



TRAINING OF SPECIALISTS IN TECHNICAL SPECIALTIES TO PROFESSIONAL ACTIVITY ACCORDING TO THE REQUIREMENTS OF THE INTEGRATIVE APPROACH

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Abstract

Relevance: based on the analysis of the features and the current state of training of specialists in technical specialties, it was established that there is an urgent need to form a new generation of employees who are able to systematically improve their professional level and implement measures and means to ensure the appropriate level of safety at their workplace.

Objective: construct a structural and functional model of training specialists in technical specialties for labor protection professional activity according to the requirements of the integrative methodological approach.

Methods: theoretical (analysis of scientific and methodical publications reflecting the problem of research, generalization of the best domestic and foreign pedagogical, regarding the training of specialists in technical specialties for labor protection professional activity); empirical (questionnaires, testing, surveys to find out the level of readiness of future specialists for labor protection professional activities; expert surveys; observation of the educational process).

Results: modern approaches to the training of specialists in technical specialties for labor protection professional activity according to the requirements of a transdisciplinary methodological approach were analyzed; an appropriate structural and functional model has been proposed for the implementation of such training of specialists in technical specialties, which contains methodological, technological and diagnostic blocks.

Conclusions: based on the results of the analysis of scientific and methodological publications and pedagogical practice on the problem under study and the conducted expert survey, a list of pedagogical conditions for training specialists in technical specialties for labor protection professional activity was created according to the requirements of an integrative methodological approach, and a list of pedagogical conditions for its implementation was determined (ensuring positive motivation of students regarding the acquisition of labor protection competencies, knowledge, abilities and skills; development of appropriate educational and methodological support; ensuring the professional orientation of labor protection disciplines and the use of information technologies at all stages of the professional training of future specialists in technical specialties).

Introduction. In accordance with the requirements of the law "On the National Program for the Adaptation of the Legislation of Ukraine to the Legislation of the European Union" (2004), the training of future specialists in technical specialties must be carried out in compliance with the requirements of European legislation. Taking into account the current requirements of European legislation for the training of specialists in technical specialties, the priority issues of the professional development of the individual are the formation of motivation regarding the preservation of the health of the employee and the creation of safe conditions for his work in the process of professional activity. This approach allows not only to create safe and harmless working conditions, but also to increase its overall productivity, which as a result has a positive effect on the economic and social performance of the enterprise.

Therefore, during the training of future specialists in technical specialties, it is necessary to focus on the development of their ability to use the acquired knowledge in the professional field, mastering new research methods and constant self-improvement. Its solution, taking into account labor protection aspects. And the obtained professional competence will allow to quickly navigate in any problem situation and understand the optimal ways to solve it, as well as the skills of labor protection professional activity.

Based on the trends in the development of modern technical education, own experience and scientific activity, as well as the analysis of primary sources, a number of contradictions were revealed, which led to the solution of the initial problem and the creation of a model of training specialists of technical specialties for labor protection professional activity according to the requirements of the integrative methodological approach, in particular between:

1) constantly growing requirements for the professional competence of employees of technical specialties in connection with the intensive development of technologies and the current state of training of future specialists in institutions of higher technical education;

2) the need for specialists in technical specialties who are able to perform professional duties in compliance with safety requirements, respond in time and act effectively in dangerous situations and the insufficient level of formation in future specialists the readiness for occupational health and safety professional activity;

3) the existing level of training of specialists in the institutions of technical higher education of the same profile and the content, technologies and methods of their training for labor protection professional activity in the conditions of rapid development of science, engineering and technology.

Insufficient development of the theoretical and methodological basis for improving the professional training of specialists in technical specialties for labor protection professional activity according to the requirements of an integrative methodological approach and the justified need for its creation, as well as the insufficient level of theoretical study of the outlined problem and its practical implementation, allows the authors to initiate and substantiate the model of training specialists in technical specialties to labor protection professional activity according to the requirements of an integrative methodological approach in institutions of higher education of a technical profile.

