

UDC 331.45

DOI: 10.31548/machenergy.13(1).2022.54-59

Oleksandr Voinalovych<sup>1\*</sup>, Andrzej Marczuk<sup>2</sup>, Tetyana Zubok<sup>1</sup>

<sup>1</sup>National University of Life and Environmental Sciences of Ukraine  
03041, 15 Heroiv Oborony, Kyiv, Ukraine

<sup>2</sup>University of Life Sciences in Lublin  
20400, 7 Stanislaw Leshchynskiy Str., Lublin, Republic of Poland

## Principles of development of occupational safety business games

**Abstract.** According to modern researchers, the professional qualities of employees and their social orientation are formed in socially significant labour activities, which are collective in nature. Therefore, for the development of independence, activity, and other important qualities, it is necessary to give the opportunity to participate in a holistic work process. This means analysing the labour task, identifying the goal, drawing up a plan and organising its implementation, current and final control, and self-assessment. As practice shows, these tasks can be most fully implemented by implementing business games. The relevance of the study is determined by the existing contradictions between: the requirements of the labour market for the quality of labour and the weak preparation of employees for work in the new socio-economic conditions; conservatism of forms and methods of professional training of employees and the need to activate labour training; the needs of employees in social protection through employment and the low level of establishment of basic professional knowledge and skills necessary for the performance of occupational safety professional functions. The goal is to present the basics of developing business games in occupational safety disciplines, adapting them to the problems of occupational safety, and evaluate the effectiveness of their application in the educational process. Methodology – the business game was considered as a simulation of the real activity of an employee in various created occupational safety situations. The paper structures the results of the morphology of stages and the sequence of conducting an occupational safety business game. The authors substantiate the structural representation of the functions (tasks) of the head of a business game. Analytical research is presented in the form of a synthesis of the function of occupational safety business games with criteria for evaluating their effectiveness. The existence of a correlation between the average scores of responses from the training module on a 100-point system for different methods of teaching the discipline against the background of the overall score of academic groups for the academic year is confirmed: control (training in the form of lectures and practical works); research (training in the form of lectures and business games)

**Keywords:** active training methods, occupational safety business game, modelling of production situations, occupational safety, industrial safety

Article's History: Received: 01.10.2021; Revised: 10.01.2022; Accepted: 23.02.2022

### INTRODUCTION

The relevance of this study is conditioned by the need to search for new methodically appropriate ways to train specialists when students study the disciplines of the “occupational safety” complex. In particular, the use of occupational safety business games in the educational process is promising [1].

Educational business games involve modelling a certain organisational activity in the presence of problematic situations at the enterprise, the solution of which

during the game lesson develops practical thinking in students, allowing them to develop the ability to analyse the conditions and consequences of decisions made [2]. The main goal of the occupational safety business game is to prepare students to solve technological and organisational situations related to the safety of work at the enterprise [3]. At the same time, the principles on which occupational safety business games are developed are not yet sufficiently substantiated.

### Suggested Citation:

Voinalovych, O., Marczuk, A., & Zubok, T. (2022). Principles of development of occupational safety business games. *Machinery & Energetics*, 13(1), 54-59.

\*Corresponding author

Currently published developments in the field of business games on occupational safety concern only certain occupational safety topics [4], and their application does not sufficiently contribute to the development of a logical approach among students to coordinate the use of normative occupational safety documents of various levels [5]. It also does not create a consistent transition from some sections of “occupational safety” to others [6]. Therefore, it is relevant to introduce the study of individual sections of “occupational safety” in the form of business games. The most common are business games that are designed for the construction industry and fire safety [7].

In particular, the development of occupational safety business games for industrial situations in agriculture, as one of the most traumatic sectors of the economy, is relevant [8].

But the main attention is now paid to the introduction of computerised occupational safety games into the educational process, which is advisable for training workers [9]. It is business games, in which workers are introduced in a playful way to the main dangers in the workplace and occupational safety requirements, that account for the main number of publications [10]. To improve the skills of enterprise officials, it is useful to use business games of the organisational plan [11], when game participants model algorithms for actions of officials of various levels of management [12].

