Study of the Activity Component of Safety Professional Activity in Education Future Engineers of Labour Protection

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The article presents the results of research and experimental work on the study of the activity component of the culture of safety of professional activity among future occupational safety and health engineers. The method of diagnosing the activity component is revealed and the main stages of research and experimental work are described. The study covered the students majoring in 263 "Civil Safety" in the field of knowledge 26 "Civil Safety" with specialization "Occupational Safety", (226 students of the control group and 221 of experimental group) of different regions of Ukraine. Indicators confirming the positive dynamics of the formation of the activity component of the culture of safety of professional activity among future occupational safety engineers have been established. It was concluded that the results of the dynamics of the formation of the activity component of the culture of safety of professional activity show better indicators in the experimental group, compared to the results of the control group.

Keywords: culture of safety of professional activity, vocational training, occupational safety and health engineer, sustainable development, professional education, occupational safety

INTRODUCTION

In the context of the implementation of the Concept of Sustainable Development and the Concept of Green Economy, the culture of safety of professional activity becomes especially relevant for the future occupational safety and health engineer, who in his professional activity should be guided by such principles of safety culture as prioritizing safety over economic and production goals, systematic training on occupational safety of managers and personnel of organizations, strict observance of discipline and labor safety requirements, distribution of duties, powers and spheres of responsibility for occupational safety between subjects of the labor protection management system at the enterprise, creation of a positive attitude to safety, motivation of personnel for safe behavior and safe activities. In this regard, the main goal of the professional training of occupational safety engineers is the implementation of the pedagogical system of the formation of the culture of safety of professional activity (CSPA), which provides for the improvement of the motivational and value sphere, professional knowledge, skills, and the development of professionally important qualities for the prevention of industrial accidents and injuries, gaining experience in safe professional activity and communication on occupational safety issues

Conceptual provisions on the formation of the culture of safety of professional activity of future occupational safety engineers are reflected in the Concept of Education Development of Ukraine for the period 2015–2025; Constitution of Ukraine (1996); Code of Labor Laws of Ukraine (1971); Civil Protection Code of Ukraine (2013); Laws of Ukraine: "On Education" (2017), "On Higher Education" (2014), "On Labor Protection" (1992), "On Ensuring Sanitary and Epidemic Welfare of the Population" (1994), "On Mandatory State Social Insurance" (1999), "Basics of Ukrainian legislation on health care" (1992), "On high-risk facilities" (2001); Concepts of reforming the labor protection management system in Ukraine (2018); National strategy in the field of human rights (2021); Orders of the State Committee for Labor Protection Supervision of Ukraine the Orders of the State Committee of Ukraine for the supervision of labor protection "On the approval of the Model Regulations on the Labor Protection Service" (2004), "On the approval of the Model Regulations on the procedure for training and knowledge testing on labor protection and the List of high-risk jobs" (2005); the UN General Assembly Resolution "Transforming our world: the 2030 Agenda for Sustainable Development" (2015); Decrees of the President of Ukraine "On the goals of sustainable development of Ukraine by 2030" (2019); Orders of the Cabinet of Ministers of Ukraine "On approval of the Development Strategy for the sphere of innovative activity by 2030" (2019); Documents and Reports of the International Labor Organization (ILO): ILO Declaration on Fundamental Principles and Rights at Work (1998), ILO Convention on Occupational Safety and Health (1981), ILO Occupational Safety and Health Recommendations (1981), ILO Promotional Framework for Occupational Safety and Health Convention (2006), ILO "A promotional framework for occupational safety and health" (2004), "Promoting a culture of occupational safety and health" (2005), "Safe and healthy workplaces: making decent work a reality" (2007), "Formation of the culture of preventive safety and health care" (2013); In the reports of the International Atomic Energy Agency "Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident" (1986), "Basic Safety Principles for Nuclear Power Plants Basic 75-INSAG-3" (1989), "Safety Culture 75- INSAG-4" (1991), "The Chernobyl Accident: Updating of INSAG-1" (1993), "Key Practical Issues in Strengthening Safety Culture INSAG-15" (2015).

The relevance and expediency of the research is evidenced by a number of contradictions that need to be resolved, in particular between:

- the need of the labor market and Ukrainian society for competent occupational safety engineers with a high level of occupational safety culture and the lack of research that reveals innovative methodological approaches and concepts that make it possible to make changes to the existing practice of vocational training of occupational safety engineers;
- a significant increase in the requirements of enterprises and organizations regarding the training of occupational safety engineers capable of carrying out professional activity based on the principles of the culture of safety of professional activity and the insufficient validity of the theoretical foundations necessary for this;
- the need for purposeful formation of the culture of safety of professional activity among future occupational safety engineers and the inconsistency of theoretical foundations and educational and methodological support that would contribute to this.

During the scientific research, we established that the culture of safety of professional activity of the future occupational safety and health engineer is an integrative formation of the personality of a specialist, which is expressed by a valuable attitude to the preservation of life, work capacity and health of a person in the process of work; it reflects a system of formed professional knowledge, skills, professionally important qualities regarding the prevention of industrial accidents and injuries, and is characterized by a high degree of responsibility, self-organization and self-development, based on a deep awareness of the priority of safety when solving professional tasks.

Taking into account the different approaches of scientists regarding the structural and substantive components of the safety culture, we came to the need to clarify the set of motives, professional knowledge, abilities and skills, professional and personal qualities of the occupational safety engineer, which will be laid in the basis of the formation of the culture of safety of professional activity. The analysis of scientific, pedagogical and psychological literature made it possible to determine the *components of the formation of the culture of safety of professional activity*, where we included: motivational and value (value orientations

and attitudes, motives for the implementation of safe professional activity); cognitive (knowledge of laws, regulations and standards in the field of labor protection); activity (the ability to identify and assess hazards and risks for safety and health at work; the ability to prevent the occurrence of hazards and accidents; the ability to determine the adequacy of planned and effective measures to protect against hazards and risks; the ability and skills to use safe methods and tools of work); personal (professionally important qualities and abilities that ensure the safety of professional activity at work). In this article, we focus on the results of an experimental study on the formation of the personal component of the CSPA. **The purpose of the article** is to reveal the results of an experimental study of the activity component of the culture of safety of professional activity of future occupational safety engineers based on the implementation of the pedagogical system for the formation of the culture of safety of future occupational safety and health engineers.

