

FORMATION OF PROFESSIONAL COMPETENCY IN CONTEMPORARY BACHELORS OF EDUCATION: A NOXOLOGICAL ASPECT

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Abstract: The paper deals with the problem of training the bachelors of education in life safety area which is relevant as of today. The paper presents the results of the research conducted by the authors during the time span from 2005 up to 2016 that reveal the particularities of training of bachelors of education in life safety on the basis of modular and noxological approaches. The main directions of organizing the educational process of life safety bachelors of education training based on an experimental technique are detailed. For understanding the role of the noxological aspect in a teacher's expertise, the regularities of development of the "Life safety" educational space (LS ES) have been determined. For assessing the noxological content of the professional competency of a life safety bachelor of education, the technique of additive and multiplicative convolution has been suggested that allows taking into account the contribution of each subject and each competence into formation of the noxological content of the professional competency. The research conducted has enabled the authors to obtain results definitely proving the efficiency of including the noxological content into the bachelors training educational process. This can be seen in a higher stability of forming of the professional competency in students of experimental groups. The question about the influence of today's complex of challenges, threats and hazards of the environment on the content of profile subject training of future life safety teachers and on formation of their professional competency remains debatable.

Keywords: Life safety, education in life safety, noxological component, bachelor of education, professional competency.

INTRODUCTION

One of the leading contemporary trends in the higher education is the search for and development of the relevant qualities in new formation teachers. Such teachers have to possess a set of knowledge, abilities and skills that will allow them to master the future profession. The total spirals into a brand new characteristic of a teacher – professional competency (Bolotov & Serikov, 2003; Carr & Skinner, 2009; Boulet, 2015; Day, 1994; Hedges, 1996; Zimnyaya, 2006).

The fundamental change in today's education system of Russia is conditioned by certain modifications urging new views on the organization of professional training of higher education institution students within the new educational paradigm

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(Bologna Declaration, 1999; Stankevich, 2006; The concept of modernization of Russian education for the period of up to 2010, 2002).

The contemporary trends and new ideas in science, the development of economic views, the axiological approach, as well as traditional regularities of personality upbringing and development, systemic and integrated approaches have determined the conditions for justifying the existence and development of the “Life safety” educational space (LS ES).

The Russian pedagogical education in life safety is currently seeing profound reforms. In its turn, this requires changing all the elements of the educational process that take place during development of the country’s higher education.

LITERATURE REVIEW

The development of a new paradigm of today’s world education, the “lifelong education”, allows saying quite confidently that the noxological aspect of LS ES will enable each student to form and develop a high personal consciousness in learners and the children’s readiness for acting in conditions of potential and actual hazards. They will also be able to render aid to themselves, their friends and close ones and to others in trouble. Accordingly, the relevant task for pedagogical and methodological science is to determine the level of formation of bachelors’ professional competency while also revealing in it the noxological aspect.

Now, the key notions as described by the scientific literature are going to be considered.

Noxological activity consists in an ability to identify hazards generated by various sources in technosphere, in an ability to evaluate fields and indices of their impact on man and habitat, in being ready to choose the hazard protection methods as applicable to the sphere of one’s professional activity and ways for ensuring comfortable life activity conditions (Abramova & Boyarov, 2011; Devisilov, 2011).

The following directions for the knowledge, abilities, skills and competences to be fulfilled can be singled out in the content of a life safety teacher’s noxological activity:

- detection of hazards, analyzing the causes of their emergence and likely consequences;
- taking preventive measures in order to prevent hazardous situations in organizing and conducting the educational and upbringing process in educational institutions;
- arranging recreation events that form a healthy way of life in learners, as well as valeological knowledge, abilities and skills in their daily life (Abramova, 2015).

For the rise of expertise of today's bachelors, *the competence-based approach* is considered as the priority one by the contemporary science. The scientific range of problems concerning training of a competent graduate is reflected by the numerous works of A. Chown (1994), N. Fernandez et. al., (2012), M. Armstrong (1995), S. Whiddett and S. Hollyforde (2000, 2007), R. Kurz and D. Bartram (2002), Y. Tatur (2004), R. Sternberg and J. Kolligian (1990) and others.

It is the noxological approach that occupies a special place in training of life safety education bachelors. The noxological approach relies on the key notion of "noxosphere" (from the Latin word *nox* – a hazard) which is a space where hazards exist permanently or emerge from time to time (Abramova, 2015).

