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TRAINING OF FUTURE ENERGY SPECIALISTS TO SOLVE PRACTICAL PROBLEMS ON THE BASIS OF PHYSICAL PROJECTS

ABSTRACT

Formulation of the problem. *In the field of higher education, general and special competencies are acquired, which have in common the ability to apply knowledge in practical situations. Therefore, the formation of mental and practical skills and abilities of future energy specialists to solve practical problems is becoming more and more important.*

The effectiveness of solving practical problems in the field of power engineering, electrical engineering and electromechanics depends on the understanding by future specialists of energy profile the theories and methods of physics. There is a need to develop and implement effective teaching methods, in particular on the basis of physical projects.

Materials and methods. *The analysis of research in the field of education, the National Qualifications Framework, the standard of higher education in the specialty 141 "Electricity, Electrical Engineering and Electromechanics" for the first (bachelor's) level of higher education to theoretically substantiate the requirements for mental and practical skills of future energy specialists to solving practical tasks and advantages of physical projects in their formation was carried out; pedagogical experiment was carried out for testing the effectiveness of the use of physical projects in the training of future energy specialists; diagnostics (using the 16-factor personal questionnaire of R. Cattell and the method of analysis of products of activity as projects) was for evaluation the levels of ability of future energy specialists to solve practical problems using theories and methods of physics; statistical calculations, such as quantitative and qualitative data processing, graphical presentation of results, were for tracking the dynamics of the levels of formation of the ability of future energy specialists to solve practical problems and establishing the scientific reliability of the results of the study.*

Results. *The essence of physical projects and features of their using are theoretically substantiated on the example of discipline "Alternative energy", the maintenance of which is directed on formation of ability to apply the received theoretical knowledge, scientific and technical methods for the decision of scientific and technical problems and problems of power.*

Such criteria as personal, content-procedural, evaluation-regulatory, indicators and diagnostic tools for testing the ability of future energy specialists to solve practical problems with the using of physics methods are characterized.

The analysis of experimental data showed significant qualitative changes in the levels of formation of the ability of future energy specialists to solve practical problems by EG physics. That is confirmed by calculations of Pearson's criterion (17,61> 7,8).

Conclusions. *The using of physical projects is an effective teaching method in the training of future energy specialists to solve practical problems in the field of power engineering, electrical engineering and electromechanics.*

KEY WORDS: *energy specialists, practical problems, physical project, competence, pedagogical experiment.*

INTRODUCTION

Ukraine's integration into the world educational space requires constant improvement of the national education system, the main result of which should be competitive and mobile individuals who acquire educational and professional competencies in the labor market, according to their own interests, abilities, capabilities, needs of the economy and society.

The quality of achieving the above results of professional education depends, in particular, on the compliance of its content with the requirements of the labor market, professional standards and the National Qualifications Framework, as a result

for the applicant of higher education is to obtain professional qualifications in demand in the labor market, the acquisition of competencies that ensure competitiveness and self-realization of the individual.

In the field of higher education, general and special competencies are acquired, which have in common the ability to apply knowledge in practical situations. Therefore, the formation of mental and practical skills and abilities of future energy specialists to solve practical problems is becoming more and more important.

Analysis of relevant research. The main components of qualification requirements under the National Qualifications Framework are knowledge, skills, communication, autonomy and responsibility. According to this, skill is the ability to apply knowledge to perform tasks and solve problems. Skills are divided into cognitive (including logical, intuitive and creative thinking) and practical (including manual dexterity, application of practical methods or techniques, materials, tools and tools, communication). Thus, the sixth level of the National Qualifications Framework, which corresponds to the first (bachelor's) level of higher education, reflects the expected results as: in-depth cognitive and practical skills, skill and innovation at the level needed to solve complex specialized problems and practical problems in the field professional activity or training (On approval of the national qualifications framework, 2011).