LITERATURE REVIEW

The activity component ensures the formation of professional skills and the ability to perform safe professional activities based on the principles of CSPA. The analysis of information sources shows that knowledge is closely related to skills. Thus, in the pedagogical dictionary of O. Novikov, skills are defined as a person's mastered ability to perform actions provided by a set of acquired knowledge and abilities. Skills are considered as complex structural formations of the personality, containing its sensual, intellectual, volitional, creative, emotional qualities, ensuring the achievement of the set goal of the activity in the changing conditions of its course. Skill is a higher human quality, the formation of which is the ultimate goal of the educational process, its completion (Novikov, 2013, p. 225). A skill is the ability to perform certain actions based on relevant knowledge (Kovalenko, 2003, p. 77). The results of the analysis of scientific works show that there are different classifications of skills in the theory and methodology of professional education. Thus, O. Kovalenko divides skills into subject-practical, subject-mental, symbolic-practical, symbolic-mental skills (Kovalenko, 2005, p. 77). E. Zeyer and N. Glukhanyuk identified the following skills for the implementation of engineering-pedagogical activities: ideological, organizational-pedagogical, didactic, organizational-methodical, communicative-directive, prognostic, gnostic, engineering-technical, containing 5 groups: general engineering, constructive-technical, technological, skills on industry specialization, and production-operational skills (Zeyer, & Glukhanyuk, 1988, p. 13). In the process of developing the information and analytical competence of managers of vocational and technical educational institutions, L. Petrenko considers information-analytical theoretical knowledge, information-analytical, technological knowledge, communicative skills and abilities, analytical skills, synthetic skills (Petrenko, 2013, pp. 82–86). O. Borodienko defined the following complex of knowledge and skills of managers of structural enterprises in the field of communication: professional knowledge and skills, psychological knowledge, andragogic knowledge and skills, communicative skills, organizational and managerial knowledge and skills (Borodienko, 2018, p. 86). In our study, the set of the following skills necessary for the formation of occupational health and safety in future occupational safety engineers is established: engineering-technical, labor protection, legal, ergonomic, medical-biological, sanitary-hygienic, organizational-managerial, informational-analytical, communicative, monitoring, pedagogical, psychological, andragogic.

Thus, *organizational-management skills* include the ability to organize the work of the team or performers with mandatory consideration of labor protection requirements; to distribute the functions, duties and powers on occupational safety in the workteam; to adopt and implement management decisions regarding improvement of working conditions, prevention of industrial injuries; to have a command of methods of motivating and stimulating employees to work safely; to carry out documentation support of management activities. As a result of the formation of *engineering-technical skills*, students should be able to develop and use graphic documentation; assess and analyze the state of high-risk production facilities, technological processes and equipment regarding compliance with the safety level; determine high-risk, extremely high-risk zones, zones of acceptable risk; determine and develop organizational and technical measures and means of safe operation of technological equipment and tools; reasonably choose systems and methods of human protection in the work process, measures aimed at preventing workplace accidents

and occupational diseases; apply methods of measuring harmful and dangerous factors of the production environment, process the obtained results, make forecasts of the development of traumatic situations. *Legal skills* should ensure the ability to apply the requirements of labor protection legislation, regulatory acts and regulatory-technical documentation to equipment; the ability to develop projects of local normative acts of the enterprise, organization, which ensure the functioning of the occupational safety management system; the ability to analyze changes in legislation on occupational safety and suggest projects of local regulatory acts on occupational safety. *Ergonomic skills* include the ability to apply ergonomic methods and principles when organizing a workspace to ensure the convenience and comfort of a working posture; skills of using methods for assessing anthropometric and psychophysiological characteristics of a person; ability to apply standard ergonomic requirements to the workplace and measures aimed at work sanitaion. *Medical-biological and sanitary-hygienic skills* involve the ability to identify the main hazards of the production environment and determine the risks of their influence; the ability to determine the normative values of harmful and dangerous production factors that negatively affect the human body; the ability to assess the level of one's own culture of health and use health-preserving technologies to increase it; skills in choosing appropriate methods and means of protection against hazards to create safe and harmless working conditions; first aid skills. *Information-analytical skills* make it possible to process and give the necessary information on workplace injuries, the investigation of accidents and occupational diseases, the state of occupational conditions and safety, control over labor protection. *Monitoring skills* provide abilities in applying the occupational health and safety control methods; running documentary support of monitoring activities; dentifying dangerous and harmful production factors affecting employees in the work process. *Communicative skills* combine the ability to establish interaction with employees, heads of structural divisions of enterprises, the employer, representatives of trade union organizations, state labor protection management bodies, state supervision and control; abilities to reasonably express one's position, evidence and persuasiveness of compliance with occupational safety requirements; ability to find optimal solutions in conflict situations; ability of diplomatic discussion with representatives of supervisory bodies for labor protection, workplace accidents and occupational diseases social insurance fund, medical organizations; abilities of team interaction and active listening to interlocutors. *Psychological skills* make it possible to determine means on eliminating psychological conflicts, establish tools on relieving psychological stress in the team, reduce and prevent employee fatigue; to have a command of psychological mechanisms of group members' interaction and psychological foundations on safety training. *Pedagogical skills* combine the abilities to select and structure the educational material on occupational safety; ability to develop training and instructing programs on occupational safety; ability to apply various methods, forms, tools and technologies on organization of occupational safety training; ability to organize a knowledge test on occupational health and safety; ability to provide methodical assistance for work managers in the development of occupational safety instructions; ability to evaluate the effectiveness of personnel training in the field of occupational safety and health. *Andragogical skills* imply the ability of an occupational safety engineer to master the theory of teaching adults; ability of organizing team training on the development of safety culture among employees; ability of forming the knowledge necessary for employees to safely implement their professional activities.

In order to create positive changes in the levels of formation of the activity component of CSPA in future occupational safety engineers, we have developed a pedagogical system for the formation of the culture of safety of professional activity in future occupational safety engineers, which is aimed at increasing and improving the motivational and value sphere, professional knowledge, skills and professionaly important qualities regarding the prevention of workplace injuries, gaining experience in safe professional activity and communication on occupational safety issues. The developed pedagogical system is carried out at the appropriate stages (design, process-technological, evaluation-reflective) during training in higher education institutions through the implementation of goals (general, strategic, tactical, final) and the content of formation (occupational safety, organizational-management, legal, ergonomic, health-preserving, communicative). The experimental methodology on the formation of CSPA in future occupational safety and health engineers ensures the formation of motivation and a positive attitude to occupational safety, professional knowledge and skills, professionally important qualities, experience in

safe professional activity and includes forms of organization of educational activities that involve interaction (problem lecture, lecture-visualization, lecture-dialogue, lectures-discussions, one-to-one lectures, practical and laboratory works, interaction, seminars-workshops, problem-based seminars); methods (problematic, moderation, training, brainstorming, modeling of professional activity); interactive pedagogical technologies (games, cooperation technologies, project, case, vitagenic learning technologies, information and communication technologies); a complex of educational and methodological support.