The cornerstone laid down for the functioning of the occupational safety management system at the enterprise [13] should be the participation of all employees in occupational safety work [14]. Under this condition, the occupational health and safety management system will be effective [15], because the majority of employees of the enterprise will be involved in maintaining a proper high level of occupational health and safety [16], and not just

a few officials [17]. This substantiates the possibility of joining the occupational safety business game in various roles of many of its participants [18], such as all students of individual subgroups [19], who must perform separate laboratory and practical work (tasks) on occupational safety [20].

Purpose of the study. Present the basics of developing business games in occupational safety disciplines, adapting them to the problems of occupational safety, and evaluate the effectiveness of their application in the educational process.

## RESULTS AND DISCUSSION

The introduction of business games of the organisational plan to occupational safety training leads to the fact that the student must work out (analyse) various sources of information related to the activities of the enterprise to gain the necessary knowledge. The student’s participation in the occupational safety business game leads to the activation of their thinking, forces (even regardless of their desire) to be active during the lesson for a long time. This contributes to independent decision-making, increases the degree of motivation of the student and their emotionality. In occupational safety business games, it is possible to combine collective and individual forms of assimilation of occupational safety principles, considering information about the state of production based on previously obtained theoretical generalisations.

An occupational safety business game should be based on simulation and game models that can be characterised by a certain sequence (Fig. 1). As the subject of the occupational safety business game, it is necessary to consider a certain order of activity of participants in accordance with a given professional activity.

