APPLICATION OF SIMULATION TECHNOLOGIES FOR FORMATION OF SAFETY RELATED COMPETENCES

ZASTOSOWANIE TECHNOLOGII SYMULACJI DO KSZTAŁTOWANIA KOMPETENCJI BEZPIECZEŃSTWA

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ABSTRACT

The formation of safety-related competencies is a difficult task. These specific safety competencies, unlike other competencies, are difficult to fully develop by providing safety learners and students. Simulation Technologies could be the solution to make it easier for students to develop competencies related to human safety. In this thesis, the following methods were used: analysis of scientific literature, projective methods, mathematical methods – in particular registration and ranking, theoretical methods including: analysis, synthesis, generalization, comparison, conclusions, modeling, induction, deduction. The study showed that the use of simulation technologies allows creating conditions for the formation of the necessary competencies without increased risk for applicants and others. One of the most promising technologies for the formation of safety-related competencies is the use of virtual reality. The use of simulation technologies in the educational process will intensify it and improve the quality of education. Simulation technologies should take a special place in the training of specialists whose professional activities are associated with increased risk, as well as with significant negative consequences of erroneous decisions, in particular in the training of rescuers, military specialists, police, operators of complex systems (including transport, nuclear, etc.), medical workers, in the aerospace industry, etc.

ABSTRAKT

Kształtowanie kompetencji związanych z bezpieczeństwem to trudne zadanie. Te specyficzne kompetencje w zakresie bezpieczeństwa, w przeciwieństwie do innych kompetencji, są trudne do pełnego rozwinięcia poprzez zapewnienie uczącym się i studentom bezpieczeństwa. Technologie symulacji mogą być rozwiązaniem ułatwiającym studentom rozwijanie kompetencji związanych z bezpieczeństwem ludzi. W pracy zastosowano następujące metody: analiza literatury naukowej, metody projekcyjne, metody matematyczne – w szczególności rejestracja i ranking, metody teoretyczne obejmujące: analizę, syntezę, uogólnianie, porównanie, wnioski, modelowanie, indukcję, dedukcję. Badanie wykazało, że wykorzystanie technologii symulacyjnych pozwala stworzyć warunki do kształtowania niezbędnych kompetencji bez zwiększonego ryzyka dla aplikantów i innych osób. Jedną

z najbardziej obiecujących technologii kształtowania kompetencji związanych z bezpieczeństwem jest wykorzystanie wirtualnej rzeczywistości. Wykorzystanie technologii symulacyjnych w procesie edukacyjnym zintensyfikuje go i poprawi jakość kształcenia. Technologie symulacyjne powinny zajmować szczególne miejsce w szkoleniu specjalistów, których działalność zawodowa wiąże się ze zwiększonym ryzykiem, a także z istotnymi negatywnymi konsekwencjami błędnych decyzji, w szczególności w szkoleniu ratowników, specjalistów wojskowych, policji, operatorów złożonych systemów (w tym transport, energia jądrowa itp.), pracownicy medyczni, w przemyśle lotniczym itp.

SŁOWA KLUCZOWE
edukacja, bezpieczeństwo, ochrona, technologie symulacyjne, kompetencje, wirtualna rzeczywistość

INTRODUCTION[1]

Safety is increasingly seen as a key characteristic of human activity. Professions related to the protection of people and the maintenance of safety in the technical, environmental, and social spheres of life have become widespread.

Safety has become one of the crucial characteristics when choosing a job. Increasingly, employees expect safe and comfortable working conditions when hiring. Often, safety and comfort can be an advantage in searching for a position, even compared to the size of wages, remoteness of the workplace, and other factors. Improving the level of safety in the workplace, from the objective perspective, reduces staff turnover in the company, which has a positive effect on its performance. Thereupon, a significant task of the enterprise's management, and the whole team, is to create and provide safe working conditions in today's production. Therefore, each employee must have the appropriate competencies to assure and maintain safe working conditions for themselves, their immediate environment, and directly or indirectly, for other members of society.