RESEARCH METHODOLOGY AND METHODS

The study of the activity component of the culture of safety of professional activity of future occupational safety engineers was carried out within the framework of the program of research and experimental work on the problem of the formation of the culture of safety of professional activity of future occupational safety engineers, which covered four stages: research, ascertaining, formative stage and generalization. The research stage of the research-experimental work included the analysis of the problem of the formation of the culture of safety of professional activity in future occupational safety engineers in pedagogical theory and practice, the development of theoretical foundations and an experimental research program. At this stage of the research, such research methods as theoretical analysis, systematization and synthesis of scientific literature, analysis of curricula and educational-vocational programs were applied; generalization of pedagogical experience; search experiment. The tasks of the ascertaining stage of the pedagogical experiment are: identification and analysis of the existing level of formation of the culture of safety of professional activity in future occupational safety engineers, establishment of control and experimental groups. During the ascertainment stage of the research, we used such methods as ascertainment experiment; study and generalization of pedagogical experience; interviewing, questionnaires, conversation, self-assessment, method of expert assessments, quantitative and qualitative analysis. The formative stage of the experiment included a study of the effectiveness of the pedagogical system of formation of the culture of safety of professional activity in future occupational safety engineers, developing and justifying the content and innovative methods of formation of the culture of safety of professional activity of future occupational safety engineers. To implement the formative experiment, we used the following research methods: pedagogical formative experiment, modeling, construction, self-assessment, expert assessment, interview, observation, questionnaire, statistical analysis of the obtained data. The tasks of the generalization stage of the research and experimental work are the analysis of the effectiveness of the pedagogical system for the formation of CSPA in future occupational safety and health engineers, generalization of the results of theoretical and practical research; formulation of general conclusions. The main research methods on this stage of the pedagogical experiment were the following: methods of measurement and mathematical processing, qualitative and quantitative analysis, graphic interpretation of the obtained data, prognostic analysis.

Diagnostics of the formation of CSPA in future occupational safety engineers required substantiation of the principles of methods selection. In our opinion, the principles that ensure the objectivity of the research results of the formation of CSPA include the following: the principle of complexity, which requires a comparison of the results of the methods used; the principle of unlimited development potential of the subject of professional activity; the principle of systematicity in order to achieve a high level of formation of CSPA in future occupational health and safety engineers. The selection of methods was carried out based on the methodological basis, the conformity of the diagnostic research situation to the goals, the possibility of obtaining a sufficiently large amount of various data on the personality qualities of the subject, related to the achievement of the formation of CSPA, the possibility of repeated express diagnostic sections. During the research, the traditional requirements for the experimental situation were taken into account: consent of future respondents and consideration of their motivation; detailed instructions on the course of the experiment and possible consequences; familiarization with the test results, observation of each research participant; research anonymity; group and / or individual consultation on the interpretation of research results. The strategy for achieving the formation of CSPA was a toolkit for solving the problems of developing safe behavior of future occupational safety engineers. The identification of the essential

characteristics of the formation of CSPA in future occupational safety engineers indicates the impossibility of a complete mathematization of the analyzed category, therefore the diagnostic procedure included the accounting of both objectively registered parameters (results of practical activities, behavioral features in some experimental situations) and subjective data (subjective opinions of students, social perceptions, emotional reactions).

The research involved 447 students majoring in 263 "Civil Safety" in higher education institutions of Ukraine. In addition, 127 teachers of higher education institutions and 112 occupational safety engineers of industrial enterprises and organizations took part in the study. To evaluate indicators of the activity component, tests, questionnaires, and tasks of the developed program for diagnosing the formation of CSPA of future occupational safety engineers were used. L. Regush's "ability to predict" evaluation method was used for diagnostic assessment of forecasting ability (Gershenzon 1999, p. 287). The results of the answers were evaluated in the form of a low (basic) level of formation of the ability to predict – up to 7 answers, an average (sufficient) level – 8–11 answers and a high level – 12–16 answers. Subsequently, as for the previous indicator, it was transferred to the experiment evaluation scale. Also, the program for diagnosing the formation of CSPA of future occupational safety engineers included a questionnaire for self-assessment of the formation of activity and behavioral criteria of CSPA in future occupational safety and health engineers.

RESULTS AND DISCUSSION

In order to diagnose the levels of formation of the activity component of CSPA of future occupational safety engineers, we chose an activity-behavioral criterion, which was determined by the following indicators:

1. Readiness for the practical application of medical-biological, sanitary-hygienic skills for preserving health and life in the work process, prevention of occupational diseases, reducing the level of occupational risks, providing first medical aid;
2. Ability to use regulatory and legal acts on occupational safety to solve the tasks of ensuring safety at work;
3. Willingness to analyze traumatic situations, working conditions and develop measures to increase occupational safety and optimize the workplace; readiness to use modern trends in the development of equipment and technologies, means of protection in the field of ensuring safety in one's professional activity;
4. Readiness to implement organizational-management, information-analytical and monitoring abilities and skills in organization, planning, development and implementation of the occupational health and safety management system at the enterprise; good command of the skills of prevention of workplace injuries, prevention of early fatigue of employees, mastery of organizational-technical and medical-prophylactic methods and means of ensuring personal safety and the safety of a work team;
5. Availability of skills and abilities of communicative interaction, resolution of conflict situations, psychological influence on employees in order to popularize occupational health and safety issues and improve the safety culture.

On the basis of theoretical analysis and research-experimental work, in accordance with the proposed criteria and indicators, we determined the following levels of formation of CSPA in future occupational safety engineers: basic (reproductive), sufficient (constructive) and high (creative). The results of the study are presented in Table 1.