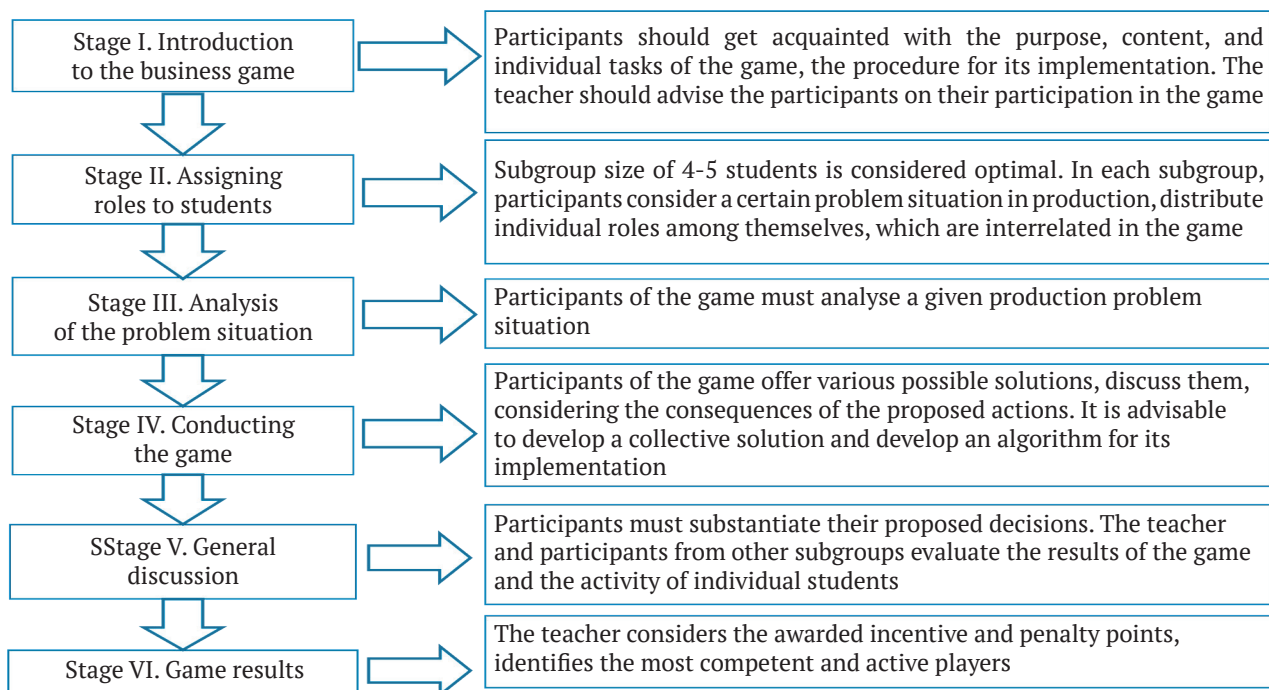


Figure 1. Stages and sequence of conducting the occupational safety business game

The development of the occupational safety business game of an organisational plan involves the use of the following research methods:

- modelling of production situations;
- structuring materials of the occupational safety regulatory framework;
- search for information

The simulation and game models used in the occupational safety business game are characterised differently. The simulation model should determine the content of activities on occupational safety issues of officials of the enterprise, as a certain part of occupational safety work.

A simulation model is considered as a prototype of a model or an object of simulation. The game model should describe the activities of participants in a business game according to the simulation model. The game model shows the actions of participants in accordance with the duties of occupational safety officials of the enterprise. During the occupational safety business game, the teacher can allow participants to suggest their own (even erroneous) actions to solve an industrial problem related to occupational safety, and give a certain freedom of action to the participants of the game. The task of the teacher, as the head of the occupational safety business game, is shown in the form of a diagram (Fig. 2).

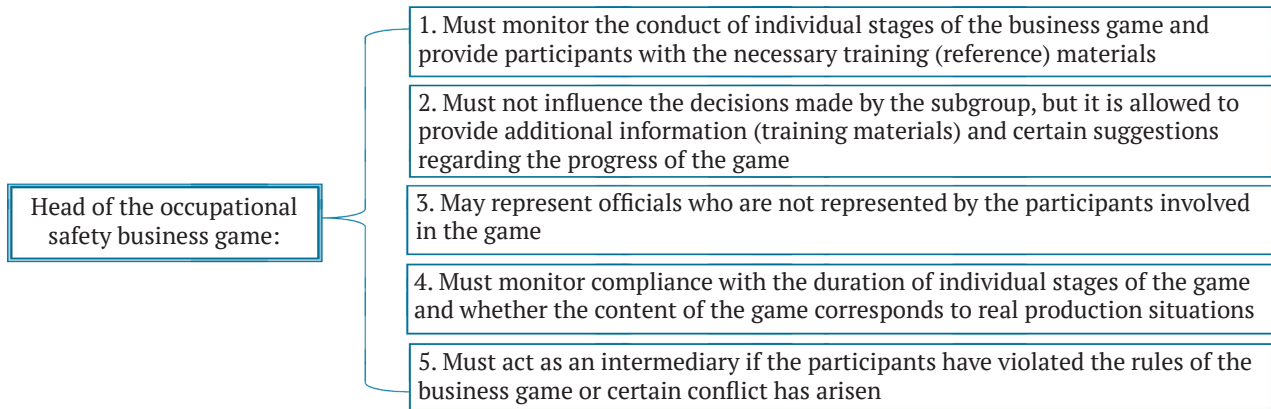


Figure 2. Structural representation of the functions (tasks) of the business game manager

The analysis of the possibilities of game technologies for solving occupational safety issues at the enterprise, which will increase the effectiveness of occupational

safety training of officials, identifies the following functions of business games (Fig. 3) and offers criteria for evaluating their effectiveness.

