DOI: 10.5604/01.3001.0013.7623

Journal of Achievements in Materials and Manufacturing Engineering

International Scientific Journal published monthly by the World Academy of Materials and Manufacturing Engineering

Relationship study between the student learning approach in the occupational safety and health field and acquired competencies

O. Nanka [a], M. Lysychenko [a], M. Kiriyenko [a], V. Pavlykivskyi [a,b,*], T. Duyunova [a], I. Senchuk [a]

[a] Kharkiv Petro Vasylenko National Technical University of Agriculture, st. Alchevskikh, 44, 61002, Kharkiv, Ukraine

[b] Kharkov University, pr. Gagarina, 187, 61080, Kharkiv, Ukraine

* Corresponding e-mail address: pvictor@i.ua

ABSTRACT

Purpose: To search for training methods for specialists in industrial safety, environmental and occupational safety and health in conditions of insufficient (or absent) laboratory support and to study the relationship between the student learning approach and acquired competencies.

Design/methodology/approach: To study modern advances in industrial safety, environmental and occupational safety and health and training methods for specialists a systematic literature review approach has been used. For publications from 2017, queries were asked through keywords and safety related topics. To relationship study between the student learning approach and acquired competencies a student survey on random sampling has been used. A total of 112 students of the 3rd and 4th year of study at the university were interviewed.

Findings: The results of the survey showed that the students' number who simultaneously successfully answered theoretical questions and completed practical tasks is 33.8% from the group with theoretical training and 75% from the group that was trained in the workplace. The relationship between the groups with a visit to the existing enterprise and acquired competencies was justified by the association coefficient and contingency coefficient that are 0.7 and 0.4 respectively.

Research limitations/implications: A student's survey was conducted at only one university. Questions were asked only according to the curriculum of the course "Labour Protection". No survey for other training courses conducted.

Practical implications: The research results are reasonable and can be applied at universities to improve the educational process of training specialists.

Originality/value: It was proposed that students be trained using existing enterprises as a laboratory base and by the methods of statistics mathematical processing was substantiated the proposal feasibility.

Keywords: Specialists training methods, Industrial safety, Environmental, Occupational safety and health, Competencies

Reference to this paper should be given in the following way:
O. Nanka, M. Lysychenko, M. Kiriyenko, V. Pavlykivskyi, T. Duyunova, I. Senchuk, Relationship study between the student learning approach in the occupational safety and health field and acquired competencies, Journal of Achievements in Materials and Manufacturing Engineering 95/1 (2019) 32-41.

1. Introduction

University labs in low-income countries are currently experiencing financial difficulties. In this regard, the hour number of students' theoretical learning is constantly increasing, and the time of practical training and laboratory research is significantly reduced. This reduces the specialists training quality in technical specialties, including specialists in industrial safety, environmental and occupational safety and health. At the same time, ensuring human safety issues, both during work and in public life, come to the fore. This is evidenced by numerous modern scientific studies [1-6].

At the same time, production enterprises continue their production activities and need industrial safety specialists. This is justified by the fact that the human health and life are priority in any activity [7-9]. In addition, in order to have the possibility of international cooperation, enterprises are required to comply with international occupational safety and health requirements and ensure the functioning of the occupational safety and health management system (OSH management system) [7,8,10].

In this regard, the study aim is to search for training methods for specialists in industrial safety, environmental and occupational safety and health in conditions of insufficient (or absent) laboratory support and to study the relationship between the student learning approach and acquired competencies.

In order to properly training specialists in industrial safety, environmental and occupational safety and health (technical science), the following should be taken into account:

- Modern achievements in the industrial safety, environmental and occupational safety and health;
- Current requirements for specialists in industrial safety, environmental and occupational safety and health;
- Effective training methods specialists in technical specialties.

2. Materials and methods

2.1. Review of information open sources and their analysis

To study modern advances in industrial safety management, to identify advanced methods of training methods specialists in technical specialties, namely in the field of industrial safety, environmental and occupational safety and health, a systematic literature review approach has been used. The review was conducted using Google Scholar (as a freely available mechanism for web search of scientific literature in a variety of formats and disciplines of publication). For publications from 2017, queries were asked through keywords and safety related topics.

Searching mechanism used keywords were terms reflecting OSH management system, namely:

1. in the text in which all the words are found:
   - Recent advances in industrial safety, occupational health, public, environmental and occupational safety and health management;
   - Requirements for specialists in the field of labour protection and occupational safety and health.
2. in the title, in which there is an exact phrase:
   - Occupational safety and health management;
   - Education occupational safety and health.