In line with this approach, the society puts forward a total of requirements for today's life safety bachelors that has to be taken into account in the modern educational process. Among such requirements, the following can be named: the abilities to detect actual and potential hazards emerging in various spheres of human life activity; the abilities to promptly find out the indices and criteria of the hazards; the abilities to assess and select means and ways for ensuring safety; a readiness to identify the integrated negative impact factors and to take measures for enhancing the reliability of production processes; the requirements on ensuring safe conditions of life and work; ensuring the safety and protection of the population and areas from hazardous situations and emergencies of various origin. The requirements for the skills of practical use of the knowledge obtained in ensuring safety for various activities also belong here.

METHODOLOGICAL FRAMEWORK

The objective of the research is the theoretical analysis of LS ES, revealing the noxological aspect in it as well as the influence of the latter on formation of the bachelors' professional competency.

The problem questions of the study were as follows: what is the noxological content of the bachelors' professional competency? What is the level of formation of the noxological competence in teachers?

The experimental research was conducted on the basis of FSBEI HE "Sakhalin State University" (life safety department) and FSBEI HE "A.I. Herzen Russian State Pedagogical University" (the faculty of life safety).

As the object of the pedagogical experiment, the educational process of training the bachelors in the direction "Pedagogical education", profile "Life safety education" was selected. 589 students took part in the experiment throughout the years of its being conducted, 2012-2017. At the initial stage of the experiment, the groups of students were selected to be homogeneous (ones with the similar average admission score of the applicants).

The authors checked the motivation and interest of the students towards learning in the area of life safety. In particular, the students were asked to answer the questions of a questionnaire form compiled according to the technique of diagnosing the cognitive interest development levels (Belyaeva, 2014; Vergasov, 1997; Shchukina, 1998) as well as K. Zamphir's technique of diagnosing the professional activity motivation (as modified by A. Rean) (Rean & Kolominskiy, 1999).

In order to confirm their validity extent, the averaged values of the professional competency formation level were further subjected to statistical analysis according to the variation coefficient, to the techniques for assessing the distinctions between two samples by the level of the quantified attribute (*Mann-Whitney U-test*) (Mann & Whitney, 1947) and for assessing the degree of association of the samples multitude (*Kruskal-Wallis test*) (Kruskal & Wallis, 1952).

The organization of the educational process of life safety education bachelors training on the basis of the experimental technique featured the following particularities:

1. Organization of training: the modular main educational program based on asynchronous learning was used, with each student being granted an opportunity to choose their individual educational route;
2. Content of training of the students: the subject profile modules of noxological content were included.
3. Characteristics of methods: at Sakhalin State University, the experimental technique based on the new organizational and methodological conditions was used while at Herzen State Pedagogical University, the organizational and methodological conditions remained unchanged.

For determining the professional competency formation level of life safety education bachelors, the authors used the vector optimization technique (Sibikina, 2013). So, when assessing the competency formation, the efficiency performances are points scored by a student in subjects that form the competency. These points are homogeneous and belong to the performance indicators, therefore, it is acceptable to apply this convolution for assessing each competence formation level in the student.

RESULTS AND DISCUSSION

The development of theory and practice of higher education, development trends of LS ES, as well as numerous scientific investigations in ensuring human safety have allowed determining the following general principles of LS ES in order to understand the role of the noxological aspect in teachers' professional competency.

1. The development of theory and practice of LS ES is based on the current needs of the contemporary society.

The main objective of development of the humanity is improvement of the quality of life. As practice shows, this results in continuous growth of needs of man. With regard to this, satisfaction of the needs depends utterly and completely on the condition of the environment, life level in the country, development of the economy and production, life safety on the whole and life safety education system in particular. Accordingly, the objectives and tasks of LS ES also change considerably influenced by the development of the society and by the scientific and technical advance.

Today's global problems of the humanity – a higher birth rate, depletion of natural resources and biological diversity, reduced quality of food products and worsening of people's health, increased volume of consumption waste and anthropogenic pollution of the atmosphere, hydrosphere, and lithosphere lead to the multiple increase and expansion of the range of threats and hazards for people (Poirier & Feder, 2001). In its turn, this brings up the necessity for the society's needs to be reconsidered. Meanwhile, the contemporary education system is in much determined by such conceptual documents as the RF Strategy of national security, the Federal laws "On production and consumption waste", "On protection of the environment", as well as the international level ratification of Stockholm Declaration of the UN Conference on the Human Environment (1972) and Rio de Janeiro Declaration of the UN Conference on Environment and Development (1992), etc.