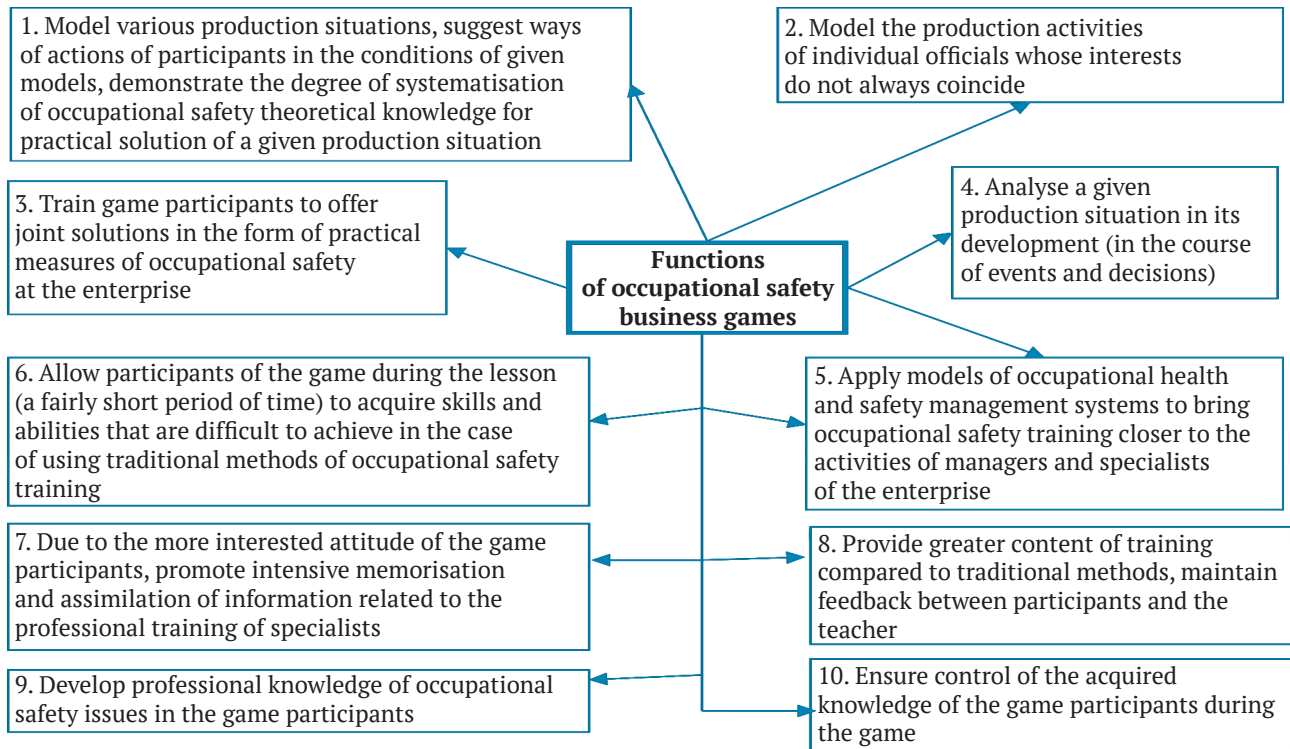


Figure 3. Functions of occupational safety business games with criteria for evaluating their effectiveness

The complex of occupational safety business games should provide for the transfer of game functions between participants, so that each participant (student of the subgroup) can perform duties in each of the multi-level positions of the enterprise – head, occupational safety engineer, head of the division, chief specialist, insurance expert of the Social Insurance Fund of Ukraine, State Labour inspector, inspector of fire supervision, etc. The variety of topics on occupational safety, on which occupational safety training is conducted, allows implementing such a distribution and interchangeability of the functions of participants.

During the occupational safety business games, students will be able to:

- get acquainted with the occupational safety duties of the company’s officials;
- acquire the ability to interact with managers and subordinates, and use the regulatory documents on occupational safety used at the enterprise;
- learn how to find out the hidden causes of injuries and occupational diseases based on the analysis of dangerous and harmful factors at work;
- learn how to offer effective measures to prevent occupational risks in the workplace.

The results of evaluating the work in the game classes of participants of occupational safety business games allow the teacher to get an objective idea of the acquired professional knowledge of the participants of the game, about the readiness for further occupational safety management activities, in particular, regarding the practical solution of complex industrial situations related to occupational safety.