More than 13800 works and 13900 works were found on the first request, (Fig. 1) and 61 works and 3 works were found on the second request (Fig. 2). Search results for each query were sorted by sort by relevance. Further the collected data were further reduced after the revision in accordance with the keyword. The screened and reduced materials again were sorted to the most important data considering recent publications and papers results. Finally, the resulting publication list was also filtered out for literature purpose that is written above, because it was difficult to include all documents that made contribution to the field. At last, 43 articles were selected for analysis.

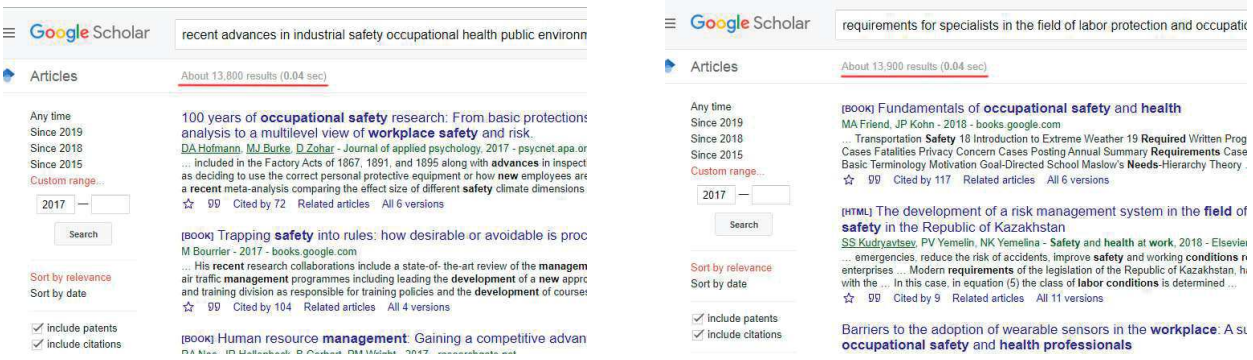

Fig. 1. Search results for open source information on first request

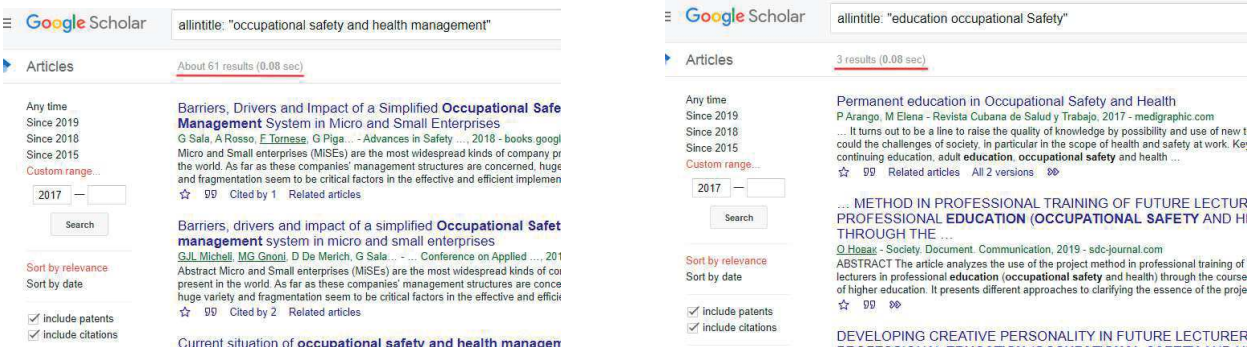

Fig. 2. Search results for open source information on second request

2.2. Relationship study between the student learning approach and acquired competencies

By random sampling 1 year after studying the course "Labour Protection", students were certified to identify of them competencies.

Questionnaires were developed, which contained 10 theoretical questions and 5 practical tasks on the course "Labour Protection".

Students were divided into 2 groups:

Group 1 – 68 people – this is a group in which the practical training for students on the "Labour Protection" course was performed without any laboratory equipment (theoretically), that is, students performed various calculations on paper, filled out tables, etc., while being in a lecture room;

Group 2 – 44 people – this is a group in which the practical training for students on the "Labour Protection" course was carried out directly at the agro-industrial complex enterprise (at existing workplaces), where dangerous and harmful workplace environmental factors influence a workers.

Moreover, the curriculum for the course "Labour Protection", according to which students were trained and certified in the semester, is the same for both groups.

A total of 112 students of the 3rd and 4th year of study at the university were interviewed.

The results were processed using methods of mathematical statistics, namely, using the mutual contingency tables, the relations study between the qualitative indicators of these groups was carried out.