In particular, the standard of higher education in the specialty 141 "Electricity, Electrical Engineering and Electromechanics" for the first (bachelor's) level of higher education states the need to develop the ability to solve practical problems involving methods of mathematics, physics and electrical engineering (C12), resulting of this is to know the basics of the theory of the electromagnetic field, methods of calculating electric circuits and be able to use them to solve practical problems in professional activities (PR05); to apply application software, microcontrollers and microprocessor technology to solve practical problems in professional activities (PR06); to carry out the analysis of processes in the electric power, electrotechnical and electromechanical equipment, the corresponding complexes and systems (PR07); select and apply suitable methods for analysis and synthesis of electromechanical and electric power systems with specified indicators (PR08); be able to assess the energy efficiency and reliability of electrical, electrical and electromechanical systems (PR09); solve complex specialized problems in the design and maintenance of electromechanical systems, electrical equipment of power plants, substations, systems and networks (PR17), apply suitable empirical and theoretical methods to reduce electricity losses in its production, transportation, distribution and use (PR19). The formed components will promote the formation of integrative competence, namely the ability to solve specialized problems and solve practical problems during professional activities in the field of power engineering, electrical engineering and electromechanics or in the learning process involving theories and methods of physics and engineering and characterized by complexity and uncertainty conditions (On approval of the standard of higher education in the specialty 141 "Electric power, electrical engineering and electromechanics" for the first (bachelor's) level of higher education, 2019).

Nowadays, research methods of teaching, in particular the project method, as an opportunity to rationally combine theoretical knowledge and their practical application to solve specific problems of reality in the process of joint activities of participants in the educational process, in particular in the context of end-to-end integration in four areas (science) , technology, engineering and mathematics) became more popular (Sosnytska et al, 2019; Sosnytska & Titova, 2020).

The word "project" (Latin projectus) means "forward". Traditionally, the concept of "project" has several meanings: 1) developed a plan for construction, manufacture, reconstruction of something; 2) the preliminary text of the document, the idea of something; 3) a certain form of organization of large and relatively independent initiatives; 4) the form of restructuring of purposeful activity; 5) in fact, the project is any plan that has a purpose, deadline and specific steps of implementation (Busel, 2005: 1152).

According to the researchers, a "project" is a time-limited purposeful change of a separate system with established requirements for the quality of results, possible costs of funds and resources and a specific organization (Burkov & Novikov, 1997); a sequence of interrelated events that occur within a set limited time and which are aimed at achieving a unique, but at the same time defined result (Bagley, 2004); systematic form of organization of activity in the relationship of its theoretical and practical aspects (Krimskiy, 2003) and others.

Thus, based on the analysis of scientific approaches to the content of this concept, we consider the project as a complete cycle of productive activities aimed to obtain an objectively new or subjectively new result.

Design as a project creation activity is characterized by two points: the ideal nature of the action and its focus on the emergence of something in the future. These two characteristics distinguish design from other activities. In the pedagogical literature there are different definitions of the educational project, but in any case they are based on the development of cognitive and creative skills of students, the ability to seek information and act independently, presenting project results and cooperation between participants in the educational process. Thus, the essence of the project I. Sergeev recognizes as "six P": problem – design (planning) – information retrieval – product – presentation – portfolio, which collects all project materials, including drafts, daily plans, reports, etc. (Sergeev, 2004: 28).

The project method is a method based on the development of cognitive, creative skills of students, the ability to independently construct their knowledge, navigate in the information space, think critically.

Reasons for the widespread use of the project method in the training of future energy specialist: pedagogical – learning to acquire knowledge independently; ability to use the acquired knowledge to solve cognitive and practical problems; ability to use research methods (collect the necessary information, comprehensively analyze it, make hypotheses, draw conclusions; social – the ability to work in different groups; the ability to perform different social roles (leader, performer, mediator, etc.); the need to acquire skills to overcome conflict; wide human contacts, acquaintance with different cultures, views on one problem (Sosnytska & Kryvylova, 2020).

All this will contribute to the formation of higher education seekers with a clear, personally meaningful and meaningful image of future professional activity, as an important step towards competitiveness in the labor market.

Tasks that are solved in the process of project activities: 1. Personal orientation of project training, taking into account the goals, objectives, needs, interests, motivation, life experience, individual characteristics and abilities of the individual. 2. Preparing learners for real activities through practical actions that affect their emotional sphere and increase motivation to

learn due to the closer connection of project ideas with real life. 3. Creative work of project participants on the basis of independently collected, systematized and generalized information from various sources. 4. Development of independent thinking in identifying and solving problems based on knowledge from various fields of science; use of various research and exploration methods and teaching methods. 5. Development of skills to establish cause and effect relationships between phenomena, to anticipate the possible consequences of different solutions, to plan and predict the results, to take action to implement decisions. 6. The use of various forms of organization of educational activities in order to enhance the interaction of teachers and students as equal partners in the educational process. 7. Increasing the individual and collective responsibility of project participants in connection with the need to coordinate actions to obtain results (Grudinin, 2017).