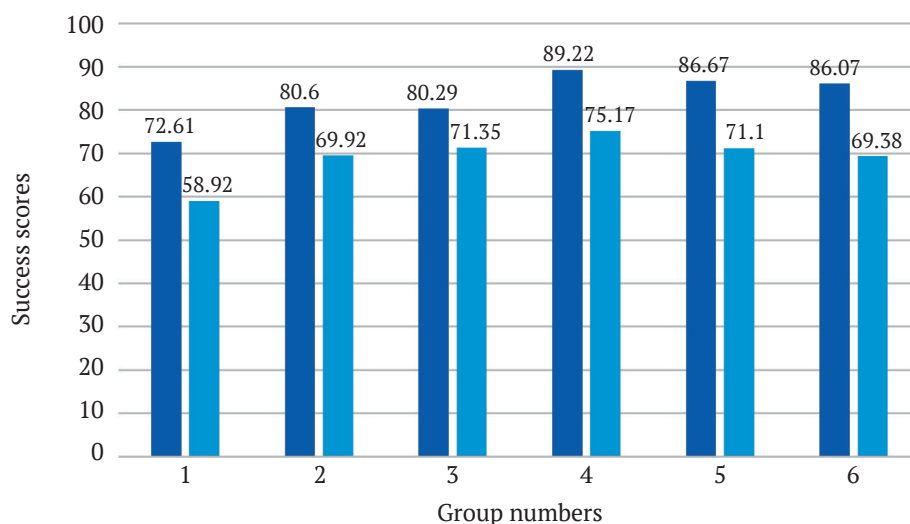
Research on the effectiveness of business games on occupational safety is characterised by certain methodological difficulties. But as a result of the analysis of the

academic performance of students, for whom certain sections of the discipline “Occupational safety” were taught in the form of occupational safety business games, allowed drawing a conclusion about a significant increase in the level of academic performance, and therefore, the professional readiness of future specialists

Before introducing occupational safety business games into the educational process, it is necessary to substantiate their place and scope in the curriculum, and formulate recommendations for their implementation. First of all, the occupational safety business game should become a practical embodiment of the previously mastered educational material. In the structure of a business game, it is necessary to adhere to the following main stages: a) preparatory; b) conduct of the game; c) analysis and summarisation of its results. Considering two aspects of the goal of a business game (motivational and didactic), the success of a business game depends on the participants’ awareness of the goal and objectives of the game, and the requirements for each of the participants.

To find out the degree of effectiveness of conducting occupational safety business games, the results of modular control of experimental groups of students from game classes were compared with the results of similar certification of students of control groups for whom traditional practical classes were conducted. The study compared the average response scores on a 100-point system for experimental and control groups, considering the overall performance score of the groups for the academic year.

The obtained data showed that the level of knowledge of students in the groups where practical classes were conducted in the form of a business game was significantly higher compared to the results of students in the control groups (Fig. 4).



**Figure 4.** Comparison of average scores of responses (left columns) from the training module on a 100-point system for different methods of teaching the discipline against the background of the overall score of academic groups (right columns) for the academic year: groups 1, 2, 3 – control (training in the form of lectures and practical works); groups 4, 5, 6 – research (training in the form of lectures and business games)

Comparing the data of averaged response scores from the student control module on a 100-point system with the overall group performance score for the academic year, a direct correlation was established between the two data sets. The strength of the correlation was 0.708, which according to the scale is a strong relationship, as evidenced by the level of significance.

## CONCLUSIONS

1. Methodological approaches to the use of occupational safety business games are described, which would allow activating independent creative activity in the case of training students and improving the occupational safety skills of officials of agro-industrial enterprises. The application of the formulated principles allows acquiring the ability to make optimal decisions on occupational safety in production conditions and in case of non-standard situations.

2. Insufficient attention of researchers to substantiate the theoretical foundations of business games on

occupational safety is noted. It is also important to improve the practice of using business games as an active occupational safety method of training. The structure of business games is proposed, which concerns the detection of violations of occupational safety at the enterprise and other issues, which allows modelling elements of future professional activity.