3. Result and discussion

3.1. Recent advances in industrial safety. Requirements for specialists in industrial safety, environmental and occupational safety and health

For given search queries the top positions are occupied by studies that focus on assessing the level of injuries (in various industries) and risk management [11-15]. The authors propose risk management approaches to occupational safety and health management. Such

approaches are used in many countries, showing great results in providing a safe working environment. At the same time, one should know (or have an idea) about the dangers that workers face in the workplaces of a certain industry (in a particular enterprise).

The intensive development of nanotechnology for various applications stimulates scientists to investigate the safety of these materials throughout their entire life cycle. Many of them consider the toxicological effects on humans [16-18]. Of course, teaching students the rules of safety and environmental control in the production of nanomaterials or when working with them is an important component in the preparation of a specialist. However, in conditions of a very weak (or absent) laboratory base, without the support of existing enterprises, it is impossible to give high-quality knowledge and skills.

The agricultural industry is equipped with heavy equipment, the work with which is associated with health risks, the working environment in this industry creates additional risks to the health of personnel due to the effects of various emissions (for example, when working with fertilizers). In the agricultural sector, all transport equipment and a lot of professional equipment operates using petroleum-based fuels and lubricants. Therefore, it is important to convey to students the results of recent studies:

- On the influence of factors harmful to human health and the environment associated with the use of petroleum-based fuels and lubricants;
- On improved research methods for assessing the toxicity profiles of petroleum-based fuels and lubricants for humans;
- On the complex mechanism of side effects caused by petroleum-based fuels and lubricants, including the formation of reactive metabolites [19].

It should be emphasized that similar work is carried out at municipal solid waste management facilities [20,21]. At the same time, those who work in the field and at solid waste management facilities are subject to high risk factors (dust, garbage, animals and insects around the perimeter) [20,21]. It has been established that these factors represent the main danger to the health of personnel [20]. Therefore, it will be appropriate to teach students a general assessment of industrial safety, environmental and occupational safety and health in accordance with new achievements in this field [20,22,23].

Much attention is also focused on the microclimate parameters and air quality under production conditions [24,25].

Despite the fact that most countries have developed labour protection policies, strategies and programs, the infrastructure, institutional and human resources for implementing the strategies remain insufficient in most countries (gap in implementation observed). This also applies to Ukraine. Qualitatively, the content and interdisciplinary nature of occupational safety and health and safety comply with international recommendations, but the coverage, completeness and content of services remain largely incomplete due to lack of infrastructure and lack of multidisciplinary human resources (capacity deficit) [26].

Given the rapid development of technologies in the manufacturing sector, the development and implementation of new materials, the often changing and improving legislative and regulatory framework in the field of industrial safety, environmental and occupational safety and health, it is very difficult to systematize and give the student the necessary knowledge.

Therefore, it is necessary to search for effective training methods that contribute to obtaining professional competencies in the field of industrial safety, environmental and occupational safety and health. Further, the authors understand competencies as the ability of an individual to independently carry out certain works in compliance with labour protection requirements, based on the necessary knowledge, skills, and experience in this field [27].

3.2. Specialists training approaches for technical specialties

One of the promising trends of student learning is the use of geoinformation technologies [28]. The authors of this article:

- have developed the principles of designing an information environment for training based on geographic information technologies, which is embedded in the general information environment of the university;
- have revealed the features of the use of geographic information technologies in non-core education,
- have developed the structure of the modules of the learning environment based on geographic information technologies and their content is described;
- have adapted the system of criteria for assessing the effectiveness of the educational information environment.

However, such training allows you to gain knowledge, but not skills in a particular workplace. Consequently, the student will not be sufficiently prepared for work after graduation.

The authors of the study [29] conducted a series of simulations in which it was consistently predicted how the improvement of individual processes in the OSH

management system affects overall safety indicators. It has been proven that safety performance has increased most significantly under the influence of improved leadership processes. This proves that among all the processes in the system, leadership has the greatest positive impact. It follows that the formation of leadership qualities in students along with professional skills is an integral part of the learning process.

Important achievements are the results of the study [30]. In this work, the authors found that there was no risk associated with age, gender or level of education. Moreover, the main cause of accidents is related to human errors. They proposed designing specialized workshops in a way that allows workers to use the protective elements available to them, as well as more workers need to be trained in safe working methods so that to minimize negative impact if there is a rotation in the workplace. But the authors of the study [31] point out that there are changes in aging workers as a result of physical and psychological processes and their possible impact on work in connection with labour protection and the concept of sustainable work and jobs. In addition, this article discusses factors affecting the ability to work and productivity of an employee in connection with the phenomenon of aging, which must be reflected in the curriculum for the course "Labour Protection".

