the effectiveness of the self-educational process are awareness of the importance and necessity of self-education in their professional development, the ability to independently solve problems, persistence in overcoming obstacles in the process of acquiring new knowledge, satisfaction with the result and more.

The strategy of reforming the educational sphere identifies new research, sound and consistent introduction of scientific and pedagogical technologies, rational and effective approaches to the organization of scientific and innovative activities in education. The development of the education system in this direction in technical HEI is based on:

– recommendations of the New Strategic Program of European Cooperation in Education and Training "Education and Training 2020";

– ensuring the priority of science development and scientific and technical potential of the HEI through grant funds and fundraising in the field of science and education;

– creating an effective system of methodological, scientific and methodological support for the modernization of national education, forecasting trends in innovative development of the education system using the results of monitoring studies; generating innovative ideas, their definition, selection and implementation; formation of an open information-analytical base of innovations in all subsystems of education;

– taking into account the synergetic approach to innovation-educational scientific environments, in particular STEM-educational;

– modernization of the topics of priority areas of scientific research in the HEI of technical profile;

– development of effective models of development of life competence and integration into society of children and youth with special needs through modern scientific and methodological support of the content of correctional and inclusive education;

– creation of a system of motivations, stimulation and encouragement of innovative activity in the field of education, development of new conceptual models of improvement of separate subsystems of education; developing a system for leveling the risks of negative consequences of innovation in the education system (Національна стратегія розвитку освіти в Україні на 2012–2021 роки).

The process of training in physics and labour protection in technical HEI should have a professional orientation, taking into account current trends in education, in particular, STEM education in Ukraine, which aims to train highly qualified specialists in the technical field of education. At the moment, it is difficult to predict what difficulties a technical freelance graduate will face in practice and what section of physics he will deal with. To do this, it is necessary to ensure an appropriate level of training in physics for students in the technical field of study using STEM technologies. This training in physics will create a basis for the development of professional disciplines, taking into account an integrated approach and will meet the challenges of the current stage of reforming higher technical education.

Let's consider examples of performance of works of the physical workshop based on technologies of STEM education. Topic: "Spectrum research".

Equipment: a set of devices for the OS-8537 training spectrophotometer; optical lava – 60 cm OS-8541; diaphragm bracket OS-8534A; high-sensitivity light sensor PS-2176; rotary motion sensor PS-2120A; round base with rod ME-8270; power supply and mounting of the spectral tube SE-9460; spectral tube (Hydrogen) SE-9461; spectral tube (helium) SE-9462; spectral tube (Mercury) SE-9466.

The wavelength of discrete lines of atomic spectra of different gases is measured using a lattice spectrophotometer (fig. 1).

The atomic spectra of hydrogen, helium and mercury are scanned manually using a lattice spectrophotometer, which measures the relative intensity of light as a function of angle. From the obtained graph determine the wavelengths of the spectral lines, measuring the angle from the central maximum to each line. Consider the lines of the first and second order.

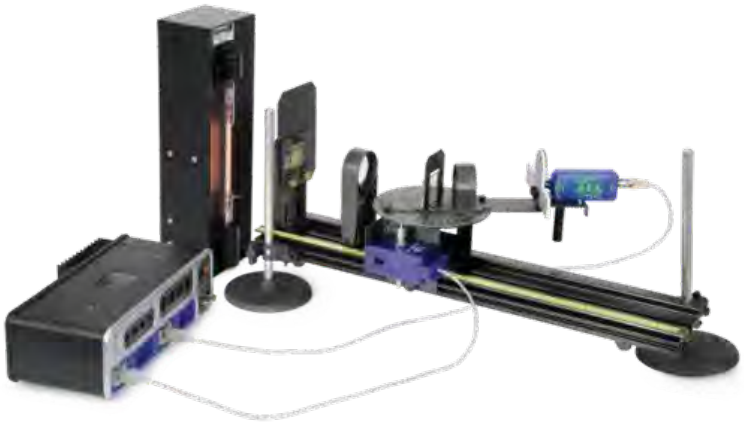

Fig. 1. Image of the installation for the study of spectra

The wavelengths of the spectral lines are compared with the accepted values, and in the case of hydrogen, the transitions of the orbits of the electrons corresponding to the lines are identified.

The advantage of PASCO over traditional methods: the open design of the spectrophotometer allows you to see the entire spectrum, while the intensity relative to the angle is displayed in real-time.

Topic: "Study of photoelectric effects".

Equipment: photoelectric device SE-6614; DC amplifier SE-6621; DC power supply SE-6615; cables for the 850 interface.

The system of photo effects is used to experiment with photo electricity, determining the Planck constancy within 5%. This device uses the usual method of determining Planck's constant. The metal plate in the photodiode is illuminated by different frequencies of light selected from a mercury lamp using filters (fig. 2). Then the voltage is adjusted to stop the photoelectric current. The stopping voltage is constructed depending on the frequency, and the Planck constant is determined by the graph.

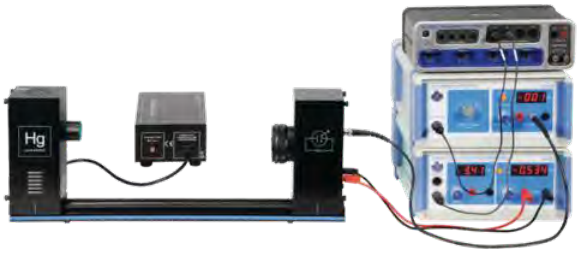

Fig. 2. Image of the installation for the study of photovoltaic effects

The concept that the stopping voltage does not change with the intensity of light is tested using various holes that change the intensity of light, partially blocking the light.

The advantage of PASCO over the traditional method: the picoammeter and the power supply for the stop voltage on the front panel have sensor ports that connect to the analogue ports of the sensor 850 Universal Interface. PASCO Capstone automatically recognizes these instruments and can read current and voltage values.

Conclusions. Thus, the results of the study give grounds to conclude that despite the presence of several publications on the implementation of self-educational activities, the problem of managing these activities of students of technical specialities has not yet been resolved. It is necessary to develop a strategy for the gradual management of self-educational activities of students in the conditions of study in higher education institutions to form a readiness for its systematic implementation throughout life.

The main components of the self-educational activity of students of technical specialities are the ability to learn, to formulate the purpose of their activities, to understand the educational task, to determine the way to solve it, to skillfully control and evaluate the correctness of the decision. In order to ensure effective self-educational activities of the specialist, it is necessary for the process of studying in higher education institutions to form readiness for this activity, motivation for self-education.

We see prospects for further scientific research in the development of methodological support for the management of self-educational activities of students of technical specialities in the process of obtaining a speciality.

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