3. The described principles of preparing and conducting the occupational safety business game can be used as one of the active teaching methods that allow students to act independently for a certain time in a simulated situation. Analysis of the development of the situation, various ways to solve it, actions, methods, and ways out of critical situations regarding labour safety improves the quality of the educational process and contributes to the accumulation of experience.

4. On the example of the use of business games in the educational process on certain topics of the "Occupational safety" discipline, their effectiveness is shown, evaluated by the results of the following testing.

## REFERENCES

- [1] Asplund, T., Neset, T.S., & Käyhkö, J. (2019). Benefits and challenges of serious gaming – the case of the Maladaptation Game. *Open Agriculture*, 4, 107-117.
- [2] Li, H., Chan, G., & Skitmore, M. (2012). Visualizing safety assessment by integrating the use of game technology. *Automation in Construction*, 22, 498-505.
- [3] Cierniak-Emerych, A., & Pietron-Pyszczek, A. (2019). Gamification as a tool to improve the level of occupational safety and health in company. *Scientific Journal of Silesian University of Technology. Organization and Management Series*, 136, 87-96.
- [4] Vigoroso, L., Caffaro, F., Cremasco, M.M., & Cavallo, E. (2021). Innovating occupational safety training: A scoping review on digital games and possible applications in agriculture. *International Journal of Environmental Research and Public Health*, 18(4), article number 1868.
- [5] Mohd, N.I., Ali, K.N., & Ebrahimi, S.S. (2021). Understanding the level of self-directed learning and decision-making style of construction-related workers. *International Association of Online Engineering: Limoges, France*, 2, 44-53.
- [6] Din, Z.U., & Gibson, G.E. (2019). Serious games for learning prevention through design concepts: An experimental study. *Safety Science*, 115, 176-187.
- [7] Pisarenko, G., Voinalovych, O., Rogovskii, I., & Motrich, M. (2019). Probability of boundary exhaustion of resources as factor of operational safety for agricultural aggregates. *Engineering for Rural Development*, 18, 291-298.
- [8] Gao, Y., Gonzalez, V.A., & Yiu, T.W. (2019). The effectiveness of traditional tools and computer-aided technologies for health and safety training in the construction sector: A systematic review. *Computers & Education*, 138, 101-115.
- [9] Williams-Bell, F.M., Kapralos, B., & Hogue, A. (2014). Using serious games and virtual simulation for training in the fire service: A review. *Fire Technology*, 51, 553-584.
- [10] Ma, Q., Yang, Z., & Chen, H. (2012). A serious game for teaching and learning agricultural machinery driving. *International Conference on Artificial Intelligence and Soft Computing*, 12, 56-62.
- [11] Caffaro, F., Cremasco, M.M., Roccato, M., & Cavallo, E. (2020). Drivers of farmers' intention to adopt technological innovations in Italy: The role of information sources, perceived usefulness, and perceived ease of use. *Journal of Rural Studies*, 76, 264-271.
- [12] Voinalovych, O.V., & Holopura, S.M. (2020). Justification of the risk-based approach of operation of mobile agricultural equipment on the example of details of separate units of tractors. *Machinery & Energetics. Journal of Rural Production Research*, 11(3), 173-179.
- [13] Carrillo, D.L., García, A.C., & Laguna, T.R. (2019). Using gamification in a teaching innovation project at the university of Alcalá: A new approach to experimental science practices. *Electronic Journal of e-Learning*, 17, 93-106.
- [14] Leba, M., Ionică, A., & Apostu, D. (2014). Educational software based on gamification techniques for medical students. In *Recent advances in information and communication technology: Proceedings of the 10<sup>th</sup> international conference* (pp. 225-230). Phuket: Prince of Songkla University.
- [15] Voinalovych, O., Hnatiuk, O., Rogovskii, I., & Pokutnii, O. (2019). Probability of traumatic situations in mechanized processes in agriculture using mathematical apparatus of Markov chain method. *Engineering for Rural Development*, 18, 563-269.