Consequently, the structure and content of the higher education system has to be improved, it being one of the most demanded by the society system. So it is on the quality of today's Russian education that the development of the Russian society in conditions of continuous influence of hazards and threats depends much, with education becoming an essential means for enhancing the country's competitiveness in the world.

Under the conditions, LS ES becomes the basis of an integrated system of the Russian education which is up to the requirements of training the civic and patriotic qualities in the rising generation. Given such conditions, in 1991, Russia was among the first countries of the world to implement the subject content of life safety in the educational process. At schools, it was a course of "Foundations of life safety", at higher education institutions – the subject "Life safety". Thus, a new direction of survival and development not only for the Russian citizens but for the entire humanity was determined.

LS ES has covered almost all spheres of human life and has become an integrative subject. It is naturally associated with the content of all courses and subjects without exceptions studied at all stages and levels of the education system.

2. The environmental, social and professional aspects of personality are interconnected with its safe existence.

Ensuring the safety has turned into a priority goal and an inherent need of civilization. This necessitates forming and developing a new world view – a system of ideals and values, standards and traditions of safe behavior, an integral culture of life safety.

The environmental aspects of LS ES determine the normal functioning of biosphere and are considered as the main condition of existence of the humanity. The contemporary environmental situation has increased the significance of man in the environment (Environmental Education, 2010). This determines the necessity of enhancing the humanist principle and environmental orientation in the relationships of an individual and the society and towards the natural environment, as well as taking these into account in the content of LS ES. Moreover, during the study process, the students' personalities are developed and socialized, which leads to improvement of the students' expertise in LS ES and conditions the rise of a spiritually developed cultural personality possessing an integral humanist world view, dynamically employing its creative energies and capacities in the professional activity. Such education is the critical condition for a successful development of the entire system of LS ES at the contemporary stage; it determines the formation and rise of a harmonious personality.

3. The integration and differentiation processes in LS ES are united.

In today's science, technology, education, the integration and differentiation processes are objectively interconnected. In the process of students' learning, integration is due to the integrative nature of LS ES and is an essential condition and means of high quality training of students.

The interdisciplinary nature of scientific knowledge in life safety is determined by the integration of natural, exact, military and other sciences. In the recent time, the trend has been maintained and enhanced due to new relevant integrated problems emerging. So, the unity of integration and differentiation in LS ES is expressed in the following points:

- the systemic understanding of the content of education;
- mutual influence of the content of specific subjects and that of general scientific subjects;
- integration of subject-related and methodological training;
- mutual influence of the content of LS ES;
- a stable interconnection of theory and practice;
- integration of various forms of educational process organization, etc.

4. Learning, upbringing and development of personality are united in LS ES.

The main aspects of the new education paradigm are reflected in the relevant regulatory instruments: Law of the RF “On education in the Russian Federation” No. 273-FZ of December 29, 2012; Federal law “On higher and postgraduate professional education” No. 125-FZ of August 22, 1996, the current educational standards and theoretical works on the problem. These documents allow singling out the tasks of teaching life safety, determining the orientation of theoretical and practical training of students having a system of knowledge about the formation of safe behavior type personality qualities and about life safety culture.

The law “On education in the Russian Federation” (2012) defines education as a “purposeful process of upbringing and learning in the interests of man and society, accompanied by confirmation of the citizen’s (learner’s) achieving the educational levels (educational standards) set by the state”. As well, it lays down the principle of protection and development of national cultures, regional cultural traditions and particularities in conditions of a multi-national state by the education system. This principle necessitates consolidating the unity of the Russian Federation educational space, with certain federal and regional development particularities borne in mind.

In the modern understanding, LS ES is defined as a category of social culture uniting the personality-related and the activity-related components. With regard to this, the human activity under action of hazards and threats determines the human life safety culture which relies on a system of social standards, beliefs and values ensuring the preservation of human life, health and integrity both at present and in the future – which also determines the noxological basis of LS ES.

Numerous studies conducted at the life safety department of Sakhalin State University and at the faculty of life safety of A.I. Herzen RSPU for over 10 years have allowed developing and justifying the procedure of determining the degree of influence (p) of each subject (M) on the formation of professional competency (S). For this, the authors ascribed code numbers to the subjects and competences (see Table 1, Table 2).