In accordance with the proposed vacancy [32], health and safety engineer should be able to develop procedures to prevent illness and injury to people and prevent property damage. They must have knowledge of systems engineering and health or safety to ensure that chemicals, machines, software, furniture and consumer products do not harm people or buildings.

Based on the analysis made, it can be seen that only at the existing workplace can one consolidate the knowledge gained during the theoretical study of the course and acquire practical skills in occupational safety and health management. And, therefore, for the acquisition of the necessary competencies by future specialists, it is recommended to conduct practical exercises at existing enterprises.

3.3. The students' certification results and the identification of their competencies

Statistics results

During the survey, students were asked to answer 10 theoretical questions and complete 5 tasks that students perform in practical classes in accordance with the curriculum of the course "Labour Protection", namely:

1. To create labour protection instructions for the operator's workplace;
2. To check light level in the warehouse premises for fertilizer storage;
3. To check noise level in the operator's cab;
4. To check dust content in the operator's cab;
5. To carry out the selection of respiratory protective equipment for workers which fertilize the soil.

After processing the questionnaires regarding theoretical questions, the following was revealed.

In the first group of 68 people, 80% or more of the correct answers were presented by 19 students (27.9%), 60%-79% of the correct answers – 24 students (35.3%), other students' answers were unsatisfactory. In accordance with the Ukrainian system of assessing knowledge, the grade is "satisfactory" (that is E according to ECTS) can be awarded to a student if he scored 60 or more points on a 100-point assessment system. Therefore, it was accepted that 25 students (36.8%) of the first group could not cope with the task on the theoretical part of the course.

In the 2 group of 44 people, 80% or more of the correct answers were provided by 15 students (34.1%), 60%-79% of the correct answers – 23 students (52.3%), 6 students (13.6%) of the second group did not coped with the task on the theoretical part of the course.

After checking the implementation of practical tasks established:

Group 1: 80% or more correctly completed tasks – 2 students (3.0%), 60%-79% – 23 students (33.8%), less than 60% – 43 students (63.2%)

Group 2: 80% and more correctly completed tasks – 11 students (25.0%), 60%-79% – 25 students (56.8%), less than 60% – 8 students (18.2%).

Comparative results are presented in Figure 3.

It should also be noted that the students' number who simultaneously successfully answered theoretical questions and completed practical tasks is 23 students (33.8%) from the first group and 33 students (75%) from the second groups (Figure 4).

Consequently, professional competencies were identified in 33.8% of graduates from those who studied theoretically without any laboratory equipment, and in 75% of graduates from those who had a close relationship with the existing enterprise.

An interesting fact is that students of the second group answered theoretical questions better than students of the first group. However, the theoretical preparation (lectures) for students of both groups was the same. From this we can make the following assumption: conducting training sessions to complete practical tasks at an existing enterprise has a positive effect on students acquiring professional competencies and there is a statistical relationship between the grouping characteristics (qualitative indicators) that were highlighted in this study.