- [16] Day, L., Voaklander, D., & Sim, M. (2008). Risk factors for work-related injury among male farmers. *Occupational and Environmental Medicine*, 66, 312-318.
- [17] Rogovskii, I.L., Titova, L.L., Voinash, S.A., Sokolova, V.A., Tarandin, G.S., & Polyanskaya, O.A. (2021). Modeling the weight of criteria for determining the technical level of agricultural machines. *Earth and Environmental Science*, 677, article number 022100.
- [18] Hall, J., Wyeth, P., & Johnson, D. (2016). Creating authentic experiences within a serious game context: Evaluation of engagement and learning. In *Joint international conference on serious games* (pp. 55-66). Cham: Marsh Springer.
- [19] Kuindersma, E., Van Der Pal, J., Van Den Herik, J., & Plaat, A. (2017). Building a game to build competencies. In *Games and learning alliance* (pp. 14-24). Cham: Marsh Springer.
- [20] Holopura, S.M., & Chmara, P.O. (2020). Business game as a way to increase the efficiency of the educational process in study topics providing of first aid to victims in accidents. *Machinery & Energetics. Journal of Rural Production Research*, 11(4), 49-56.

**Олександр Володимирович Войналович<sup>1</sup>,  
Анджей Марчук<sup>2</sup>, Тетяна Олександрівна Зубок<sup>1</sup>**

<sup>1</sup>Національний університет біоресурсів і природокористування України  
03041, вул. Героїв Оборони, 15, м. Київ, Україна

<sup>2</sup>Університет наук про життя в Любліні  
20400, вул. Станіслава Лещинського, 7, м. Люблін, Республіка Польща

## **Засади розроблення працезохоронних ділових ігор**

**Анотація.** Як зазначають сучасні дослідники, професійні якості працівників, їхня громадська спрямованість формуються у соціально значущій трудовій діяльності, колективній за своїм характером. Тому для розвитку самостійності, активності, а також інших необхідних якостей потрібно дати можливість брати участь у цілісному процесі праці. Мається на увазі аналіз трудового завдання, виявлення мети, складання плану та організація його виконання, поточний та підсумковий контроль, самооцінка. Як показує практика, найповніше ці завдання можна реалізувати шляхом впровадження ділових ігор. Актуальність дослідження визначається існуючими протиріччями між: вимогами ринку праці до якості робочої сили та слабкою підготовкою працівників до трудової діяльності у нових соціально-економічних умовах; консерватизмом форм та методів професійного навчання працівників та необхідністю активізації трудової підготовки; потребами працівників у соціальному захисті шляхом працевлаштування та низьким рівнем сформованих базових професійних знань та умінь, необхідних для виконання працезохоронних професійних функцій. Мета – представити засади розроблення ділових ігор з працезохоронних дисциплін, адаптувавши їх до проблематики безпеки праці, та оцінити ефективність їх застосування у навчальному процесі. Методологія – ділову гру розглядали як моделювання реальної діяльності працівника в різних створених працезохоронних ситуаціях. В статті структуровано результати морфології етапів і послідовності проведення працезохоронної ділової гри. Авторами обґрунтовано структурне представлення функцій (завдань) керівника ділової гри. Аналітичні дослідження представлені у вигляді синтезу функції працезохоронних ділових ігор з критеріями оцінювання їх ефективності. Підтверджено існування кореляційного зв'язку усереднених оцінок відповідей з навчального модуля за 100-бальною системою за різних методик викладання дисципліни на фоні загального балу успішності навчальних груп за навчальний рік: контрольні (навчання у вигляді лекцій та практичних робіт); дослідні (навчання у вигляді лекцій та ділових ігор)

**Ключові слова:** активні методи навчання, працезохоронна ділова гра, моделювання виробничих ситуацій, охорона праці, виробнича безпека