In the present-day environment, the formation of competencies related to personal safety, health, and safety and health of others is an important task in the training of future professionals. "Ability to carry out safe activities" is one of the most important common competencies for each level

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of higher education according to the list of the *EU TUNING Project*. It should be noted that a number of other general competencies can be directly or indirectly considered from the standpoint of ensuring and forming their own safety and the safety of the environment, including the ability to: abstract thinking, analysis, and synthesis; apply knowledge in practical situations; be critical and self-critical; to adapt and act in a new situation; identify, pose and solve problems; make informed decisions; the desire to preserve the environment.[2]

Due to the specifics of the formation of security-related competencies, an urgent issue is an impossibility of reproducing real dangerous situations, and, consequently, the need to use specific teaching methods. Choice and assessing the effectiveness of specific training methods for the development of competencies related to hazardous conditions and safety is a significant issue in the proper training of specialists.

The purpose of the article is to publish the results of research on determining the feasibility of using simulation technologies for the formation of competencies in future professionals whose activities are associated with increased risk and safety.

PRESENTATION OF THE MAIN MATERIAL

At first glance, the small circle of specialists whose professional activity is associated with increased risk and security in a detailed analysis is significantly expanding. First of all, based on one of the crucial axioms of the science of hazards and safety, that "any activity is potentially dangerous" the formation of basic competencies for their health and safety is relevant. At the same time, being in society and in more or less close interaction with people in professional activities, the issue of acquiring competencies to ensure safety for others becomes relevant. All these competencies are common and should be formed in the process of general and professional training. In addition, a number of specialists

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[2] *Metodychni rekomendaciji shhodo rozroblennja standartiv vyshhoji osvity*, Zatverdzheno Nakaz Ministerstva osvity i nauky Ukrajiny vid 01.06.2017 r., no. 600 (u redakciji nakazu Ministerstva osvity i nauky Ukrajiny vid 30.04.2020 r. # 584. Skhvaleno sektorom vyshhoji osvity Naukovo-metodychnoji rady Ministerstva osvity i nauky Ukrajiny protokol vid 06.02.2020 r., no. 7 (In Ukrainian); *Methodical recommendations for the development of standards of higher education*, Accepted, Regulation of the Ministry of Education and Science of Ukraine, 01.06.2017 r. no. 600 (in the editorial office of the Ministry of Education and Science of Ukraine, 30.04.2020 r. # 584. 02/06/2020 no. 7) (In English).

should be educated for special, professional competencies. Due to the large number of specialists whose activities are directly or indirectly related to hazards, safety, and the diverse nature of their activities, it is proposed to divide such specialists into groups depending on the vector and magnitude of the hazards.

The first group should include those whose professional activities will occur in conditions of increased risk for them personally, for example, military, firefighters, a number of technical professions, chemists, biologists, medical workers, police, etc. Given the diversity of dangerous professions, there is no single approach to their definition. In particular, in addition to the mentioned above, the following professions are dangerous: pilot, lumberjack, fisherman, miner,[3] driver, teacher, secretary, flight attendant, and even sales consultant.[4] To classify them according to the level of risk, it is suggested to use the matrix of the danger of professional activity (Fig. 1). The matrix intentionally does not specify the exact values of the risks. Determining the level of danger connected to following a professoin can not be limited to general statistics on mortality, the number of more or less serious injuries, or the development of occupational diseases.What should be taken into account are the specifics of professional activities in different countries, different climatic conditions, and different levels of technical support, and implementation measures for labor protection and hazard prevention.

[3] TOP-25, 'Самые опасные профессуу v myre', https://zen.yandex.ru/media/id/5d3d8553f8e-a6700ae171a21/top25-samye-opasnye-professii-v-mire-5d431a41fe289100ae9c5b83, (accessed 11 May 2021) (In Ukrainian); [TOP-25, The most dangerous professions in the world', https://zen.yandex.ru/media/id/5d3d8553f8ea6700ae171a21/top25-samye-opasnye-professii-v-mire-5d431a41fe289100ae9c5b83, (accessed 11 May 2021)].

[4] 'Najbiljsh nebezpechni i shkidlyvi profesiji' [The most dangerous and harmful professions], https://bestfacts.com.ua/najtsikavishe/najbilsh-nebezpechni-i-shkidlivi-profesiyi.html, (accessed 12 May 2021), (In Ukrainian).