It can be seen from the tabular data that the indicator "Readiness for the practical application of skills for preserving health and life in the work process, prevention of occupational diseases, reducing the level of occupational risks, providing first medical aid" is demonstrated by students mainly on the basic and sufficient levels. Among students of the control group, this indicator was 40.3 % and 41.2 %, and among students of the experimental group 39.8 % and 43.0 % respectively. The ability to reduce the level of professional risks involves the implementation of the process of identifying hazards and establishing their

quantitative, qualitative, temporal, spatial characteristics for the possibility of developing operational and preventive measures to ensure the reduction of the level of professional risks. Taking into account the previously analyzed cognitive component, it is quite logical that the lack of an information base regarding the existing spectrum of dangers manifests itself in the lack of skills to ensure a decrease in their level. The number of students according to the indicator "Ability to use regulatory and legal acts on occupational safety to solve the tasks of ensuring safety at work", showing the basic (reproductive) and sufficient (constructive) levels, was 38.5 % and 47.3 % in CG and in EG 40.3 % and 48.0 %.

As shown by the results of diagnosing the levels of formation of abilities and skills of the implementation of professional activities on the basis of CSPA of future occupational safety engineers, presented in the Table 1, to the smallest degree, they have developed the readiness to analyze traumatic situations, working conditions and develop measures to increase occupational safety and optimize the workplace; willingness to use modern trends in the development of engineering and technology, means of protection in the field of ensuring safety in their professional activities (the number of students with a basic level is: 46.0 % in CG and 48.9 % in EG) and readiness to implement organizational-managerial, information-analytical and monitoring abilities and skills in the organization, planning, development and implementation of the occupational health and safety management system at the enterprise; mastery of the skills of workplace injuries prevention, worker's early fatigue prevention, mastery of organizational-technical and medical preventive methods and means of ensuring personal safety and safety of the team (the number of students with a basic level is: 52.2 % in CG and 51.6 % in EG).

The obtained results can proof that students do not fully master the algorithm of processes during the implementation of various types of activities to ensure CSPA. In the best case, when carrying out the order of security actions, they violate the procedural logic of their implementation (during actions in emergency situations, etc.). So, for example, when providing first aid in CG 40.3 % and EG 39.8 % of students violate the sequence of correct actions, and in situations of fire, they violate the conditions of the "fire triangle", which does not eliminate it, but increases it with the help of an influx of oxygen. The indicator "Availability of skills and abilities of communicative interaction, resolution of conflict situations, psychological influence on employees in order to popularize occupational health and safety issues and improve the safety culture" among students at the beginning of the experiment is manifested mainly at the basic (reproductive) level for CG (40.3 %) , and at the sufficient (constructive) level for EG (40.3 %). As a result, some students are unable to reliably predict the possible scale of the consequences of recklessness from the safety standpoint.

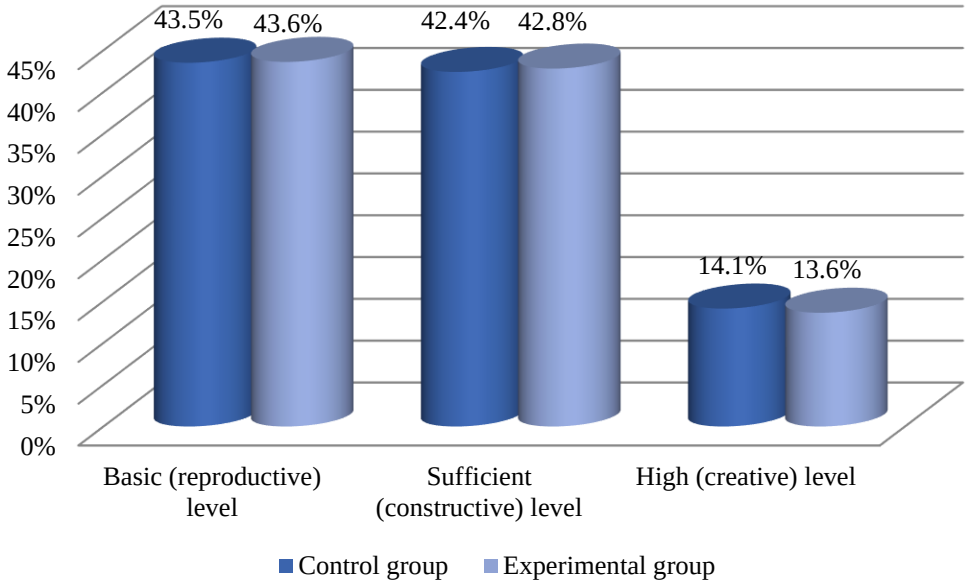
From the data in Table 1, it can be seen that $\chi^2_{emp} = 0.0344 < \chi^2_{cr} = 5.99$, that is, the differences are considered insignificant, which proves, accordingly, the homogeneity of the sample. Therefore, the characteristics of the compared samples on the activity component as a whole and on a separate indicator at the ascertainment stage of the experiment coincide at the significance level of $p = 0.05$. The results of statistical data on the levels of formation of CSPA in future occupational safety engineers showed the identity of CG and EG at the beginning of the experiment on the diagnosis of the activity component (Figure 2). Thus, the number of students with a basic (reproductive) level in CG is 0.1 % less than in EG; with sufficient (constructive) level in CG is 0.4 % less than in EG; with high (creative) level in CG is 0.5 % more.

TABLE 1
THE RESULTS OF DIAGNOSING THE LEVELS OF FORMATION OF CSPA ACCORDING TO THE ACTIVITY-BEHAVIORAL CRITERION (AT THE ASCERTAINING STAGE OF THE EXPERIMENT)

Indicators	Groups / Total number of people	Levels						χ^2
		Basic (reproductive)		Sufficient (constructive)		High (creative)		
		Number of respondents, persons	Ratio to the total number of respondents, %	Number of respondents, persons	Ratio to the total number of respondents, %	Number of respondents, persons	Ratio to the total number of respondents, %	
1. Readiness for the practical application of skills for preserving health and life in the work process, prevention of occupational diseases, reducing the level of occupational risks, providing first medical aid	CG	91	40.3	93	41.2	42	18.6	0.2157
	EG	88	39.8	95	43.0	38	17.2	
2. Ability to use regulatory and legal acts on occupational safety to solve the tasks of ensuring safety at work	CG	87	38.5	107	47.3	32	14.2	0.5923
	EG	89	40.3	106	48.0	26	11.8	
3. Willingness to analyze traumatic situations, readiness to use modern trends in the development of equipment and technologies in one's professional activity	CG	104	46.0	107	47.3	15	6.6	1.0053
	EG	108	48.9	95	43.0	18	8.1	
4. Readiness to implement skills and abilities in organization, planning, development and implementation of the occupational health and	CG	118	52.2	92	40.7	16	7.1	0.3591
	EG	114	51.6	88	39.8	19	8.6	

safety management system at the enterprise; good command of the skills on occupational injury prevention								
5. Availability of the skills and abilities of communicative interaction, improvement of the safety culture	CG	91	40.3	81	35.8	54	23.9	0.931
	EG	83	37.6	89	40.3	49	22.2	
The overall level of formation of the component	**CG 226**	**98**	**43.5**	**96**	**42.4**	**32**	**14.1**	0.0344
	EG 221	**96**	**43.6**	**95**	**42.8**	**30**	**13.6**	