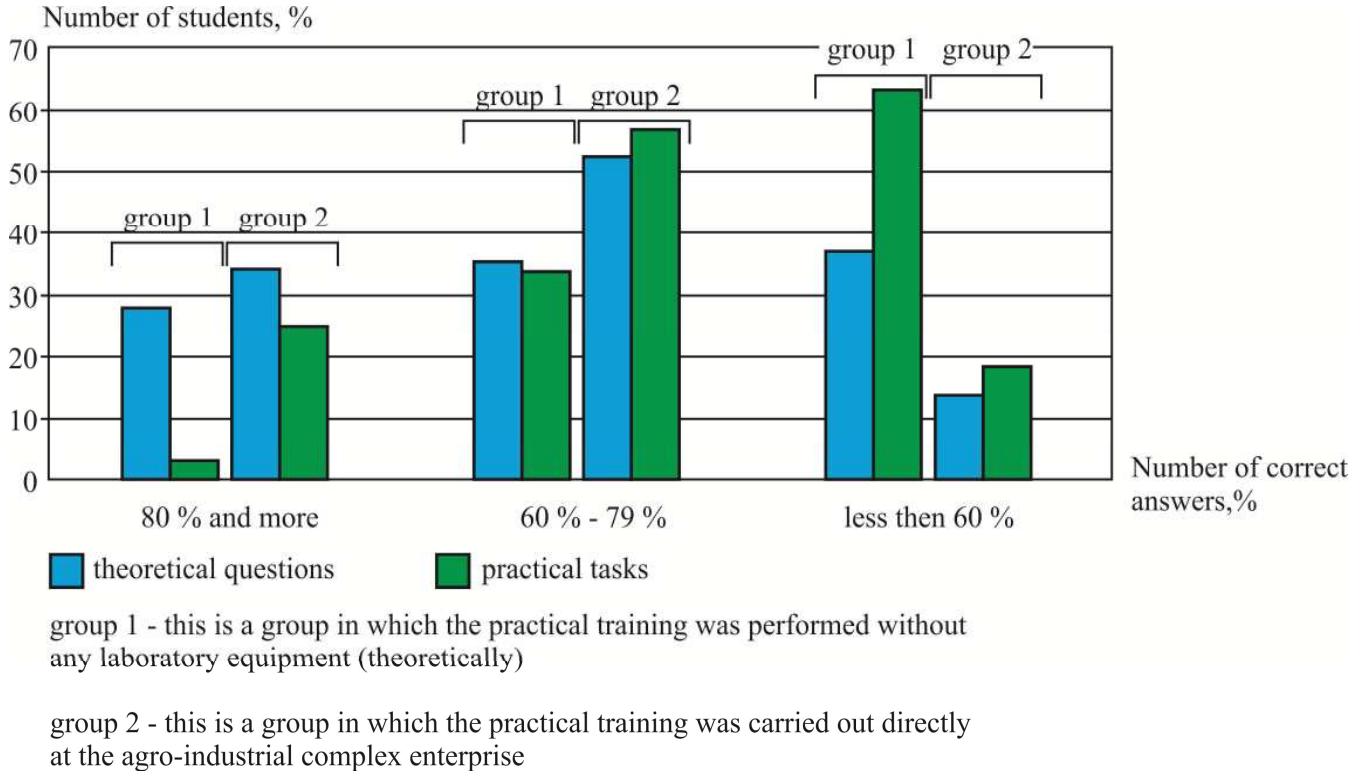

Fig. 3. Student survey statistics

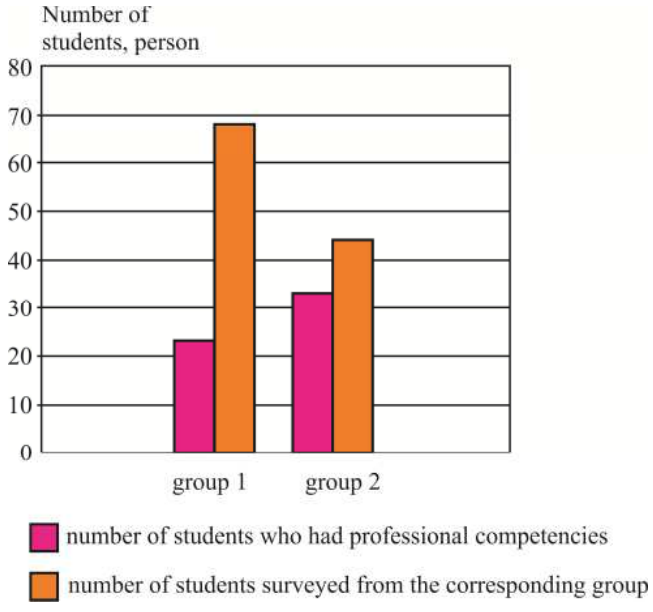

Fig. 4. Percentage of students with competencies to the total students surveyed number for two groups

To confirm this assumption and study the relationship between the selected quality indicators, we use conjugation table [33].

Studying the tightness of the relationship between quality characteristics of different groups

Since attributive characteristics were studied in this study (that is, characteristics that have more than two options and are expressed in the form of concepts or names), to study the relationships, we used the combination distribution of grouping units by two characteristics. This distribution is presented as a conjugation table (Tab. 1). In the Table 1 shows the distribution of 112 students surveyed by two characteristics: training in a lecture room (or in an existing enterprise) and the fact of the presence (or absence) of competencies 1 year after studying the course.

To measure the tightness of the relationship between grouping characteristics, indicators such as the association coefficient K_{AS} and contingency coefficient K_{KONT} were used [33].