The aim of the article. The purpose of the research is to theoretically substantiate the peculiarities of training future energy specialists to solve practical problems on the basis of physical projects and to reveal the results of experimental verification of the effectiveness of the chosen method.

To achieve this goal, the following tasks are formulated: theoretically substantiate the essence of physical projects and features of their use; to characterize the criteria, indicators and diagnostic tools for testing the ability of future energy specialists to solve practical problems; to reveal the results of experimental verification of the effectiveness of the use of physical projects.

RESEARCH METHODS

The analysis of research in the field of education, the National Qualifications Framework, the standard of higher education in the specialty 141 "Electricity, Electrical Engineering and Electromechanics" for the first (bachelor's) level of higher education to theoretically substantiate the requirements for mental and practical skills of future energy specialists to solving practical tasks and advantages of physical projects in their formation was carried out; pedagogical experiment was carried out for testing the effectiveness of the use of physical projects in the training of future energy specialists; diagnostics (using the 16-factor personal questionnaire of R. Cattell and the method of analysis of products of activity as projects) was for evaluation the levels of ability of future energy specialists to solve practical problems using theories and methods of physics; statistical calculations, such as quantitative and qualitative data processing, graphical presentation of results, were for tracking the dynamics of the levels of formation of the ability of future energy specialists to solve practical problems and establishing the scientific reliability of the results of the study.

RESULTS

During the training of future energy specialists, we use a physical project, which means solving practical problems in the field of power engineering, electrical engineering and electromechanics using theories and methods of physics. When considering the topics and content of project activities of future energy specialists, we adhere to the following conditions: 1) the physical project should be based largely on already known knowledge and skills; 2) the physical project must contain contradictions between the known and the search - the problem of research; 3) the physical project should arouse interest in finding ways to solve a practical problem.

For example, we use physical projects in teaching the discipline "Alternative Energy", which aims to develop the ability to apply the acquired theoretical knowledge, scientific and technical methods to solve scientific and technical problems and problems of energy. We take into account interdisciplinary connections with the discipline "Physics", in particular electrodynamics, which occupies a special place given the richness of worldview and polytechnic content. It is in this section that the problems of electric power are considered – generation, transmission and conversion of electric energy with induction generators and transformers, etc.

Thus, future energy specialists are developing a project with the general title "Physical Fundamentals of Alternative Energy", which is adjusted according to the chosen direction.

The main task of the projects is to consolidate the general principles of energy efficiency assessment of non-conventional and renewable energy sources based on knowledge of the principle of operation and the main functional and structural features of non-conventional energy installations, namely solar, wind, heat pump installations, hydropower plants, energy batteries, hydro and ebbs, fuel cells, biofuels, magnetohydrodynamic energy converters, thermoelectric generators, radioisotope energy sources, etc.

In particular, while choosing the topic "Physical foundations of wind turbines" higher education students perform the calculation of wind turbines taking into account the parameters of wind turbines and the proposed conditions of their location. The content of the work includes: calculation of wind turbine power with rotor radius R, m at starting wind speed V, m / s, wind utilization factor ξ, reducer efficiency - η_{red} .; generator efficiency - η_{gen}; calculation of wind speed at which the wind turbine will generate enough power to provide energy, for example, the average cottage with a radius of rotor R, m, wind utilization factor - ξ, efficiency of the reducer - η_{red}; Generator efficiency - η_{gen} .; or calculation of wind power capacity containing n of the same type of wind power plants, where the length of the windmill blade L, wind speed V, wind turbine efficiency η_w, electric efficiency of the installation (generator and converter) η_e, air temperature t, atmospheric pressure p and others.

The process of developing a physical project consists of the main stages: the choice of topic; problem formulation; setting tasks; selection of participants (group or individual project development); distribution of tasks; analysis of sources on the research problem; experimental part (if it is necessary); processing of results; report preparation and project defense.

The order of execution provides for the implementation of actions by future energy specialists: 1) to get acquainted with the primary information; 2) perform an analysis of methods of obtaining electricity; 3) search for information on the Internet at the addresses of the above sites in order to obtain and analyze the physical and technical characteristics of devices for obtaining alternative energy; 4) make assumptions about the methods of obtaining electricity that can be sold in your area; 5) provide information on the methods of obtaining electricity that are sold in your area; 6) design and implement a device for obtaining alternative energy; 7) draw conclusions; 8) compile a project portfolio.