FIG. 1. MATRIX OF THE LEVEL OF DANGER OF PROFESSIONAL ACTIVITY
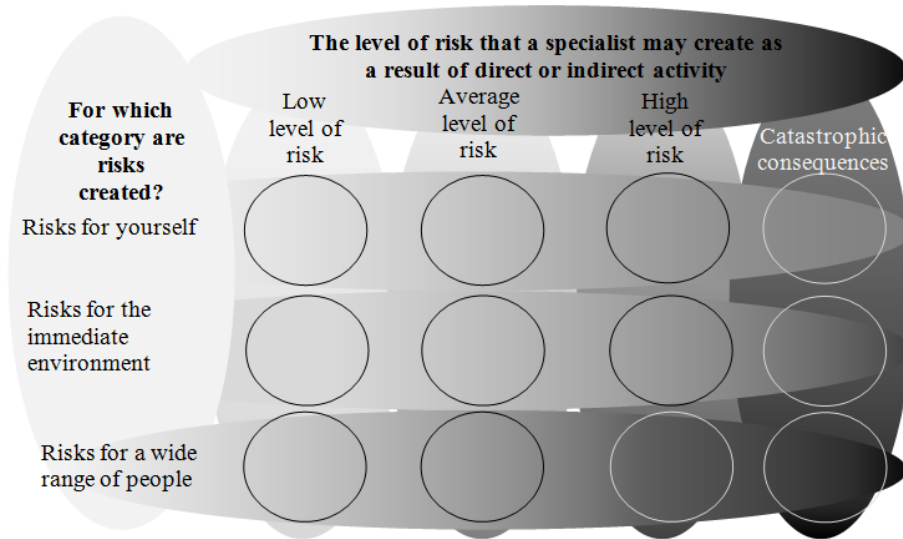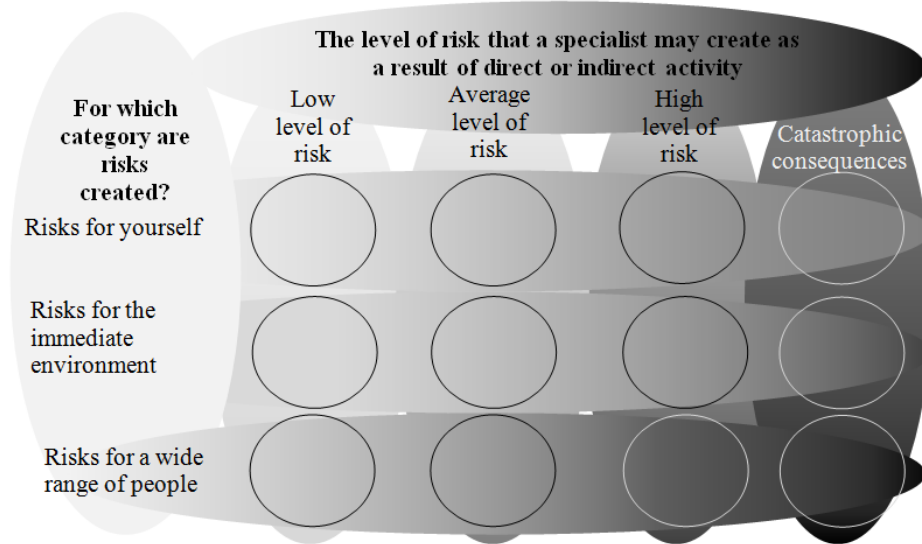

Source: Own development

Thus, instead of a single indicator of the danger of this profession, it is better to use an integrated range, which shows the highest and lowest level of risk for this profession in modern conditions. Of course, it would be possible to apply the average values of the risk of an unquestionable professional activity. However, those averages will not reflect the actual situation and be misleading in the calculations.

The next group of occupations is associated with the possible creation of risks to the safety and health of others (fig. 2). These include those that can create hazards directly, including medics, pilots, drivers, ship captains, workers involved in the usage of toxic, toxic, radioactive substances, hazardous biological organisms, etc. To the next group belong occupations in which dangers are created indirectly or remotely in time. This should include professionals who depend on the environmental condition, product safety (food and technical products), design and construction professionals, some health professionals, teachers and educators, cybersecurity professionals, technologists, and managers in many areas.

Assessing the possibility of creating high risks due to professional activity is a rather complex process and requires consideration of a number of indicators and characteristics. In the case of an apparent direct relation-

ship between human actions and the consequences of the issues does not arise. As a rule, a number of measures have already been created for such professions today, which reduce the probability of making accidental or intentional (spontaneous or planned) decisions leading to an increased level of risk or even catastrophic consequences. These professions include nuclear power plant operators, pilots, and so on.