TABLE 1: FSES HE AND CODE NUMBER

Federal State Educational Standard of Higher Education (FSES HE) competence code	OK-9	OK-12	PK-2	PK-4	PK-7	PK-8	PK-11
Code number	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇

Source: The Authors

TABLE 2: CODE OF SUBJECT ACCORDING TO THE CURRICULUM AND CODE NUMBER

<i>Code of subject according to the curriculum</i>	<i>Code number</i>
B2.B.1	M ₁
B2.B.3	M ₂
B3.B.1	M ₃
B3.B.2	M ₄
B3.B.3	M ₅
B3.B.4	M ₆
B3.V.OD.1.6	M ₇
B3.V.OD.2	M ₈
B3.V.OD.3.3	M ₉
B3.V.DV.3.2	M ₁₀

Source: The Authors

The degree of influence (p) was determined on the basis of knowledge about the influence of each subject on the degree of formation of certain competences obtained as a result of expert analysis. The expert analysis had the following features:

1. The survey was based on the opinions of experts (teachers of departments, graduates of A.I. Herzen RSPU and Sakhalin State University of 2005-2015, postgraduate students and master students of various years of study).
2. The experts worked as an open group discussion.
3. The experts generated the shared opinion about the inclusion of a subject into the list as a one forming this or that competence.
4. The degree of importance of each subject for the formation of a certain competence was identified on the basis of determining its weight factor.

The data obtained revealed the relation between the competences acquired and subjects forming them in direction of training 44.03.01 “Pedagogical education”, profile “Life safety education” (Table 3).

TABLE 3: WEIGHT FACTORS OF SUBJECTS

<i>Subjects/ modules</i>	<i>Competences, S</i>						
	S_1	S_2	S_3	S_4	S_5	S_6	S_7
M ₁	0,14	0,10	0,12	0,08	0,04	0,05	0,05
M ₂	0,17	0,15	0,16	0,12	0,05	0,13	0,09
M ₃	0,05	0,05	0,07	0,09	0,08	0,10	0,09
M ₄	0,05	0,04	0,06	0,08	0,09	0,10	0,09
M ₅	0,06	0,10	0,08	0,13	0,11	0,16	0,14

Subjects/ modules	Competences, S						
	S_1	S_2	S_3	S_4	S_5	S_6	S_7
M ₆	0,10	0,10	0,10	0,09	0,11	0,09	0,10
M ₇	0,07	0,10	0,07	0,09	0,14	0,08	0,11
M ₈	0,07	0,13	0,07	0,08	0,13	0,09	0,11
M ₉	0,09	0,08	0,09	0,09	0,11	0,09	0,10
M ₁₀	0,19	0,15	0,17	0,14	0,14	0,10	0,12

Source: The Authors

The experts were also asked to determine the weight factor of each competence in the noxological content of professional competency (Table 4).

TABLE 4: WEIGHT FACTORS OF THE NOXOLOGICAL CONTENT OF PROFESSIONAL COMPETENCY

S_i	1	2	3	4	5	6	7
p_i	0,04	0,05	0,12	0,45	0,11	0,09	0,14

Source: The Authors

When assessing the contribution of each subject into formation of a certain competence determining the noxological content of professional competency of life safety education bachelors, the authors used the method of additive convolution which allows taking into account the level of students' mastering some subjects at the expense of others. On top of that, for assessing the contribution of each competence formation degree into formation of the noxological content of professional competency, the authors used the multiplicative convolution method which takes into account the significance of each competence formed during studying the subjects and modules.

Thus, the authors have developed a procedure for assessment the noxological content of professional competency of life safety education bachelors. The procedure consists of two stages (Figure 1):

1. Determining the level of development of each significant competence of FSES HE in the graduates;
2. Assessing the graduates' competency level.

The level of development of each competence depends directly on the integral score (points, $b_1...b_n$) a learner gets in the competence forming subjects as well as on the weight with which each subject influences the competence.

The calculation is performed according to the formula:

$$S_i = b_i \cdot p_i, \quad (1),$$

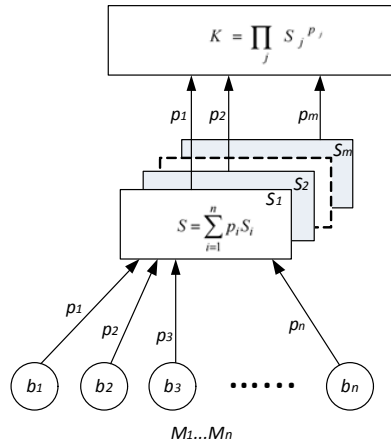


Figure 1: Noxological Content of Professional Competency Assessment Procedure

Source: The Authors

here i is the quantity of subjects influencing the formation of the competence, $i = 1, \dots, n$; b_i is the score that a learner has in this subject; and p_i is the weight factor of the subject influencing on i -th competence formation.