Research sources. The analysis of scientific publications on the problem under study proved that the issue of training specialists in technical specialties for labor protection professional activity arouses the scientific interest of many scientists, both in the domestic educational space and abroad. The conducted research is based on taking into account new strategies of thinking in education and the analysis of professional education standards, which are highlighted in the works of domestic scientists I. Galimska (2016), O. Gerasimchuk (2015), S. Honcharenko, R. Gurevich, A. Gurzhiya, V. Kremenyha, N. Nychkalo, Y. Pelekha, P. Tadeeva and others, as well as foreign M. Birolim, A. Mesas, A. González, H. Dos Santos, M. Haddad, S. De Andrade (2019), G. Borghini, P. Aricò, G. Di Flumeri, V. Ronca, A. Giorgi, N. Sciaraffa, C. Conca, S. Stefani, P. Verde, A. Landolfi, R. Isabella, F. Babiloni (2022), J. Cromley (1992), S. Ebisine (2015), F. Esfandiar, D. Hassanvandl, M. Eskandari (2022), T. Louca, C. Zacharia, D. Tzialli (2012), J. Luskin (1992), S. Murthy, S. Iyer, J. Warriem (2015), C. Schwarz, Y. Gwekwerere (2007), P. Smith, C. Mustard (2007), C. Su-Chang (2010), R. Vanderlinde, J. van Braak (2013), D. Weinstock, C. Slatin (2012), F. Wu, Z. Ren, Q. Wang, M. He, W. Xiong, G. Ma, X. Fan, X. Guo, H. Liu, X. Zhang (2021) and others.

In this context, the opinion of a number of scientists, in particular I. Galimska (2016), O. Gerasimchuk (2015) and others, that the content of technical education requires updating is relevant. The most

promising directions are: the use of educational material that corresponds to modern achievements of science and technology; constant adjustment of training programs of disciplines in accordance with scientific progress; actualization of the content of education thanks to the separation of fundamental educational objects, systemic patterns, principles, concepts from secondary or outdated materials.

For example, Smith and Mustard (2007) substantiated that the prevention of occupational injuries at work in Canada is thorough training on occupational safety issues during professional training. According to the results of their study, only 12.2% of workers received preliminary training about occupational risks during training and only one in five workers received occupational health and safety training in the first year of employment. Such situation is unacceptable and requires serious measures to increase the level of knowledge on occupational health and safety among students.

Researchers Weinstock D., Slatin C. (2012), in order to maximally eliminate industrial risk, give priority to practical training in labor protection directly at workplaces. In addition, scientists suggest training future specialists in creating safe working conditions at workplaces even during training in vocational and technical educational institutions.

Scientists Wu, Ren, Wang (2021) and others emphasize the importance of training employees to implement measures and tools to improve working conditions in the workplace, since quality occupational safety education allows them to critically analyze the organizational and technical causes of safety problems during the production process and carry out their prevention in order to prevent the occurrence of occupational diseases and accidents.

In addition, there is a number of publications that discuss the need for workers to be involved in the development of occupational health and safety curriculum and training in vocational training (Cromley, 1992; Luskin, 1992).

In a number of studies, examples of educational programs for the professional training of employees are given and methods of assessing the level of their training are discussed, as well as pedagogical conditions for the formation of the appropriate level of competences, knowledge, skills of occupational safety specialists in the process of acquiring a profession (Schwarz, Gwekwerere, 2007; Su-Chang, 2010). Vocational education experts discuss the integration of vocational training and occupational health and safety programs, which emphasize the creation of mandatory incentives for workers to en-

courage compliance with occupational health and safety requirements (Vanderlinde, van Braak, 2013).

Separate issues of training specialists taking into account labor protection aspects are reflected in the publications of Borghini, Aricò, Di Flumeri and others. (2022), Esfandiar, Hassanvand, Eskandari (2022), Birolim, Mesas, González et al. (2019). Currently, the health and safety of the employees are recognized as the fundamental human rights, and therefore it is necessary to expand the implementation of measures (medical, engineering, legislative and educational) to ensure their safety in the process of production activities at every workplace, especially in developing countries (Ebisine, 2015; Louca, Zacharia, & Tzialli, 2012; Murthy, Iyer, & Warriem, 2015).