FIG. 2. MATRIX OF THE POSSIBILITY OF CREATING RISKS DUE TO PROFESSIONAL ACTIVITIES

Source: Own development

It is much more demanding to determine the possibility of creating dangers in occupations where the consequences are indirect or may occur over a long period. In some cases, in particular when assessing long-term environmental consequences, objective analysis of future risks may be complicated by insufficient development of science for the assessment period, the inability to take into account the full range of exogenous and endogenous effects, and so on.

A separate group should include specialists whose activities are associated with a high level of risk for professionals and others. In particular, this group should contain the military, rescuers, firefighters, health and safety professionals, police, and more.

The use of matrices presented in fig. 1. and fig. 2. allows to assign this or that profession to a certain category according to the level of danger, but specific figures can be used only for certain characteristics, usually in the case of sufficient statistics.

It should be noted that the activities of a number of professionals can be associated with a number of direct and hidden dangers for themselves and others. Risks in each case can differ significantly in type and size.

Therefore, when training specialists in certain professions should be guided not only by recognized recommendations, but also taken into account development trends in this field, regional features, and at best, the specific conditions in which further work of the student is expected.

Of course, specific teaching methods should be combined with traditional methods: lectures, seminars, practical, laboratory classes, etc. Conventional teaching methods are effective primarily for the formation of theoretical knowledge, in particular, about the causes of hazards, general principles of safety, to acquire skills in working with documentation, initial acquaintance with special tools and instruments, etc.

The effectiveness of the formation of competencies related to rapid response to hazards in a situation of crisis, psychological pressure, lack of time, and information of increased responsibility for life requires special training methods that will effectively develop relevant skills and will not endanger the lives and health of applicants education and the people around.

The primary issue in the selection of training methods for future professionals whose professional activities will be related to security is the choice of training methods for specific competencies. Specific competencies are distinguished by a number of characteristic features, including:

✓ the need to make a decision in a short and limited time;
✓ limited current information;
✓ the need for a clear formulation of the team or order;
✓ psychological pressure due to responsibility for the correctness of the decision;
✓ activities in uncomfortable, dangerous, or extreme conditions.

Let's take a closer look at each of the characteristics of specific competencies separately and in their relationship. Unlike most competencies, safety competencies may require urgent decisions, especially in the event of an accident, emergency, or threat of occurrence. That is important in view of the fact that in case of danger and emergencies the issues of evacuation, protection, rescue are significantly determined by the time frame.

It should be noted that a quick decision is associated with the following characteristic, namely the understandable wording of the order or instruction. The ability to make quick decisions is not enough in itself. It is necessary to move just as quickly to the action and/or coherent and concise formulation of the command or order, which would be perceived and executed.

The decision may made in conditions of limited and insufficient information to choose the best option. Limited time frames may not allow the use of information retrieval tools, and technical means of communication in a dangerous or emergency may be damaged or disabled.

Deciding on a threatening or dangerous situation is usually accompanied by psychological pressure due to responsibility for the correctness of the decision. After all, the consequences of the decision may depend on one's own life and the lives of others, as well as harmful environmental or social consequences, material losses, and so on.

It should be noted that decision-making can take place in two variants of conditions, namely in the conditions of direct danger and the influence of negative factors, and circumstances not related to the direct impact of hazard. In the absence of immediate danger to the decision-maker, psychological pressure is felt less, sometimes the sense of responsibility for the consequences is weakened. Making decisions in uncomfortable, dangerous, or extreme conditions is much more difficult. As a rule, the first and second conditions of decision-making differ significantly in incompleteness, sources, and speed of information.

Accordingly, training methods for the acquiringof competencies related to safety in professional activities must meet at least part of the characteristics, otherwise, it is useless to talk about the effective acquisition of a particular competence.

In order to identify the most effective teaching methods for specific competencies, we will analyze a number of modern methods.

First of all, these are active methods that contribute, according to I.M. Dychkivska, to the activation of educational and cognitive activities of students through a broad, preferably comprehensive, use of both pedagogical (didactic) and organizational and managerial tools.[5] Active teaching methods include a fairly wide arsenal, including: discussion,

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[5] I.M. Dychkivsjka, *Innovacijni pedaghoghichni tekhnologhij* [*Innovative pedagogical technologies*], Akademvydav, 2004. p. 320, (in Ukrainian).