Table 1.
Mutual conjugation of attributive characteristics for two groups

Attributive characteristics	Students number who do not have professional competencies	Students number who have professional competencies	Total number of students surveyed
Training sessions that were held at an existing enterprise	11	33	44
Training sessions that were held in the lecture hall (without any laboratory equipment)	45	23	68
Total number of students surveyed	56	56	112

The association coefficient K_{AS} was determined by the formula:

$$K_{AS} = \frac{11 \cdot 23 - 33 \cdot 45}{11 \cdot 23 + 33 \cdot 45} = -0.71.$$

The contingency coefficient K_{KONT} was determined by the formula:

$$K_{KONT} = \frac{11 \cdot 23 - 33 \cdot 45}{\sqrt{(11+33) \cdot (45+23) \cdot (11+45) \cdot (33+23)}} = -0.40.$$

The relationship is considered significant enough and confirmed if, if the conditions are met [33]:

$$|K_{AS}| > 0.5 \text{ and } |K_{KONT}| > 0.3 .$$

Thus, the results of the calculation show a fairly close relationship between groups with a visit to existing enterprise and acquired competencies.

In this regard, for universities with a weak material base and insufficient laboratory equipment, it is possible to recommend that laboratory work and practical tasks, which are planned in the curriculum of the course, be carried out at workplaces of existing enterprises. Herewith:

- First of all, trips to organizations (institutions) with a slight negative impact on the employee health and institutions that monitor working conditions should be planned. Such organizations include industry training and research laboratories, organizations that provide audit services in the field of occupational safety and health, etc;
- The second stage is a gradual acquaintance with the work of research institutes that will draw the students' attention to modern problems in the field of occupational safety and health and methods for solving these problems;
- The third stage is a direct visit to operating enterprises and the working conditions study (identification of harmful factors and measurement of their parameters, establishing a dangerous border for these factors influence, etc.) at the particular workplace.

This specialist learning approach in the field occupational safety and health provides student acquisition:

- Knowledge – understanding, preservation in memory and the ability to reproduce occupational safety and health requirements (laws, rules, instructions, etc.) and other information required to perform the function of health and safety engineer.
- Skills – the employee's possession of safe methods and techniques for performing work (work organization), identify and correct potential hazards by inspecting facilities, machinery, and safety equipment, review employee safety programs and recommend improvements, maintain and apply knowledge of current policies, regulations, and industrial processes, etc.
- Some experience – the totality of knowledge and skills practically acquired while studying at university necessary for safe work performance and/or it organization, for identify hazards and assess the hazards risk.

These criteria are the main components of competencies.

It should be emphasized that the recommendations presented can be applied not only for the health and safety engineer training, but also for the production workers training that will increase their culture in this field of knowledge and reduce the injuries and morbidity rates.

4. Conclusions

Summing up the results of this study, several key findings were highlighted:

1. Rapid progress is observed in the technical support of industrial safety, environmental and occupational safety and health, in the OSH management system and in modern specialists training methods (including use of geoinformation technologies). It was revealed that leadership in the OSH management system has the greatest positive impact, and therefore, it is necessary to form leadership qualities among students along with professional skills. In addition, the most common cause of accidents is related to human errors, and therefore, more workers need to be trained in safe working methods. Such training is possible in specialized workshops (they are not available at low income countries due to poor funding) or in existing enterprises.
2. Certification of students on the course "Labor Protection" 1 year after studying the course showed that professional competencies were identified in 33.8% of graduates from those who studied theoretically without any laboratory equipment, and in 75% of graduates from those who had a close relationship with the existing enterprise. Besides, students that had a close relationship with the existing enterprise answered theoretical questions better than students of the first group, but the theoretical preparation (lectures) for students of both groups was the same.
3. Mathematical processing of statistics showed a relationship between the student learning approach in the occupational safety and health field and acquired competencies. This is justified by the association coefficient $|K_{AS}| = 0.71$, which is more than 0.5, and contingency coefficient $|K_{KONT}| = 0.4$, which is more than 0.3. Therefore the training of highly qualified specialists in the field of industrial safety and labour protection is impossible without constant cooperation with existing enterprise.
4. Providing a continuous connection with production, a qualified specialist can be trained focused on ensuring and managing industrial safety, occupational health, public, environmental and professional health, since graduates already have:
   - Knowledge in the field of ensuring and managing industrial safety, occupational health, public, environmental and occupational health;
   - Work experience in the production environment (unlike graduates who studied at university laboratories using outdated equipment);
   - Practical skills in using modern equipments and methods for solving problems in ensuring industrial safety and OSH management.
5. Industrial enterprises that need specialists with work experience have the opportunity to select the most capable students from those who perform laboratory classes according to the instruction of the teacher at the enterprise.

Acknowledgements

The authors' team is grateful to the administration of the Kharkiv Petro Vasylenko National Technical University of Agriculture and Kharkov University for the opportunity to conduct scientific research.