The purpose of the article is to construct a structural-functional model of training specialists in technical specialties for labor protection professional activity according to the requirements of the integrative methodological approach.

Research methods: theoretical (analysis of scientific and methodical publications reflecting the research problem, generalization of the best domestic and foreign pedagogical experience regarding the training of specialists in technical specialties for labor protection professional activity); empirical (questionnaires, testing, surveys to find out the level of readiness of future specialists for labor protection professional activities; expert surveys; observation of the educational process).

Results and discussion. Analyzing the international practice of preparation for labor protection professional activity, scientists emphasize the need to form readiness for its implementation, starting from the institution of higher education. This lays the foundation for awareness of the dangers in the future workplace and allows the employee to effectively adapt to industrial conditions and feel more confident when performing professional duties.

The training of specialists in technical specialties, the qualifications of which meet the requirements of employers and enables to implement the occupational health and safety professional activities, requires thorough scientific research. In this process, an important role belongs to the determination of the methodological component, namely those methodological approaches and principles that will be used during the development of a structural-functional model of training future specialists in mechanical engineering for labor protection professional activities.

The results of the analysis of scientific research

showed that the following methodological approaches are currently used during the training of technical specialists in higher education institutions: competence-based, activity-based, system-based, and person-oriented. The use of other approaches is related to the object of research and the peculiarities of conducting a pedagogical experiment. In the context of our research, in our opinion, it is also appro

appropriate to use an integrative methodological approach as fundamental in the process of updating professional training programs for specialists in technical specialties and curricula of disciplines.

The characteristics of the selected methodological approaches that must be used when constructing a model of training specialists in technical specialties for labor protection professional activity are shown in Figure 1.