The individual activity of future energy specialists during project development depended on external factors, namely: the functional distribution between group members; availability of author's findings; opportunities to argue their own positions and summarize the results of activities, to discuss with opponents, etc.

Thus, future energy specialists not only demonstrate the formation of mental and practical skills in solving specialized problems by physics, but also acquire the ability to be critical and self-critical in making informed decisions and assess the quality of work performed.

The pedagogical experiment was carried out on the basis of higher education institutions of Ukraine: Dmytro Motornyi Tavria State Agrotechnological University (Faculty of Energy and Computer Technologies) and Berdyansk State Pedagogical University (Faculty of Physics, Mathematics, Computer and Technology Education) during 2018-2021 academic years.

To conduct a pedagogical experiment, an experimental and control groups of higher education students of the specialty 141 "Electric Power, Electrical Engineering and Electromechanics" (1-4 levels) were selected. These groups covered a total of 284 people. A representative sample in the study consists of parallel experimental and control groups. The control group included 142 students who studied on the basis of traditionally formed practice, the experimental group - 142 students of the same faculties, who studied using the developed educational and methodological support.

The pedagogical experiment involved the implementation of actions of ascertaining, formative and control content. Thus, the purpose of the observational experiment was to establish the actual state and level of the studied characteristics of the participants at the beginning of the experiment. The formative experiment is aimed at studying the phenomenon under study directly in the process of implementing physical projects. The control experiment was conducted in order to compare the results of the experimental and control groups regarding the dynamics of acquiring the ability of future energy professionals to solve practical problems by all criteria and levels.

Criteria and indicators of the formation of the ability of future energy specialists to solve practical problems involving the methods of physics: personal criterion - the presence and level of development of professionally important abilities and qualities; substantive-procedural criterion - practical and operational application of knowledge to specific situations; evaluation and regulatory criterion - self-assessment and self-control of activities (Kryvylova, 2017).

In particular, the need to successfully solve practical problems in the energy sector, interest to the process of solving them and a strong desire to master the physical foundations in the modeling, design, development and maintenance of energy systems (personal criterion); understanding the content of practical problems in the energy sector, assessing their significance and knowledge of ways to solve them by physical methods, ability to solve practical problems in the energy sector with the use of physical laws (substantive and procedural criteria); ability to self-assessment and self-control of own actions on the application of physical laws in solving practical problems in the energy sector and focus on self-improvement in achieving the expected results (evaluation and regulatory criteria).

The level of formation of the ability of future energy specialists to solve practical problems with the use of physics methods was checked using a 16-factor personality questionnaire R. Kettell (Metodika mnogofaktornogo issledovaniya lichnosti R. Kettella) and the method of analysis of products of activities - projects.

The purpose of using the 16-factor personality questionnaire R. Kettell was to establish the presence and level of development of professionally important qualities of future energy specialists who can contribute to or hinder the successful acquisition of the ability to solve practical problems by physics.

According to the theory of personality traits of R. Kettell, the personality consists of stable, stable, interconnected elements (properties, traits) that determine its inner essence and behavior. Differences in behavior are explained by differences in the expression of personality traits. The set of individual factors creates symptom complexes of communicative, intellectual, emotional and regulatory personality traits.

After the experiment, a significant shift in the group of regulatory personality traits of future energy specialists EG (+16.15% at a high level), which indicates the formation of the ability to mobilize to achieve this goal in spite of internal resistance and external obstacles; ability to act thoughtfully, persistently and organized (to finish the started cases, to have a clear idea of the order of executed cases, to plan time); the ability to maintain self-control in critical situations and regulate the external manifestations of emotions; be critical of yourself.

The shift in the group of intellectual properties of EG (+5.21% – high level, -4.17% – low level) indicates an increase in the number of future energy specialists who are able to establish cause-and-effect relationships between phenomena and have developed figurative thinking (different high level of generalization). These manifestations prove the effectiveness of the use of physical projects in the training of future energy specialists.