»brainstorming«, demonstration and guided practice, role-playing games, small group work, educational games and situation simulation, case studies, storytelling, debate, audiovisual activities, decision making or problem trees, practical development of life skills within a certain context with other participants, case method, training. A rather detailed list and analysis of active teaching methods are given by O.I. Bashkir,[6] including scribing, 'Plus – Minus – Interesting', storytelling, etc. The author also highlights interactive teaching methods, among which one of the most important for higher education institutions is the business game. A detailed description of one hundred and nineteen interactive teaching methods is given by O. Pometun,[7] who defines the essence of interactive learning in the fact that the learning process takes place only through constant, active interaction of all students. The student and the teacher are equal subjects of learning. Among the methods given by O. Pometun there are the following: a continuous scale of opinions; blitz discussion; debate; decision tree; expert group meeting (or loop discussion); Round Table; exchange of problems; symposium; synthesis of thoughts; situational modeling (simulation or business games); joint agreement, etc.

Active teaching methods are a kind of training ground where students can practice professional skills in conditions that seem to be real.[8]

However, the use of a significant number of the above-given methods does not always achieve the desired result in the training of security professionals. More specifically, on the one hand, it allows to provide some knowledge and form a steady skill in the student but still, it does not assure the opportunity to implement this skill in extreme conditions or situations. Active learning methods allow to implement of specific competencies taking into account only three of the five characteristics, namely:

✓ decision-making in a short and limited time;
✓ understandable wording of the team or order;

[6] O.I. Bashkir, 'Aktyvni j interaktyvni metody navchannja u vyshhij shkoli [Active and interactive teaching methods in higher education]', *Pedaghoghika ta psykhologhija*, no. 60, 2019, pp. 33–44, (in Ukrainian).

[7] O. Pometun, *Encyklopedija interaktyvnogho navchannja* [*Encyclopedia of interactive learning*], Kyji, 2007, p. 142, (in Ukrainian).

[8] V.P. Vonsovych, 'Vykorystannja imitacijnykh tekhnologhij i pryjomiv u navchaljno-profesijnij dijaljnosti studentiv [The use of simulation technologies and techniques in the educational and professional activities of students]', *Visnyk Cherkasjkogho universytetu* (Serija Pedaghoghichni nauky), no. 126, 2008, pp. 40–43, (in Ukrainian).

✓ decision making in conditions of limited information.

It should be noted that the inclusion of these characteristics in active teaching methods, which are traditionally used, requires additional refinement of a chosen method.

The most promising methods of teaching competencies, the implementation of which in practice is associated with increased risk, are methods based on modeling. The method of modeling or simulation (simulation) should be an organic part of security training, especially for practical skills and psychological training.[9]

Simulation or modeling technologies can be divided into several groups:

1. Live (real) simulation technology involves performing tasks in real conditions on real equipment, but in the absence of a real threat. It is advisable to use it in the final stages of training to complete the formation of the necessary competencies. This technology allows applicants to fully gain the necessary skills.

2. Computer simulation technology involves the use of computer models. This technology allows you to model processes, including special equipment, human activities, etc., creates opportunities to verify the correctness of decisions or design changes. Allows you to track the consequences within a given spatial and temporal limits. It creates the impression of carrying out activities in real conditions.

3. Virtual simulation technology involves the use of a model of equipment. For this purpose special models of the equipment or workplaces in a complex with computer systems are used that create the real impression of work in real-time. It is most often used to train pilots, drivers, nuclear power plant operators, etc.