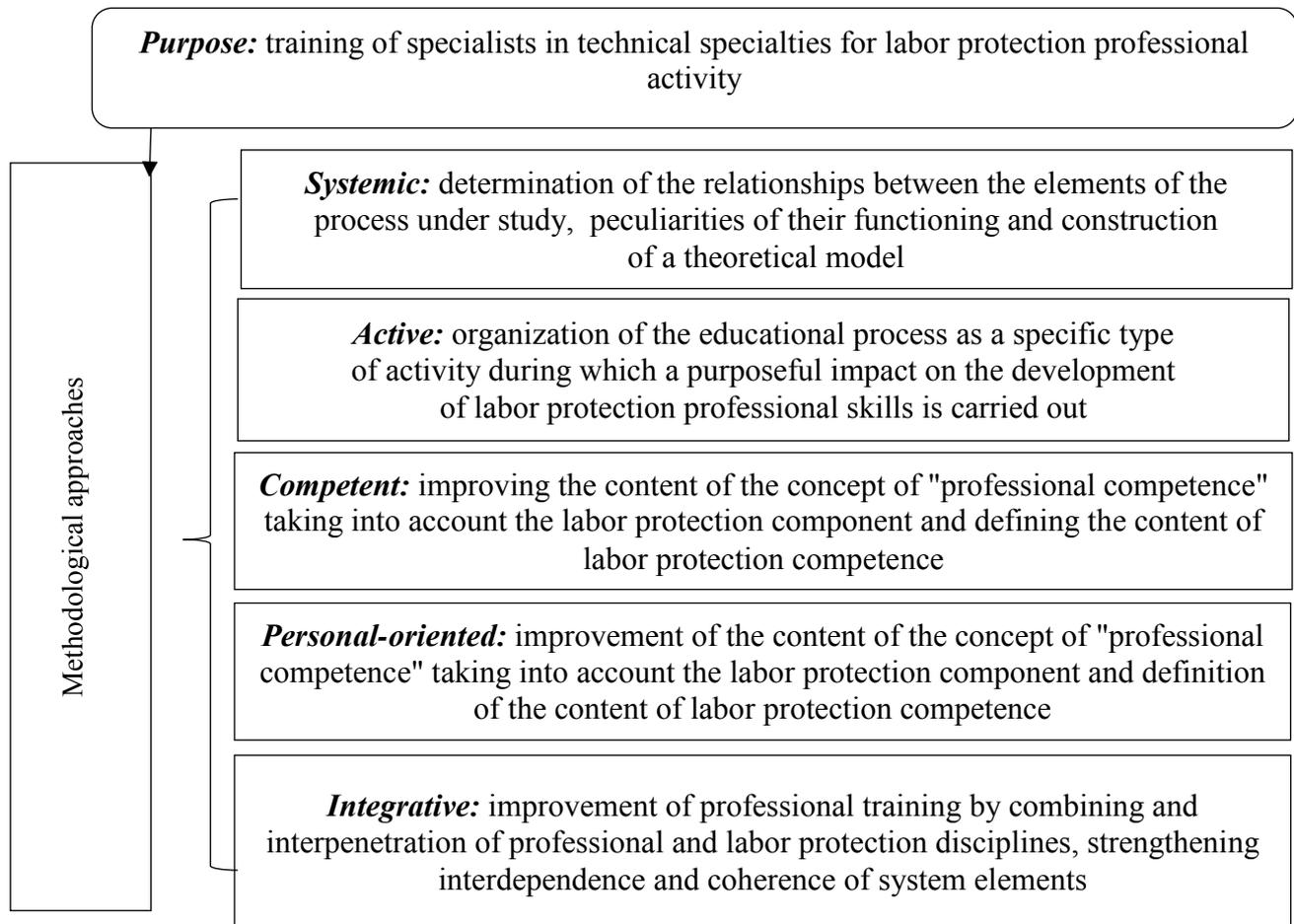


Fig. 1 Methodological approaches in the professional training of specialists in technical specialties

One of the fundamental conditions for improving the system of training specialists in technical specialties for labor protection professional activity according to the requirements of the integrative methodological approach is the development of appropriate educational and methodological support for the implementation of contextual training of future specialists in mechanical engineering of interdisciplinary integration.

To confirm this statement, a survey of experts was conducted. The required number of experts is calculated using the formula:

$$N = \frac{t_{\alpha}^2}{\varepsilon_1^2}, \quad (1)$$

where t_{α}^2 is the table coefficient, ε_1^2 is the permissible absolute error for expert evaluation.

The number of experts required to specify the pedagogical conditions for the training of specialists in technical specialties for labor protection professional activity according to the requirements of the integrative methodological approach with a confidence level of 95% and an absolute error of 0.5% should be at least 15 experts. 18 experts took part in the survey, which is quite enough. 83.3% confirmed our assumption

regarding the need to create appropriate educational and methodological support for the implementation of an integrative approach in professional training, which is quite sufficient, because with a positive indicator of 71-90% (relative frequency for fashion from 0.7 to 0.9) – the degree of consistency of experts' opinion is assessed as high.

To implement interdisciplinary integration with professional disciplines, joint methodological workshops of teachers of professional disciplines involved in the training of future specialists in technical specialties were held at Vinnytsia National Technical University and Flight Academy of the National Aviation University. We consider the use of contextual training to be one of the promising options, the meaning of which is that future specialists need to determine and justify complex means of solving the existing problem, find additional information, make a forecast of possible consequences, taking into account its various aspects, including occupational safety.

Contextual learning provides an opportunity to simulate a certain professional situation, to give the student the opportunity to be an employee, manager, labor safety inspector, victim or witness of an accident at the enterprise, and others. In the process of work, possible options for the development of events are outlined, we analyze which are unacceptable, and we determine ways to solve this problem. Such training in the process of future specialists study creates conditions for the development of the following professional qualities: the ability to work in a team; to be aware of the responsibility for making a decision; take the initiative; to understand that any problem has several solutions, from which the most optimal one must be chosen, taking into account social and material losses; find a compromise in communication with others, etc.

The purpose of modeling the system of professional training for occupational health and safety professional activity of specialists in technical specialties according to the requirements of the integrative methodological approach is to develop a model that will organize such a process in accordance with the requirements of a modern higher school.

The object of modeling is the process of forming occupational health and safety competence of future mechanical engineering specialists. During its component analysis, structural elements were determined and significant connections between them were established.