The group of communicative properties at the end of the experiment characterizes future energy specialists at a high level as: energetic, sincere in relationships with others, dynamic in communication, which promotes leadership in group activities; socially courageous, active, ready to deal with unfamiliar circumstances, prone to risk; independent in judgments and behavior; independent in decision-making; prudent, perceptive, intelligent with a sentimental approach to events and others; open, tolerant of others, willing to cooperate with the team. These shifts in communicative properties became possible due to the use of physical projects.

The use of project results as a diagnostic tool helped to identify knowledge, skills, abilities and professionally important qualities of future energy specialists who provide the ability to solve practical problems of future professional activity.

At the end of the experiment, the development of group and individual projects began to contain a large number of original and inventive techniques, characterized by complete independence and high activity of future energy specialists. The formed generalized integrated abilities and skills on the analysis and documentation of the information are observed; ability to realize goals and make decisions in professional activity in the conditions of complex systems of different nature; perfect mastery of various methods and means of modeling, forecasting, design.

During the pedagogical experiment, future energy specialists changed their attitudes to their personal and academic achievements, which was reflected in predicting the prospects of self-improvement and the desire to achieve better results in developing the ability to solve practical problems, including physics.

The analysis of experimental data showed qualitative changes in the low level of formation of the ability of future energy specialists to solve practical problems, due to a decrease in the number of students in the relevant category during the pedagogical experiment by 3.9% in CG and 9.64% in EG. At the average level, there was an increase in the number of students by 1.82% in CG and a decrease of 10.15% in EG. Sufficient and high levels of formation of this component also showed positive qualitative changes: an increase in the number of students in the control (by 0.52% and 1.56%, respectively) and experimental (by 10.42% and 9.37%, respectively) groups.

Comparative analysis of the absolute average value of qualitative changes in the level of formation of the ability of future energy specialists to solve problems in control and experimental groups led to the conclusion that the positive dynamics of qualitative changes in CG (Aver. = 1.95%) due to traditional training, and in EG (Aver.= 9.9%) – the result of professional training of students by experimental methods (Fig. 1).

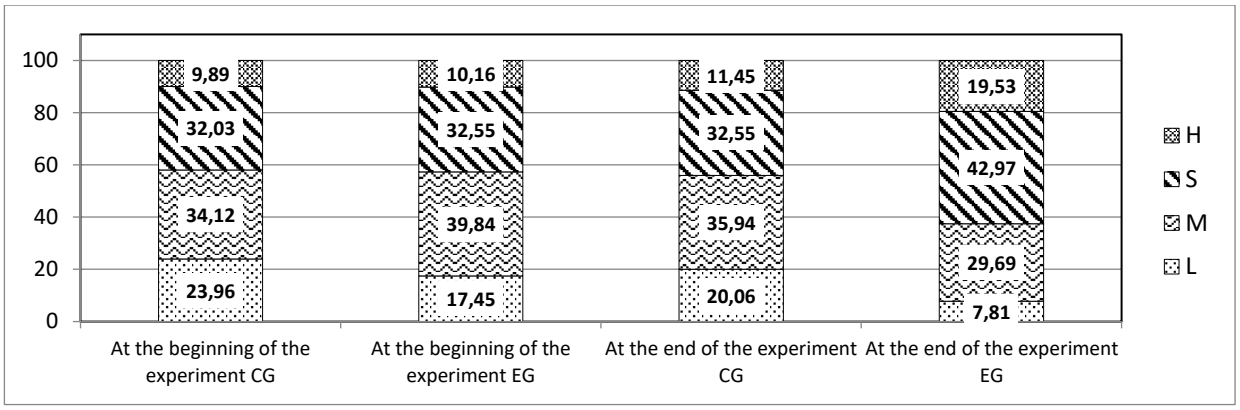

Fig. 1. Dynamics of qualitative changes in the formation of the ability to solve practical problems of control and experimental groups at the beginning and end of the experiment

The results of the experimental study were confirmed by using the methods of mathematical statistics, in particular the calculation of the nonparametric Pearson criterion – χ^2. For this purpose, statistical hypotheses were formulated:

H_0: experimental forms, methods and means of training future energy specialists do not affect the qualitative changes in the level of formation of mental and practical skills and abilities to solve practical problems by methods of physics, and the results are random.

H_1: qualitative changes in the level of formation of mental and practical skills and abilities to solve practical problems of future energy specialists due to the influence of experimental forms, methods and tools.