4. In an interactive simulation technology – equipment models are used in combination with computer models. This technology uses a special protocol (Distributed Interactive Simulation), which allows you to combine computer simulation and virtual simulation into a single complex. This allows for special classes with groups of students who perform different

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[9] V. Zaplatynsjkyj, V. Ghajda, 'Zastosuvannja innovacijnykh metodiv navchannja u pidghotovci fakhivciv z pytanj bezpeky u vidomchykh navchaljnykh zakladakh. [Application of innovative teaching methods in the training of security specialists in departmental educational institutions', *Kryminaljno-vykonavcha polityka Ukrajiny ta Jevropejsjkogho Sojuzu: rozvytok ta integhracija: zb. materialiv mizhnar. nauk.-prakt. Konf*, Kyjiv, 2015, pp. 400–402, (in Ukrainian).

tasks, for example, to combine the activities of rescue teams, military units, dispatchers, special services, in the simulation of various hazards.[10]

5. A promising area is the use of virtual reality systems that allow you to create situations that are unattainable when using other technologies. Virtual reality makes it possible to create an artificial world, to fill it with models of objects and devices whose interaction with other objects and people is extremely realistic. Sensor devices are used by the user to interact with objects in the artificial world. Virtual reality allows you to attract groups of people who interact with the objects of the artificial world and with each other. Virtual reality systems are now widespread in the gaming industry. However, V.S. Berezovsky and other authors believe that one of the most popular areas of virtual reality is education. After all, students will be able to interact with objects in cyberspace or even virtually participate in important historical events.[11] The advantage of virtual reality is the ability for users with special needs to access and use the same learning materials from home as in a real school.[12] V.E. Klymnyuk identifies the following five main benefits of using virtual reality technologies in education: clarity, security, engagement, focus, and virtual lessons. First of all, it's clarity. Virtual reality is able not only to provide information about the phenomenon itself but also to demonstrate it with any degree of detail[13] and in conditions that are not available in reality. This technology allows you to delve into the microworld, and look at the structure of cells or even atoms, speed up or slow down reality, demonstrate dangerous chemical, physical, biological processes. A person can feel in a crowd, during hostilities, in a fire, and so on.

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[10] V. Zaplatynskyi, 'Vozmozhnosty y perspektyvы yspoljzovanyja symuljacyonnыkh tekhnologhyj pry prepodavanyy kursov svjazannыkh s bezopasnostjju cheloveka [Possibilities and prospects of using simulation technologies in teaching courses related to human safety]', *Zbornik vedeckych prac: Riešenie krízových situácií prostredníctvom simulačných technológií*, Akadémia ozbrojených síl, Simulačné centrum, 2013, pp. 213–220, (in Russian).

[11] V.S. Berezovskij, *Sozdanie jelektronnyh uchebnyh resursov i onlajnovoe obuchenie: ucheb. Posob* [*Creation of e-learning resources and online learning*], Izd. gruppa BHV, 2013, p. 176, (in Russian).

[12] V. Klymnjuk, 'Je. Virtualjna realjnistj v osvitnjomu procesi [Virtual reality in the educational process]', *Zbirnyk naukovykh pracj Kharkivsjkogho nacionaljnogho universytetu Povitrjanykh Syl.*, no. 2, 2018. pp. 207–212, (in Ukrainian).

[13] Klymnjuk, 'Je. Virtualjna realjnistj v osvitnjomu procesi', pp. 207–212, (in Ukrainian).

Involvement involves the ability to change scenarios, influence the course of the experiment, or solve problems in a game and understandable form.

The virtual world surrounds the user on all sides, which allows him/her to focus entirely on the material and not be distracted by external stimuli, ie focus.

The development of virtual reality systems will allow the future to fully simulate classes. It can be predicted that such virtual classes will be used primarily to acquire security-related competencies. In virtual reality, you can simulate a variety of actions, for example, during firefighting or other man-made and natural emergencies. Classes for the military, police, surgeons, and many other professionals whose professional activities are associated with high personal risk and risk to others will be very valuable.

Classes with the use of virtual reality systems in the case of distance education will allow applicants to get the effect of presence, which will bring the quality of these classes closer to the face. In virtual reality, you can simulate all types of classes: lectures, seminars and practicals, laboratory, and even industrial practice. Moreover, the role of a teacher can take on artificial intelligence. Already today, advances in artificial intelligence have made it possible to introduce robot teachers in the education system.[14] For example, virtual teachers were created at the Innovative Learning Technology Research Center (Center for Research of Innovative Technologies for Learning — RITL) at the University of Florida. Such a virtual teacher, in addition to providing material, also interacts with the applicant through non-verbal communication. Unlike a living educator, a virtual educator can change gender, ethnicity, age, personality, and communication style to suit the individual characteristics of the learner. Virtual teachers can be specially configured and personalized, which increases the emotional response of a group of people or a particular applicant.[15] This opens wide opportunities in modeling and using different learning styles and learning strategies.[16] It should be noted that the virtual teacher does not get tired,

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[14] K.N. Menjshykh, *Dydzhytalyzacyja obrazovanyja [Digitalization of education], Mnoghomernostj obshhestva: cyfrovoj povorot v ghumanytarnom znanyy*, Ekaterynburgh, 2019, pp. 1068-1070, (in Russian).