Next, the additive convolution of vector criterion is used and the numerical characteristic of each competence development level in the learner is obtained:

$$S = \sum_{i=1}^n p_i S_i, \quad (2)$$

The use of additive convolution in this case is conditioned by the fact that a low score in one subject influencing the formation of a competence can be compensated by a high score in another subject influencing the formation of the same competence.

For calculating the level of competency, it is necessary to know the development level of each competence S_j , as well as weight factor p_j showing the degree of influence of each competence on the noxological content of professional competency. For this, the multiplicative convolution of vector criterion was used:

$$K = \prod_j S_j p_j, \quad (3)$$

Here j is the quantity of competences determining the competency, $j = 1 \dots m$; S_j is the numerical characteristic of the development level of j -th competence; and p_j – weight factor of the degree of influence of j -th competence on the noxological content of professional competency.

Thus, using the technique suggested, the numerical values of the professional competency development level for each student were obtained and so were

the corresponding to them weight factors of the degree of significance of each competence. Next, after applying the multiplicative convolution of vector criterion with weight factors of degree of influence of each competence on the noxological content of professional competency taken into account, the corresponding professional competency development levels were obtained for each student.

The statistical hypotheses were checked stage by stage for the experimental and control groups. For more convenient interpretation of the results of analysis, the years of students' admission to the higher education institution and academic years are indexed, with the indices obtained determining the code names of the control (X) and experimental (Y) groups (Table 5).

TABLE 5: THE LEVEL OF FORMATION OF PROFESSIONAL COMPETENCY AS DETERMINED BY THE CALCULATION METHOD

<i>Parameter</i>	<i>Value</i>	
	<i>X</i>	<i>Y</i>
The level of formation of the noxological content of professional competency, K	3,14	4,18
The quantity of students having the relevant formation level, in %		
Minimum	10,7	5,1
Low	24,1	16,4
Medium	45,7	33,8
High	17,5	24,6
Top	6,6	17,5
Dispersion of values (<i>D</i>)	0,775	0,558
Mean root square deviation of values (σ)	0,880	0,747
Values variation coefficient (<i>V</i>), in %	9,4	5,1

Source: The Authors

In order to assess the differences in the level of the noxological content of professional competency, for students of experimental groups, the following criteria were used according to terms of study: *Mann-Whitney U-test* for the case of two unrelated samples, and *Kruskal-Wallis test* for the case of three and more unrelated samples. The null hypothesis put forward is $H_0 = \{\text{there are only random distinctions in the level of the attribute studied between the samples}\}$, the alternative hypothesis is $H_1 = \{\text{there are stable distinctions in the studied attribute level between the samples}\}$. Results of the calculations are given in Tables 6 and 7.

TABLE 6: EMPIRICAL VALUES IN KRUSKAL-WALLIS TEST

Sample	Study term	Degrees of freedom, k	Critical value, N_{cr}	Criterion value, H	Hypothesis adopted
$Y_{31} - Y_{43} - Y_{55}$	3	2	180,1	178,1	H_0
$Y_{32} - Y_{44} - Y_{56}$	4	2	175,4	173,4	H_0

Source: The Authors

TABLE 7: EMPIRICAL VALUES IN MANN-WHITNEY U-TEST

Sample	Study term	Degrees of freedom, k	Critical value, U_{cr}	Criterion value, U	Hypothesis adopted
$Y_{33} - Y_{45}$	5	1	175,7	170,2	H_0
$Y_{34} - Y_{46}$	6	1	171,2	170,5	H_0

Source: The Authors

CONCLUSION

After processing of the obtained experimental results, it can be seen that the experimental group shows an increase of the high (24,6 % against 17,5%) and a decrease of the medium (33,8 % against 45,7 %) level of the professional competency formation. Alongside with this, in the experimental group, the obtained variation coefficient is lower (5,1 % as compared to 9,4 %), which allows saying that it is in experimental group that the stabler results have been obtained.

Meanwhile, with the null hypothesis adopted in all end-of-term assessments at the level of significance 0,5, the effect of the experimental technique of life safety bachelors of education training can be considered similar, and the level of distinctions in formation of the noxological content of the professional competency in students of the relevant groups – insignificant. The situation gives evidence about the stable positive effect of the experimental technique on the formation of the professional competency in study groups.

Thus, the experiment conducted has demonstrated that under experimental conditions, formation of the noxological content of the professional competency in life safety education bachelors is efficient.

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