FIGURE 1
GENERALIZED RESULTS OF DIAGNOSING THE LEVELS OF FORMATION OF CSPA IN FUTURE OCCUPATIONAL SAFETY AND HEALTH ENGINEERS ACCORDING TO THE ACTIVITY-BEHAVIORAL CRITERION (AT THE ASCERTAINING STAGE OF THE EXPERIMENT)



Source: Compiled by the authors

Thus, it is possible to state that the strategy of professional activity among the students majoring in 263 "Civil Safety" is not formed according to the selected indicators. This result confirms the relevance of the formation of prognostic abilities, skills of students in higher educational institutions, in the context of problems of safety of professional activity. In the course of diagnosing the formation of CSPA according to the activity component, simultaneously with the questionnaire and self-assessment of the relevant abilities and skills of future occupational safety engineers, we conducted talks with them, made observation of the performance of practical work, analysis of various work situations, participation in project activities, etc., and the obtained data were analyzed and summarized. So, based on the results, it can be stated that the majority of future occupational safety engineers need to improve the skills and abilities of implementing professional activities based on the principles of CSPA and increase the level of its formation.

The results of diagnosing the levels of formation of CSPA in future occupational safety engineers according to the activity-behavioral criterion during the formative stage of the experiment are shown in Table 2. From the tabular data, it can be seen that at the formative stage in the CG, students, as before, mainly have a basic (reproductive) and sufficient (constructive) level of formation of indicators of the activity component of CSPA. Thus, the indicator "Readiness for the practical application of skills for preserving health and life in the work process, prevention of occupational diseases, reducing the level of occupational risks, providing first medical aid" is demonstrated by them at the basic (reproductive) and sufficient (constructive) level of 33.5 % and 50.9 %. The number of respondents in CG at the high level according to this indicator was 15.6 %. However, in EG, the high (creative) level was reached by 32.7 % and the sufficient level of this indicator is 50.9 %.

The data of further analysis show that in CG the indicator "Willingness to analyze traumatic situations, readiness to use modern trends in the development of equipment and technologies in one's professional activity" is demonstrated by students mainly at the basic (reproductive) and sufficient (constructive) levels – 35.7 % and 50.9 %, while in EG this indicator is presented at the sufficient (constructive) and high (creative) levels – 50.0 % and 30.0 %. The indicator "Availability of the skills and abilities of

communicative interaction, improvement of safety culture" in CG is mainly presented at the sufficient (constructive) and basic (reproductive) levels: 47.8 % and 32.68 %, respectively, and in EG this indicator is 44.1 % at the high (creative) level. As the results of mathematical processing showed, after the experiment, differences appeared in CG and EG. It can be seen from the table data that $\chi^2_{emp} = 24.9303 > \chi^2_{cr} = 5.99$. Accordingly, the reliability of the differences of the compared samples on the cognitive component with a significance level of $p = 0.05$ is confirmed. In addition, Table 2 presents statistical data on the individual indicators of this component (χ^2_{emp} 26.4810; 19.5706; 23.9890; 22.7491; 35.1105 = > $\chi^2_{cr} = 5.99$.) Thus, we can state the statistically significant reliability of differences in CG and EG after conducting the experiment, both for a single indicator and for the component in general.

The comparative characteristics of the levels of formation of indicators according to the activity-behavioral criterion are presented in the Table 3. The high (creative) level of skill formation in the field of CSPA in the EG at the formative stage of the experiment was shown by 31.5 % of future occupational safety engineers; the sufficient (constructive) level – 50.2 %; the basic (reproductive) level – 18.3 %. Compared to the results of the ascertainment stage of the experiment, the share of students with the high (creative) level increased by 18.0 % (from 13.6 %); with the sufficient (constructive) level – increased by 7.4 % (from 42.8 %); with the basic (reproductive) level – decreased by 25.4 % (from 43.6 %), among students of CG these indicators are lower: +0.7 %, +8.1 %, and -8.8 %, respectively.

The results of the analysis of the data given in the Table 3 testify to the effective positive changes in the levels of formation of CSPA of future occupational safety engineers according to the activity-behavioral criterion. To visualize these results, let's construct a diagram (Figure 2). The results of the analysis of the diagram show that the increase in the indicators that characterize the high (creative) level and, accordingly, the decrease in the indicators that correspond to the sufficient (constructive) and basic (reproductive) levels are more pronounced among the students of the experimental group. The share of future occupational health and safety engineers who show the high (creative) level of formation of CSPA according to the activity-behavioral criterion at the stage of the formative experiment is 16.8 % higher than the CG; the sufficient (constructive) level – by 0.5 % less; the basic (reproductive) level is less by 16.3 %.

TABLE 2
THE RESULTS OF DIAGNOSING THE LEVELS OF FORMATION OF CSPA OF FUTURE OCCUPATIONAL SAFETY AND HEALTH ENGINEERS ACCORDING TO THE ACTIVITY-BEHAVIORAL CRITERION (AT THE FORMATIVE STAGE OF THE EXPERIMENT)