[15] Roboty-prepodavateli zanimajutsja so studentami v onlajne [Robot teachers train with students online], https://www.prorobot.ru/06/robot-virtualgirl.php (accessed 12 May 2021), (in Russian).

[16] Roboty-prepodavateli zanimajutsja so studentami v onlajne [Robot teachers train with students online], https://www.prorobot.ru/06/robot-virtualgirl.php (accessed 12 May 2021), (in Russian).

does not worry about other problems, is not late, is always »emotionally stable«, has a much higher speed of communication with applicants, is able to take into account many factors of applicants' reaction and behavior. The use of virtual teachers in virtual reality systems can be one of the most promising areas of digitalization of education.

The development of robotics will contribute in the future to the widespread use of robots and systems that will be controlled by humans in conjunction with artificial intelligence. Such works will find use, first of all, in professions that are dangerous today. Accordingly, the training of such specialists-operators will be concentrated in the format of virtual reality with the use of equipment that is similar to the real one.

The use of virtual reality systems is particularly promising for the building of security-related competencies. In virtual reality systems you can simulate activities in uncomfortable, dangerous, or extreme conditions. It is even possible, to some extent, to create psychological pressure on a person, to simulate the negative or tragic consequences of wrong decisions, etc., and at the same time to ensure the safety of applicants. Virtual reality systems are improving and more realistically shaping the artificial world.

Despite all the benefits of using simulation systems, there are already reports that the use of simulation technologies reduces a person's sense of danger in real circumstances. This may be a factor that eliminates the possibility of using the acquired competencies for a number of applicants. It is only partially possible to implement such a specific characteristic as »psychological pressure through responsibility for the correctness of the decision made«. The full implementation of this characteristic is possible only in terms of training when there is a complete simulation and applicants are not informed that it is training or training in real conditions.

CONCLUSIONS

The introduction of simulation technologies in the educational process requires an analysis of the possibility and feasibility of their application for some disciplines, the study of which develops skills of safe behavior and creates a safe environment. In order to increase the effectiveness of the usage of an active teaching methods, it is necessary to select from all disciplines, in the process of studying which security-related competencies

are formed, those that form competencies to work in conditions of threat or directly in extreme situations their study is not associated with immediate risk. The same analysis must be conducted in the substantive part of each of the disciplines.

In the process of using simulation methods, the student performs or simulates his own actions or the actions of subordinates or others, similar to those that may occur in his actual activities. At the same time, it is possible to 'speed up' or »slow down« the time of the real process, to stop at any time to explain the situation. Analysis of errors after simulating the situation, reveals the causes of their occurrence and reduces the likelihood of recurrence of such errors in real life. Simulation methods make it possible to «go through» the situation the required number of times in order to determine the most optimal solution or behavior, and gain a solid skill in a particular situation. The main advantage of simulation technologies is their safety for students and others. Mistakes in real life, especially in matters of prevention and counteraction to dangers, can have catastrophic consequences – while simulation methods allow one to carry out training safely. It should be noted that simulation technologies (except for real simulation) can not create psychological states of stress, fear, confusion, etc., which are characteristic of really dangerous situations, which in some way reduces their effectiveness. However, the use of virtual reality systems today is able to some extent, to bring the psychological state of the student closer to the real thing.

The use of simulation technologies in the educational process will intensify it and improve the quality of education. Simulation technologies should take a special place in the training of specialists whose professional activities are associated with increased risk, as well as with significant negative consequences of erroneous decisions, in particular in the training of rescuers, military specialists, operators of complex systems (including transport, nuclear, etc.), medical workers, in the aerospace industry, etc.

The development of methodological and software is a promising area of further research on the use of simulation technologies for the formation of security-related competencies. An important area of research is to assess the psychological consequences of the use of simulation technologies, especially issues related to reducing the feeling of danger to the person.

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