The obtained value of Pearson's criterion (17.61> 7.8), that means the experimental value of Pearson's criterion, is the basis for rejecting the null hypothesis H_0 and accepting the alternative hypothesis H_1 about the influence of experimental training on the ability of future energy specialists to solve practical problems by physics.

Thus, for all parameters there were statistically significant changes in the level of formation of the ability of future energy specialists to solve practical problems by methods of physics, which gives reason to conclude about the high efficiency of using the physical projects.

CONCLUSIONS

Based on the analysis of scientific research in the field of education, the National Qualifications Framework, the standard of higher education in the specialty 141 "Electricity, Electrical Engineering and Electromechanics" for the first (bachelor's) level of higher education theoretically substantiated requirements for mental and practical skills of future energy specialists. and the advantages of physical projects in their formation.

Criteria and indicators of the formation of the ability of future energy specialists to solve practical problems involving the methods of physics: personal criterion – the presence and level of development of professionally important abilities and qualities; substantive-procedural criterion – practical and operational application of knowledge to specific situations; evaluation and regulatory criterion – self-assessment and self-control of activities.

The expediency of diagnostic tools to test the formation of the ability of future energy specialists to solve practical problems by methods of physics (16-factor personality questionnaire R. Cattell and the method of analysis of products as projects) is indicated.

The analysis of experimental data showed significant qualitative changes in the levels of formation of the ability of future energy specialists to solve practical problems by EG physics: high level – increase by 9.37%, sufficient level – increase by 10.42%, medium level - decrease by 10.15 %, low level – a decrease of 9.64%. The positive dynamics of qualitative changes in CG (Aver. = 1.95%) is due to traditional training, and in EG (Aver. = 9.9%) – the result of professional training of students based on physical projects. That is confirmed by calculations of Pearson's criterion (17,61> 7,8).

References

1. Resolution of the Cabinet of Ministers of Ukraine On approval of the national qualifications framework from November 23 2011, № 1341. (2011, november). Retrieved from http://zakon4.rada.gov.ua/laws/show/1341-2011-п [in Ukrainian].

2. Order of the Ministry of Education and Science On approval of the standard of higher education in the specialty 141 "Electric power, electrical engineering and electromechanics" for the first (bachelor's) level of higher education from June 20 2019, № 867. (2019, June). Retrieved from http://www.tsatu.edu.ua/enf/wp-content/uploads/sites/42/141-eee-standart-zatverdzhenyj.pdf [in Ukrainian].
3. Sosnytska, N., Titova, O., Symonenko, S., Kravets, O. (2019). Examining the creative potential of engineering students. Modern Development Paths of Agricultural Production, p. 299-306, doi: https://doi.org/10.1007/978-3-030-14918-5_31 [in English].
4. Sosnytska, N., Titova, O. (2020). The Engineer's Creative Potential Scales. 2020 IEEE Problems of Automated Electrodrive. Theory and Practice (PAEP), Kremenchuk, Ukraine. DOI: https://doi.org/10.1109/PAEP49887.2020.9240882 [in English].
5. Busel, W. T. (ed.). (2005). Velykyi tlumachnyi slovnyk suchasnoi ukrainskoi movy [Large explanatory dictionary of the modern ukrainian language]. K.; Irpen: VTF "Perun" [in Ukrainian].
6. Burkov, V.N., Novikov, D.A. (1997). Kak upravlyat proektami [How to manage projects]. Moscow: Sinteg-GEO [in Russian].
7. Bagley, F. (2004). Upravlenie proektom [Project Management]. Moscow: GRAND [in Russian].
8. Krimskiy, S.B. (2003). Zapyty filosofskykh smysliv [Requests of philosophical meanings]. Kyiv [in Ukrainian].
9. Sergeev, I.S. (2004). Kak organizovat proektnuyu deyatelnost uchaschihsya: prakticheskoe posobie dlya rabotnikov obscheobrazovatelnyih uchrezhdeniy [How to organize project activities of students: a practical guide for employees of educational institutions]. Moscow [in Russian].
10. Sosnytska, N., Kryvylova, O. (2020). Formation of social skills as a step towards competitiveness in the labor market of future specialists of energy profile. 2020 IEEE Problems of Automated Electrodrive. Theory and Practice (PAEP). Kremenchuk, Ukraine. Retrieved from https://ieeexplore.ieee.org/document/9240836 [in English].
11. Grudinin, B.O. (2017). Doslidnytska kompetentnist uchniv starshykh klasiv u protsesi navchannia fizyky: teoriia i praktyka [Research competence of high school students in the process of teaching physics: theory and practice]. Kharkiv [in Ukrainian].
12. Kryvylova, O. A. (2017). Psykholoho-pedahohichna pidhotovka maibutnikh vykladachiv profesiino-tekhnichnykh navchalnykh zakladiv: teoretychnyi ta metodychnyi aspekty [Psychological and pedagogical training of future teachers of vocational training schools: theoretical and methodological aspects]. Berdyansk: BSPU [in Ukrainian].
13. Metodika mnogofaktornogo issledovaniya lichnosti R. Kettella [Methods of multifactorial study of the personality of R. Kettell]. Retrieved from http://psycabi.net/testy/293-16-faktornyj-lichnostnyj-oprosnik-r-b-kettella-metodika-mnogofaktornyj-oprosnik-kettella-test-kettela-187-voprosov-test-ketela-16-pf [in Russian].