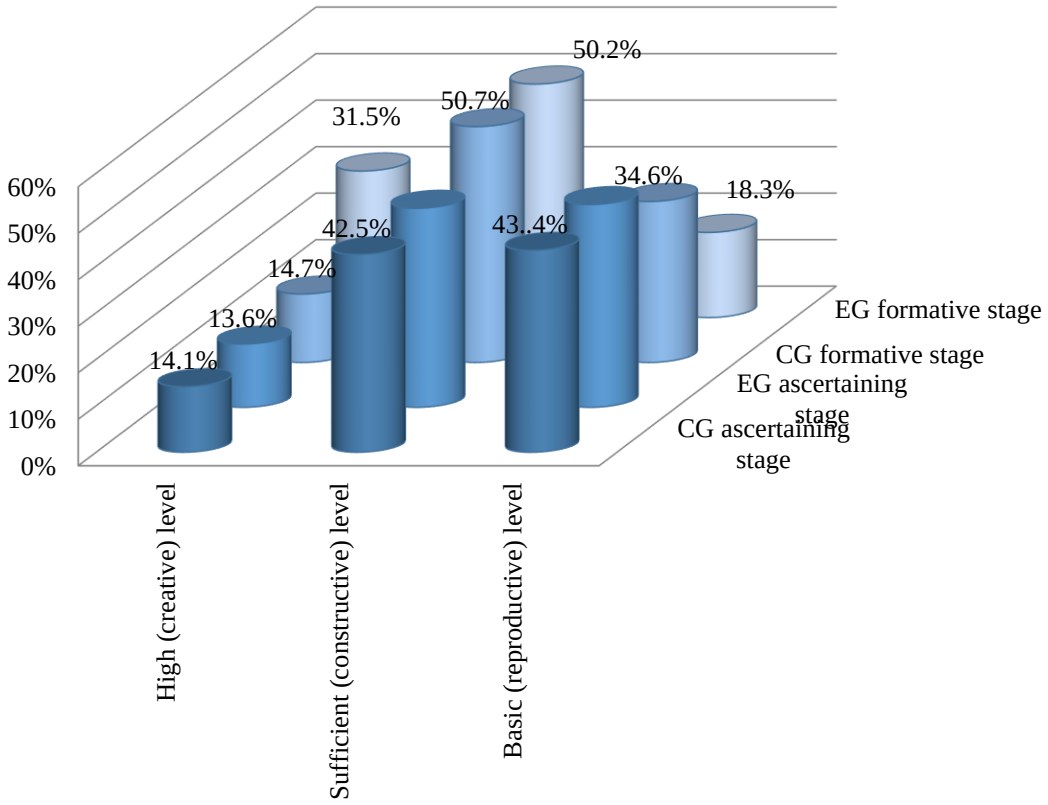
Indicators	Groups / Total number of people	Levels						χ^2
		Basic (reproductive)		Sufficient (constructive)		High (creative)		
		Number of respondents, persons	Ratio to the total number of respondents, %	Number of respondents, persons	Ratio to the total number of respondents, %	Number of respondents, persons	Ratio to the total number of respondents, %	
1. Readiness for the practical application of skills for preserving health and life in the work process, prevention of occupational diseases, reducing the level of occupational risks, providing first medical aid	CG	75	33.5	114	50.9	35	15.6	26.4810
	EG	36	16.4	112	50.9	72	32.7	
2. Ability to use regulatory and legal acts on occupational safety to solve the tasks of ensuring safety at work	CG	79	35.3	114	50.9	31	13.8	19.5706
	EG	40	18.2	126	57.3	54	24.5	
3. Willingness to analyze traumatic situations, readiness to use modern trends in the development of equipment and technologies in one's professional activity	CG	80	35.7	114	50.9	30	13.4	23.9890
	EG	44	20.0	110	50.0	66	30.0	
4. Readiness to implement skills and abilities in organization, planning, development and implementation	CG	81	36.2	118	52.7	25	11.2	22.7491

of the occupational health and safety management system at the enterprise; good command of the skills on occupational injury prevention	EG	46	20.9	116	52.7	58	26.4	
5. Availability of the skills and abilities of communicative interaction, improvement of the safety culture	CG	73	32.6	107	47.8	44	19.6	35.110
	EG	35	15.9	88	40.0	97	44.1	
The overall level of formation of the component	**CG 224**	**78**	**34.6**	**113**	**50.6**	**33**	**14.7**	24.9303
	EG 220	**40**	**18.3**	**110**	**50.2**	**69**	**31.5**	

TABLE 3
THE DYNAMICS OF THE LEVELS OF FORMATION OF CSPA ACCORDING TO THE ACTIVITY-BEHAVIORAL CRITERION (AT THE ASCERTAINING AND FORMATIVE STAGES OF THE EXPERIMENT)

Levels	**Ascertaining stage of the experiment**				**Formative stage of the experiment**				**Dynamics, %**	
	Control groups		**Experimental groups**		**Control groups**		**Experimental groups**			
	Number of respondents, persons	**Ratio to the total number of respondents, %**	**Number of respondents, persons**	**Ratio to the total number of respondents, %**	**Number of respondents, persons**	**Ratio to the total number of respondents, %**	**Number of respondents, persons**	**Ratio to the total number of respondents, %**	**Control groups**	**Experimental groups**
High creative	32	14.1	30	13.6	33	14.7	69	31.5	+0.7	+18.0
Sufficient constructive	96	42.5	95	42.8	113	50.7	111	50.2	+8.1	+7.4
Basic reproductive	98	43.4	96	43.6	78	34.6	40	18.3	-8.8	-25.4
Total	**226**	**100**	**221**	**100**	**224**	**100**	**220**	**100**		

FIGURE 2
DYNAMIC CHANGES IN THE LEVELS OF FORMATION OF CSPA OF FUTURE OCCUPATIONAL SAFETY ENGINEERS ACCORDING TO THE ACTIVITY-BEHAVIORAL CRITERION



Source: Compiled by the authors

Empirical values of the χ^2 criterion of the results of diagnosing the levels of formation of CSPA of future occupational safety engineers according to the activity-behavioral criterion at the ascertaining and formative stages in CG and EG are given in Table 4.

TABLE 4
EMPIRICAL VALUES OF THE X^2 CRITERION OF THE RESULTS OF DIAGNOSING THE LEVELS OF CSPA IN FUTURE OCCUPATIONAL SAFETY ENGINEERS ACCORDING TO THE ACTIVITY-BEHAVIORAL CRITERION

Groups under research	CG ascertaining experiment	CG formative experiment	EG ascertaining experiment	EG formative experiment
CG ascertaining experiment	–	$\chi^2_{emp.} = 3.6621$ $\chi^2_{cr.} = 5.99$ The characteristics of the samples coincide at the level of significance p = 0.05	$\chi^2_{emp.} = 0.0344$ $\chi^2_{cr.} = 5.99$ The characteristics of the samples coincide at the level of significance	$\chi^2_{emp} = 38.7822$ $\chi^2_{cr.} = 5.99$ The reliability of the difference in the characteristics of the samples is P = 95 %