References

[1] Y. Gao, Y. Fan, J. Wang, J. Pei, Procedural management of safety regulations and rules for the chemical industry, Process Safety Progress 38/2 (2019) 1-15, DOI: 10.1002/prs.11999.

[2] P. Ziarati, M. Tamaskoni-Zahedi, M. Mostafidi, F. Shirkhan, S. Vambol, V. Vambol, Theoretical study of food contamination mechanisms by melamine and hazard of melamine for health, Journal of Achievements in Materials and Manufacturing Engineering 89/2 (2018) 73-84, DOI: 10.5604/01.3001.0012.7111.

[3] O. Kruzhilko, O. Polukarov, V. Kalinchyk, I. Tkalych, Improvement of the workplace environmental physical factors values monitoring by determining the optimal interval for their control, Archives of Materials Science and Engineering 99/1-2 (2019) 42-49, DOI: 10.5604/01.3001.0013.5881.

[4] S. Vambol, V. Vambol, O. Kondratenko, V. Koloskov, Y. Suchikova, Substantiation of expedience of application of high-temperature utilization of used tires for liquefied methane production, Journal of Achievements in Materials and Manufacturing Engineering 87/2 (2018) 77-84, DOI: 10.5604/01.3001.0012.2830.

[5] A. Dakkoune, L. Vernières-Hassimi, S. Leveneur, D. Lefebvre, L. Estel, Risk analysis of French chemical industry, Safety Science 105 (2018) 77-85, DOI: 10.1016/j.ssci.2018.02.003.

[6] S. Vambol, V. Vambol, V. Sobyna, V. Koloskov, L. Poberezhna, Investigation of the energy efficiency of waste utilization technology, with considering the use of low-temperature separation of the resulting gas mixtures, Energetika 64/4 (2018) 186-195, DOI: 10.6001/energetika.v64i4.3893.

[7] World Health Organization, The health promoting work place, 2010, Retrieved from: http://www.cepis.org.pe/bvsast/i/fulltext/whp/whp.html, Accessed February 15, 2015.
[8] J. Takala, International agency efforts to protect workers and the environment, International Journal of Occupational and Environmental Medicine l5 (1999) 30-37, DOI: 10.1179/oeh.1999.5.1.30.
[9] D. Sokolov, V. Sobyna, S. Vambol, V. Vambol, Substantiation of the choice of the cutter material and method of its hardening, working under the action of friction and cyclic loading, Archives of Materials Science and Engineering 94/2 (2018) 49-54, DOI: 10.5604/01.3001.0012.8658.
[10] R. Kleinová, P. Szaryszová, The new health and safety standard ISO 45001: 2016 and its planned changes, International Journal of Interdisciplinarity in Theory and Practice 3/4 (2014) 43-47.
[11] K. Pykhtin, T. Simankina, V. Sharmanov, A. Kopytova, Risk-based approach in valuation of workplace injury rate for transportation and construction industry, IOP Conference Series: Earth and Environmental Science 90 (2017) 012065, DOI: 10.1088/1755-1315/90/1/012065.
[12] O. Kruzhilko, V. Maystrenko, Management decision-making algorithm development for planning activities that reduce the production risk level, Journal of Achievements in Materials and Manufacturing Engineering 93/1-2 (2019) 41-49, DOI: 10.5604/01.3001.0013.4141.
[13] D.C. Darabont, R.I. Moraru, A.E. Antonov, C. Bejinariu, Managing new and emerging risks in the context of ISO 45001 standard, Proceedings of the 7th International Multidisciplinary Symposium „Sustainable development through quality and innovation in engineering and research", 2017, 11-14.
[14] S.S. Kudryavtsev, P.V. Yemelin, N.K. Yemelina, The development of a risk management system in the field of industrial safety in the Republic of Kazakhstan, Safety and Health at Work 9/1 (2018) 30-41, DOI: 10.1016/j.shaw.2017.06.003.
[15] M.S. Cañamares, B.V. Escribano, M.G. García, A.R. Barriuso, A.R. Sáiz, Occupational risk-prevention diagnosis: A study of construction SMEs in Spain, Safety Science 92 (2017) 104-115, DOI: 10.1016/j.ssci.2016.09.016.
[16] M.S. Hull, D.M. Bowman (Eds.), Nanotechnology Environmental Health and Safety: Risks, Regulation and Management, Third Edition, Elsevier Science Ltd, 2018, 534.
[17] S. Vambol, I. Bogdanov, V. Vambol, Y. Suchikova, H. Lopatina, N. Tsybuliak, Research into effect of electrochemical etching conditions on the morphology of porous gallium arsenid, Eastern-European Journal of Enterprise Technologies 6 (5/90) (2017) 22-31.
[18] Y. Suhikova, S. Vambol, V. Vambol, N. Mozaffari, N. Mozaffari, Justification of the most rational method for the nanostructures synthesis on the semiconductors surface, Journal of Achievements in Materials and Manufacturing Engineering 92/1-2 (2019) 19-28, DOI: 10.5604/01.3001.0013.3184.
[19] C.E. Ekpenyong, A.E. Asuquo, Recent advances in occupational and environmental health hazards of workers exposed to gasoline compounds, International Journal of Occupational Medicine and Environmental Health 30/1 (2017) 1-26, DOI: 10.13075/ijomeh. 1896.00800.
[20] St. Kontogianni, N. Moussiopoulos, Investigation of the occupational health and safety conditions in Hellenic solid waste management facilities and assessment of the in-situ hazard level, Safety Science 96 (2017) 192-197, DOI: 10.1016/j.ssci.2017.03.025.
[21] S. Vambol, V. Vambol, M. Sundararajan, I. Ansari, The nature and detection of unauthorized waste dump sites using remote sensing, Ecological Questions 30/3 (2019) 43-55, DOI: 10.12775/EQ.2019.018.
[22] T. Kontogiannis, M.C. Leva, N. Balfe, Total Safety Management: Principles, processes and methods, Safety Science 100 (Part B) (2017) 128-142, DOI: 10.1016/j.ssci.2016.09.015.
[23] H.H.K. Sønderstrup-Andersen, E. Bach, Managing preventive occupational health and safety activities in Danish enterprises during a period of financial crisis, Safety Science 106 (2018) 294-30, DOI: 10.1016/j.ssci.2017.03.022.
[24] S. Ragimov, V. Sobyna, S. Vambol, V. Vambol, A. Feshchenko, A. Zakora, E. Strejekurov, V. Shalomov, Physical modelling of changes in the energy impact on a worker taking into account high-temperature radiation, Journal of Achievements in Materials and Manufacturing Engineering 91/1 (2018) 27-33, DOI: 10.5604/01.3001.0012.9654.
[25] K. Hess-Kosa, Indoor Air Quality. The Latest Sampling and Analytical Methods, Third Edition, Boca Raton, CRC Press, 2018, 420, DOI: 10.1201/9781315098180.
[26] J. Rantanen, S. Lehtinen, A. Valenti, S. Iavicoli, A global survey on occupational health services in selected international commission on occupational health (ICOH) member countries, BMC Public Health 17/1 (2017) 787.