In the process of modeling, the researchers

started from the essence of the concept of "occupational safety competence" as a combination of knowledge and practical skills in occupational safety, methods of risk-oriented thinking, which determines the ability of a person to successfully carry out occupational safety and health professional activities and its role in the professional formation of specialists in technical specialties, took into account the possibilities of higher education institutions, as well as the availability of the necessary pedagogical staff, methodical support, etc.

Figure 2 shows the structural-functional model of the process of formation of labor protection competence of future mechanical engineering specialists, which reflects its main elements and essential connections between them, and also defines the set of functions (targeted actions) aimed at achieving the set goal.

The results of the analysis of scientific, philosophical and methodical literature were used to provide theoretical and methodological support for the constructed model. In the process of model construction, the transition to theoretical knowledge of the object from empirical knowledge was used, during which the functioning and development of scientific knowledge is carried out on two relatively independent levels: theoretical and empirical, provided that the relevant research tasks are formulated and the optimal methods of their generalization and solution are determined. Due to this, the structural-functional model was developed in accordance with the methodology and principles of professional training of future specialists in technical specialties.

Compliance with the requirements of the integrative methodological approach was ensured by the selection of educational materials from professional and labor protection disciplines, which improved the level of both general scientific and professional, in particular, labor protection training of students and ensured successful mastery of the future profession.

Accordingly, within the scope of our research, based on the results of the generalization of the results of the theoretical analysis of scientific sources, practical experience with the research problem, expert evaluation and the conducted pedagogical experiment, a structural-functional model was developed, which schematically reflects the structure and process of training specialists of technical specialties for labor protection professional activity according to the requirements of the integrative methodological approach.

To find out the effectiveness of the proposed model and possible problematic moments, a chamber pedagogical experiment was conducted.

Four academic groups of students (a total of 87 students) were involved in the chamber experiment, two experimental groups (24 and 20 students,

respectively) and two control groups (21 and 22 students) were formed. The non-parametric Pearson test was used to check the homogeneity of the distribution of the selected groups. The results obtained at the end of the chamber experiment are shown in Table 1.