			p = 0.05	
CG formative experiment	$\chi^2_{emp.} = 3.6621$ $\chi^2_{cr.} = 5.99$ The characteristics of the samples coincide at the level of significance P = 0.05	–	$\chi^2_{emp.} = 3.5426$ $\chi^2_{cr.} = 5.99$ The characteristics of the samples coincide at the level of significance P = 0.05	$\chi^2_{emp} = 24.9303$ $\chi^2_{cr.} = 5.99$ The reliability of the difference in the characteristics of the samples is P = 95 %
EG ascertaining experiment	$\chi^2_{emp.} = 0.0344$ $\chi^2_{cr.} = 5.99$ The characteristics of the samples coincide at the level of significance p = 0.05	$\chi^2_{emp.} = 3.5426$ $\chi^2_{cr.} = 5.99$ The characteristics of the samples coincide at the level of significance p = 0.05	–	$\chi^2_{emp} = 39.5115$ $\chi^2_{cr.} = 5.99$ The reliability of the difference in the characteristics of the samples is P = 95 %
EG formative experiment	$\chi^2_{emp} = 38.7822$ $\chi^2_{cr.} = 5.99$ The reliability of the difference in the characteristics of the samples is P = 95 %	$\chi^2_{emp} = 24.9303$ $\chi^2_{cr.} = 5.99$ The reliability of the difference in the characteristics of the samples is P = 95 %	$\chi^2_{emp} = 39.5115$ $\chi^2_{cr.} = 5.99$ The reliability of the difference in the characteristics of the samples is P = 95 %	–

When comparing CG and EG at the formative stage, EG at the formative and ascertaining stages, CG at the ascertaining stage and EG at the formative stage, we claim that the reliability of the difference in sample characteristics is P = 95 %. Comparison of CG and EG at the ascertaining stage, CG at the ascertaining and formative stages CG at the formative and EG at the ascertaining stages with the probability $\rho = 0.05$ we claim that there is no significant difference in the comparison. The values of the statistical criterion χ^2 presented in the Table 3 give grounds to claim that as a result of the formative stage of the experiment, there were effective positive changes in the levels of formation of CSPA in future occupational safety and health engineers according to the activity-behavioral criterion. The data of the comparative analysis show that the indicators of the activity component of CSPA in future occupational safety and health engineers with traditional training also have a tendency towards formation. However, the process is less effective.

CONCLUSION

In the course of a scientific study of the problem of formation of the culture of safety of professional activity in future occupational safety and health engineers, a pedagogical experiment was implemented, during which the real state of formation of CSPA of future occupational safety and health engineers was determined. The diagnosis of formation of CSPA in future occupational and safety engineers was carried out according to motivational-value, intellectual-cognitive, activity-behavioral, subject-reflexive criterion; three levels of formation of CSPA are defined: basic (reproductive), sufficient (constructive), high (creative). The purpose of this work was to substantiate the results of diagnosing the activity component of CSPA in future occupational health and safety engineers. The experimental study presents the author's

vision regarding the content and structure of the activity component of CSPA of future occupational safety and health engineers, as well as the methods of its diagnosing.

Based on the quantitative analysis of the obtained results of the pedagogical experiment, the indicators confirming the positive dynamics of the formation of the activity component of CSPA in future occupational safety and health engineers were ascertained. The generalization and comparison of the results of the dynamics of formation of CSPA show better indicators in the experimental group, in comparison with the results of the control group, according to the activity-behavioral criterion, an increase of the high (creative) level in EG by 16.8 % and the sufficient (constructive) level by 0.5 % is shown; a decrease in the basic (reproductive) level by 16.3 % than in CG (statistical significance $\chi^2 = 24.9303$). The positive dynamics of the growth of the levels of formation of CSPA of the students from the experimental groups were revealed. The results of the analysis of the levels of formation of CSPA among future occupational safety engineers in the control and experimental groups at the ascertaining and formative stages of the research give grounds for affirming the effectiveness of the developed pedagogical system.

The conducted research does not cover all areas of solving the problem of formation of the culture of safety of professional activity of future occupational safety and health engineers. We see the prospect of further research in the study of the theoretical and methodological foundations of the development of the culture of safety of professional activity among occupational safety and health engineers, the foundations of formation, development and education of value orientations in future occupational safety and health engineers in the system of continuous education, the formation of professional competence and professional culture among future occupational safety engineers based on the principles of safety culture, foreign systems of vocational training of future occupational safety and health engineers and the formation of the safety culture.

REFERENCES

Borodienko, O.V. (2018). *Systema rozvytku profesiynoyi kompetentnosti kerivnykiv strukturnykh pidrozdiliv pidpryyemstv sfery zv'yazku.* [System of development of professional competence of managers of structural divisions of enterprises in the field of communications.] (Dissertation of Doctor of Pedagogical Sciences). Institute of Vocational Education and Training of the National Academy of Sciences of Ukraine, Kyiv. [in Ukrainian].

Constitution of Ukraine. No. 254k/96-BP. (1996). Retrieved from https://zakon.rada.gov.ua/laws/show/254%D0%BA/96-%D0%B2%D1%80#Txt [in Ukraininan].

Gershenzon, M.I. (1999). *Filosofs'ki rozdumy pro tvorchyy samorozvytok lyudyny.* [Philosophical reflections on the creative self-development of a person.] Kyiv: Prime-EUROZNAK.

INSAG-15. (2015). *Key Practical Issues in Strengthening Safety Culture*. Vienna: International Atomic Energy Agency.

INSAG-3. (1989). *Basic Safety Principles for Nuclear Power Plants*. Vienna: International Atomic Energy Agency.

INSAG-4. (1991). *Safety culture*. Vienna: International Atomic Energy Agency.

INSAG-7. (1993). *The Chernobyl Accident: Updating of INSAG-1*. Vienna: International Atomic Energy Agency.

INSAG-l. (1986). *Summary Report on the Post-Accident Review Meeting on the Chernobyl Accident*. Vienna: International Atomic Energy Agency.

Kovalenko, O.E. (2003). *Metodyka profesiynoho navchannya. Pidruchnyk dlya inzheneriv-pedahohiv, vykladachiv spetsdystsyplin systemy profesiyno-tekhnichnoyi ta vyshchoyi osvity.* [Methodology of vocational training. Textbook for engineer-pedagogues, teachers of special disciplines of the system of vocational and higher education.] Kharkiv: PP "Shtryh". [in Ukrainian].

Kovalenko, O.E. (2005). *Metodyka profesiynoho navchannya.* [Methodology of vocational training.] Kharkiv: Publishing House of the National Academy of Sciences. [in Ukrainian].

Novikov, A.M. (2013). *Pedagogika: slovar' sistemy osnovnykh ponyatiy.* [Pedagogy: A dictionary of the system of basic concepts.] Moscow: Publishing Center of the IET. [in Russian].