ПІДГОТОВКА МАЙБУТНІХ ФАХІВЦІВ ЕНЕРГЕТИЧНОГО ПРОФІЛЮ ДО ВИРІШЕННЯ ПРАКТИЧНИХ ЗАДАЧ НА ОСНОВІ ФІЗИЧНИХ ПРОЄКТІВ

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Анотація.

Формулювання проблеми *У сфері вищої освіти набуваються загальні та спеціальні компетентності, спільними для яких є здатність застосовувати знання у практичних ситуаціях. Відтак, формування розумових та практичних вмінь та навичок майбутніх фахівців енергетичного профілю до вирішення практичних задач, набуває все більшої актуальності. Результативність вирішення практичних задач галузі електроенергетики, електротехніки та електромеханіки залежить від розуміння майбутніми фахівцями енергетичного профілю теорій та методів фізики. Виникає потреба у розробці та запровадженні ефективних методів навчання, зокрема на основі фізичних проєктів.*

Матеріали і методи. *Проведено аналіз наукових досліджень у галузі освіти, Національної рамки кваліфікацій, стандарту вищої освіти за спеціальністю 141 «Електроенергетика, електротехніка та електромеханіка» для першого (бакалаврського) рівня вищої освіти з метою теоретичного обґрунтування вимог до розумових та практичних умінь майбутніх фахівців енергетичного профілю до вирішення практичних задач та переваг фізичних проєктів у їхньому формуванні; педагогічний експеримент – для перевірки дієвості використання фізичних проєктів у професійної підготовки майбутніх фахівців енергетичного профілю; діагностика (за допомогою 16-факторного особистісного опитувальника Р. Кеттелла та методу аналізу продуктів діяльності у якості проєктів) – для оцінки рівнів сформованості вміння майбутніх фахівців енергетичного профілю розв'язувати практичні задачі з використанням теорій і методів фізики; статистичні розрахунки (кількісна та якісна обробка даних, графічне подання результатів) – для відстеження динаміки рівнів сформованості вміння майбутніх фахівців енергетичного профілю розв'язувати практичні задачі та встановлення наукової достовірності отриманих результатів дослідження.*

Результати. *Теоретично обґрунтовано сутність фізичних проєктів та особливості їх використання на прикладі дисципліни «Альтернативна енергетика», зміст якої спрямовано на формування здатності застосовувати отримані теоретичні знання, наукові і технічні методи для вирішення науково-технічних проблем і задач енергетики.*

Схарактеризовано критерії (особистісний, змістовно-процесуальний, оцінно-регулятивний), показники та діагностичний інструментарій перевірки сформованості здатності майбутніх фахівців енергетичного профілю до вирішення практичних задач із залученням методів фізики.

Аналіз експериментальних даних засвідчив вагомі якісні зміни рівнів сформованості здатності майбутніх фахівців енергетичного профілю до вирішення практичних задач методами фізики (ЕГ), що підтверджено розрахунками критерію Пірсона (17,61>7,8).

Висновки. *Використання фізичних проєктів є дієвим методом навчання у підготовці майбутніх фахівців енергетичного профілю до вирішення практичних задач у галузі електроенергетики, електротехніки та електромеханіки.*

Ключові слова: *фахівці енергетичного профілю, практичні задачі, фізичний проєкт, компетентності, педагогічний експеримент.*