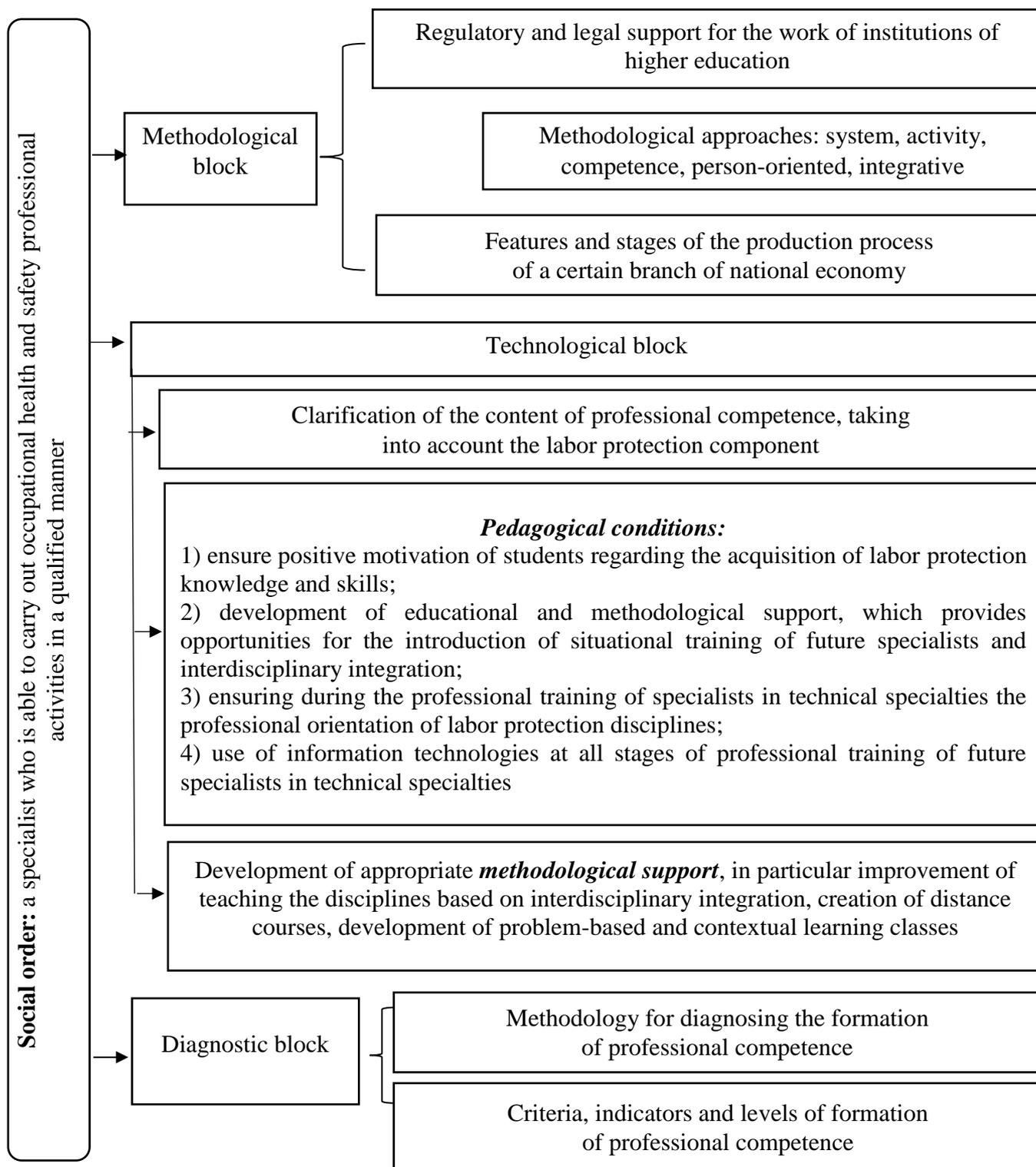


Fig. 2. Structural and functional model of training specialists in technical specialties for labor protection professional activity according to the requirements of the integrative methodological approach

Table 1. Results of the formation of labor protection competence in CG and EG of future specialists at the end of the chamber experiment

| Groups | Levels of formation of labor protection competence | | | | | | | | Number of people in the group |
|------------|--|-------|--------------|-------|------------|-------|----------|-------|-------------------------------|
| | Initial | | Reproductive | | Sufficient | | Creative | | |
| | q-ty | % | q-ty | % | q-ty | % | q-ty | % | |
| CG -1 | 10 | 47,62 | 7 | 33,33 | 3 | 14,29 | 1 | 4,76 | 21 |
| EG -1 | 5 | 20,83 | 10 | 41,67 | 6 | 25,00 | 3 | 12,50 | 24 |
| CG -2 | 11 | 50,00 | 9 | 40,91 | 2 | 9,09 | 0 | 0,00 | 22 |
| EG -2 | 4 | 20,00 | 11 | 55,00 | 3 | 15,00 | 2 | 10,00 | 20 |
| CG (total) | 21 | 48,84 | 16 | 37,21 | 5 | 11,63 | 1 | 2,33 | 43 |
| EG (total) | 9 | 20,45 | 21 | 47,73 | 9 | 20,45 | 5 | 11,36 | 44 |