Petrenko, L.M. (2013). *Teoriya i praktyka rozvytku informatsiyno-analitychnoyi kompetentnosti kerivnykiv profesiyno-tekhnichnykh navchal'nykh zakladiv.* [Theory and practice of development of informational and analytical competence of managers of vocational and technical educationl institutions.] (Monograph). Dnipropetrovsk: IMA-press. [in Ukraininan].

The International Labor Organization Report. (2004). *A promotional framework for occupational safety and health.* Geneva: ILO. Retrieved from http://www.ilo.org/public/english/protection/safework/promoframe.htm

The International Labor Organization Report. (2005). *Promoting a culture of occupational safety and health*. Moscow: International Labor Office; ILO DWT and Country Office for Eastern Europe and Central Asia. Retrieved from: http://www.ilo.org/moscow/information-resources/publications/WCMS_312121/lang--ru/index.htm

The International Labor Organization Report. (2007). *Safe and healthy workplaces: making decent work a reality*. Geneva: ILO.

The International Labor Organization Report. (2015). *Join us in building a culture of prevention on OSH*. Moscow: International Labor Office; ILO DWT and Country Office for Eastern Europe and Central Asia. Retrieved from http://www.ilo.org/global/docs/WCMS_405838/lang--en/index.htm

The International Labor Organization. (1981). *Occupational Safety and Health Convention.* No. 155. Retrieved from https://zakon.rada.gov.ua/laws/show/993_050#Text [in Ukraininan].

The International Labor Organization. (1981). *Promotional Framework for Occupational Safety and Health Recommendation*. No. 164. Geneva: ILO. Retrieved from https://zakon.rada.gov.ua/laws/show/993_075#Text

The International Labor Organization. (1998). *Declaration on Fundamental Principles and Rights at Work.* Retrieved from https://zakon.rada.gov.ua/laws/show/993_260#Text

The International Labor Organization. (2006). *Promotional Framework for Occupational Safety and Health Convention.* No. 187. Geneva: ILO. Retrieved from http://docs.cntd.ru/document/902237545

The International Labor Organization. (2006). *Promotional Framework for Occupational Safety and Health Recommendation*. No. 197. Geneva: ILO. Retrieved from http://www.conventions.ru/view_base.php?id=627

The UN General Assembly Resolution. (2015). *Transforming our world: the 2030 Agenda for Sustainable Development.* Retrieved from https://documents-dds-ny.un.org/doc/UNDOC/GEN/N15/291/92/PDF/N1529192.pdf?OpenElement

The Verkhovna Rada of Ukraine. (1971). Labor Code of Ukraine. No. 322-08. Retrieved from https://zakon.rada.gov.ua/laws/show/322-08#Text [in Ukrainian].

The Verkhovna Rada of Ukraine. (1992). Fundamentals of Ukrainian legislation on health protection. No. 2801-12. Retrieved from https://zakon.rada.gov.ua/laws/show/2801-12# [in Ukraininan].

The Verkhovna Rada of Ukraine. (1992). Law of Ukraine "On Labor Protection". No. 2694-12. Retrieved from https://zakon.rada.gov.ua/laws/show/2694-12#Text [in Ukrainian].

The Verkhovna Rada of Ukraine. (1994). Law of Ukraine "On Ensuring Sanitary and Epidemic Welfare of the Population". No. 4004-12. Retrieved from https://zakon.rada.gov.ua/laws/show/4004-12#Text [in Ukrainian].

The Verkhovna Rada of Ukraine. (1999). Law of Ukraine "On mandatory state social insurance". No. 1105-14. Retrieved from https://zakon.rada.gov.ua/laws/show/1105-14#Text [in Ukrainian].

The Verkhovna Rada of Ukraine. (2001). Law of Ukraine "On high-risk facilities". No. 2245-14. Retrieved from https://zakon.rada.gov.ua/laws/show/2245-14#Text [in Ukrainian].

The Verkhovna Rada of Ukraine. (2004). Order of the State Committee for Labor Protection Supervision of Ukraine "On the approval of the Standard Regulation on the labor protection service". No. 255. Retrieved from https://zakon.rada.gov.ua/laws/show/z1526-04#Text [in Ukraininan].

The Verkhovna Rada of Ukraine. (2012). Code of Civil Protection of Ukraine. No. 5403-17. Retrieved from https://zakon.rada.gov.ua/laws/show/5403-17#Text [in Ukrainian].

The Verkhovna Rada of Ukraine. (2013). *Decree of the President of Ukraine "National development strategy for education in Ukraine by 2021"*. No. 344/2013. Retrieved from https://zakon.rada.gov.ua/laws/show/344/2013#Text [in Ukraininan].
The Verkhovna Rada of Ukraine. (2014). Law of Ukraine "On Higher Education". No. 1556-18. Retrieved from https://zakon.rada.gov.ua/laws/show/1556-18#Text [in Ukrainian].
The Verkhovna Rada of Ukraine. (2017). Law of Ukraine "On Education". No. 2145-19. Retrieved from https://zakon.rada.gov.ua/laws/show/2145-19#Text [in Ukrainian].
The Verkhovna Rada of Ukraine. (2018). The Concept of Reforming the Labor Protection Management System in Ukraine No. 989. Retrieved from https://zakon.rada.gov.ua/laws/show/989-2018-%D1%80#n8. [in Ukraininan].
The Verkhovna Rada of Ukraine. (2019). *Sustainable Development Strategy for Ukraine by 2030: Project.* Retrieved from https://zakon.rada.gov.ua/laws/show/722/2019#Text [in Ukraininan].
The Verkhovna Rada of Ukraine. (2021). D*ecree of the President of Ukraine "On the National Strategy in the Field of Human Rights"*. No. 119/2021. Retrieved from https://zakon.rada.gov.ua/laws/show/119/2021#Text [in Ukraininan].
The Verkhovna Rada of Ukraine. O (2005). rder of the State Committee for Labor Protection Supervision of Ukraine "On the approval of the Model Regulations on the procedure for training and knowledge testing on labor protection and the List of high-risk jobs." No. 15. Retrieved from https://zakon.rada.gov.ua/laws/show/z0231-05#Text [in Ukraininan].
Zeer, E.F., & Glukhanyuk, N.S. (1988). S*truktura i osobennosti inzhenerno-pedagogicheskoy deyatel'nosti*. [Structure and features of engineering and pedagogical activity.] SPO, 98–110. Retrieved from https://elar.rsvpu.ru/bitstream/123456789/10044/1/spo_1988_011pdf. [in Russian].