[27] G.Ye. Sedel'nikov, Kompetentsii i kompetentnost' personala v sfere okhrany truda i promyshlennoy bezopasnosti, Otsenka kompetentnosti. Vestnik Nauchnogo tsentra po bezopasnosti rabot v ugol'noy promyshlennosti 2 (2014), Available at: https://cyberleninka.ru/article/n/kompetentsii-i-kompetentnost-personala-v-sfere-ohrany-truda-i-promyshlennoy-bezopasnosti-otsenka-kompetentnosti/viewer.

[28] E.Y. Levina, A.R. Masalimova, N.I. Kryukova, V.V. Grebennikov, N.N. Marchuk, D.A. Shirev, R.V. Shagieva, Structure and content of e-learning information environment based on geo-information technologies, EURASIA Journal of Mathematics, Science and Technology Education 13/8 (2017) 5019-5031, DOI: 10.12973/eurasia.2017.00974a.

[29] A. Skład, Assessing the impact of processes on the Occupational Safety and Health Management System's effectiveness using the fuzzy cognitive maps approach, Safety Science 117 (2019) 71-80, DOI: 10.1016/j.ssci.2019.03.021.

[30] A.F.M. Giraldo, A.S.A. Alzate, 885 Occupational health and safety management for general service employees, Occupational and Environmental Medicine 75 (2018) A31-A32, DOI: 10.1136/oemed-2018-ICOHabstracts.88.

[31] C. Varianou-Mikellidou, G. Boustras, C. Dimopoulos, J.L. Wybo, F.W. Guldenmund, O. Nicolaidou, I. Anyfantis, Occupational health and safety management in the context of an ageing workforce, Safety science 116 (2019) 231-244, DOI: 10.1016/j.ssci.2019.03.009.

[32] Health and Safety Engineer (vacancies). Available at: https://www.truity.com/career-profile/health-and-safety-engineer (appeal 11/19/2019).

[33] P.M. Kilin, N.I. Chekmareva, Statisticheskiye metody obrabotki dannykh, Tyumen', TyumGNGU, 2013 128.