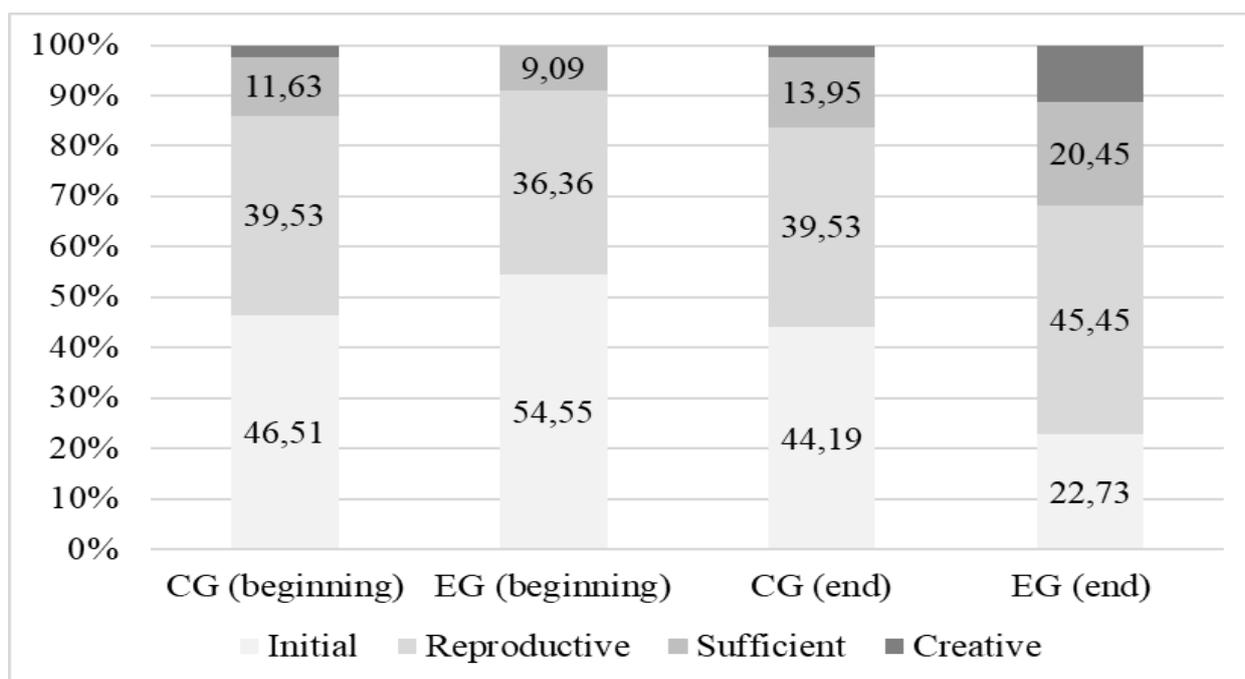


Fig. 3 Dynamics of occupational safety competence levels at the beginning and at the end of the chamber experiment

In fig. 3 shows the results of the analysis of changes in the levels of labor protection competence of students during the chamber experiment.

As can be seen from fig. 3, at the end of the chamber experiment, there was a decrease in the number of students in the experimental group with the initial level of labor protection competence (from 54% to 20.45%), in the control group, such a decrease was insignificant (from 53.49% to

48.84%). In the experimental group, at the end of the chamber experiment, a significant increase in the number of students with sufficient and creative levels was observed (from 9.09% to 20.45% – sufficient level; from 0.00% to 11.36% – creative level). This dynamic is not observed in the control group.

To check the statistical significance of the obtained changes, we will use the non-parametric

Pearson test. We formulate the null and alternative hypotheses in the following formulation:

- the share of students who showed a certain level of occupational safety competence formation at the end of the chamber experiment in the experimental group is not greater than in the control group;

- the proportion of students who showed a certain level of occupational safety competence at the end of the chamber experiment in the experimental group is greater than in the control group.

We check the hypotheses formulated by us using the Pearson test:

$$\chi^2_{\text{empire}} = 43 \cdot 44 \cdot \left[\frac{\left(\frac{21}{43} - \frac{9}{44}\right)^2}{21 + 9} + \frac{\left(\frac{16}{43} - \frac{21}{44}\right)^2}{16 + 21} + \frac{\left(\frac{5}{43} - \frac{9}{44}\right)^2}{5 + 9} + \frac{\left(\frac{1}{43} - \frac{5}{44}\right)^2}{1 + 5} \right] = 9,27$$

According to the results of calculations, $\chi^2_{\text{empire}} > \chi^2_{\text{crit}}$, which for a significance level of 0.01 is 9.2. Therefore, there are reasons to believe that the alternative hypothesis has been implemented and to state the presence of significant statistical differences in the levels of occupational health and safety competence at the end of the chamber experiment.

Conclusions. Therefore, the issue of training future specialists in technical specialties for labor protection professional activity has become of primary importance in the modern conditions of the development of science, engineering and technology. In the process of constructin of a structural-functional model of training specialists in technical specialties for labor protection professional activity according to the requirements of the integrative

methodological approach, the following was taken into account:

- in the center of the process under study is the personality of the future specialist and his|her professional formation;

- improvement of the content of professional competence, taking into account the labor protection component of future specialists in technical specialties – is a necessary element of the professional training system;

- future specialist – is a subject of training who takes an active position in the modern educational process, which is implemented in accordance with the requirements of a person-oriented approach;

- freedom to choose the strategy of the individual path of professional development.

The proposed model of training specialists of technical specialties for labor protection professional activity according to the requirements of the integrative methodological approach makes it possible to reveal in detail and study the components of the system of training of future employees of technical specialties for labor protection professional activity, to reveal the mechanisms of their interrelationships and mutual influences, comprehensively and systematically investigate the main principles of optimizing educational environments and predict their effectiveness. The relevance of this study is determined by the needs of the system of higher technical education to respond to modern production conditions, the rapid development of scientific and technical progress, and a significant increase in the requirements of the labor market and employers.

The effectiveness of the proposed structural-functional model was confirmed by the results of a chamber pedagogical experiment. In addition, in the process of experimental work, the shortcomings of the created model were clarified and possible ways to eliminate them were determined, which are prospects for our further scientific research.

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ПІДГОТОВКА ФАХІВЦІВ ТЕХНІЧНИХ СПЕЦІАЛЬНОСТЕЙ ДО ПРОФЕСІЙНОЇ ПРАЦЕОХОРОННОЇ ДІЯЛЬНОСТІ ЗА ВИМОГАМИ ІНТЕГРАТИВНОГО ПІДХОДУ

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Реферат

Актуальність: на підставі аналізу особливостей і сучасного стану підготовки фахівців технічних спеціальностей встановлено, що існує нагальна потреба формування нової генерації працівників, здатних систематично підвищувати фаховий рівень та реалізовувати заходи й засоби забезпечення належного рівня безпеки на своєму робочому місці.

Мета: побудова структурно-функціональної моделі підготовки фахівців технічних спеціальностей до працезохоронної професійної діяльності за вимогами інтегративного методологічного підходу.

Методи: теоретичні (аналіз науково-методичних публікацій, що відображають проблему дослідження, узагальнення кращого вітчизняного та зарубіжного педагогічного досвіду щодо підготовки фахівців технічних спеціальностей до працезохоронної професійної діяльності); емпіричні (опитування для з'ясування рівня готовності майбутніх фахівців до працезохоронної професійної діяльності; експертне опитування – для побудови структурно-функціональної моделі підготовки фахівців технічних спеціальностей до працезохоронної професійної діяльності та визначення педагогічних умов її реалізації); експериментальні (камерний педагогічний експеримент – для доведення дієвості побудованої структурно-функціональної моделі).

Результати: на підставі теоретичного аналізу наукових джерел і наявного практичного досвіду підготовки фахівців технічних спеціальностей до працезохоронної професійної діяльності та отриманих результатів педагогічного експерименту запропоновано структурно-функціональну модель підготовки фахівців технічних спеціальностей до працезохоронної професійної діяльності; визначено перелік педагогічних умов для реалізації представленої моделі.

Висновки: структурно-функціональна модель підготовки фахівців технічних спеціальностей до працезохоронної професійної діяльності побудована з урахуванням вимог інтегративного методологічного підходу, містить методологічний, технологічний та діагностичний блоки; основними педагогічними умовами її реалізації є: забезпечення позитивної мотивації студентів щодо набуття працезохоронних компетенцій, знань, умінь і навичок; розроблення відповідного навчально-методичного забезпечення; забезпечення професійної спрямованості працезохоронних дисциплін і використання інформаційних технологій на всіх етапах професійної підготовки майбутніх фахівців технічних спеціальностей; дієвість запропонованої моделі доведена результатами камерного педагогічного експерименту.

Ключові слова: професійна підготовка, працезохоронна діяльність, інтегративний методологічний підхід, заклади вищої освіти, модель підготовки фахівців.

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