

APPROACHES TO ECOLOGICAL EDUCATION FOR FUTURE ENGINEERS

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Now there is a deepening of ecological crisis. Ecological education of future engineers can help us overcome these tendencies. In technical colleges, this type of education should be constructed on the principle of eco-centric approach. Besides, in ecological education of future engineers it is necessary to apply the theory of risk. Authors distinguish consecutive stages in forming of ecological consciousness of future engineers. Criteria and indicators of the development of ecological consciousness are determined in the research. Materials from this article represent value for teachers in technical colleges who teach ecology and for those researchers, who is dealing with problems of ecological education.

Keywords: the higher education, techno-sphere riskology, ecological training of engineers, ecological education, ecocentric approach.

INTRODUCTION

The problem of society and nature interrelation is a global universal problem, therefore the future generations as a species are doomed to physical and spiritual destruction without new way of looking at the world and a place of the person in it (Abdel Mohsen *et al.*, 2013). The solution of environmental and social problems both of global and regional scale is possible only on condition of creation of new type of ecological culture, making education more ecological according to actual needs of a person and civil society (Zhumabaeva *et al.*, 2013). The necessity of ecological education is defined by need of society to understand that people should provide the favorable environment for activity of the person. It is so because destruction of system of the ecological relationship and absence of responsibility are one of the components of global ecological crisis that can negatively impact future generations.

The difficult ecological situation which has developed in the world and low level of ecological consciousness of the population dictate need of more persistent improvement of ecological education and enlightenment (Shavaliyeva *et al.*, 2013; Berkimbaev *et al.*, 2013). One of the conditions of technological load lowering in the biosphere is increase of level of ecological consciousness of future engineers.

Therefore, training of workers of the techno-sphere who have a high level of development of ecological consciousness, who are capable to be compatible with

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biosphere and who are ready to make suitable solutions in the system “the person – the technology – the nature” becomes one of the major tasks in connection with society transition to model of a sustainable development (Ge Zhang *et al.*, 2013). However the solution of the specified task is interfered by traditionally developed technocratic bias in teaching of subjects of an ecological cycle at the institution of higher education. It is necessary to include an eco-centric component into the system of technical education as a way out that, in turn, demands development of new tasks, methods, technologies and means of ecological education of technical colleges students (Muravyeva, 2011).

METHODOLOGICAL FRAMEWORK

Eco-centric approach is a fundamental approach in ecological education of technical college students as a basic component of ecological crisis overcoming. Taking this into account ecological education of technical college students has to be based on the all-didactic and special principles:

All-didactic principles are:

inter-subject – ecological education is inter-subject in its essence as it is created on the basis of several branches of education dealing with problems of environment, such as geography, biology, chemistry, economy, law, etc.;

- systematic character and sequences – following the eco-centric logic in learning of professional knowledge, abilities, skills to form ecological consciousness;
- scientific character – use of mathematical modeling, theories of risk, modern theories of science;
- practice-orienting– creation of educational process based on the maximum use of real production and environmental problems of the region. Use of the results of work practice while writing undergraduate and degree projects. Studying of scientific ecological and technical problems at higher technical educational institution has to be carried out in close connection with reveal of the major ways of their application in production. Realization of this communication has great world outlook value. Optimum variant of realization of this principle is work practice.

Special principles of professional and eco- centric approach are:

- variability – possibility to solve ecological production problems in several ways;
- eco-centric reflection – sure justification of the safest technical solutions. From our point of view, the principle of an eco-centric reflection is very significant, and in our case it is possible to speak not just about a professional reflection, and about the professional reflection based on eco-centric consciousness. Formation of a professional and eco- centric

reflection is directly connected with integration of making technical education more ecological and ecological preparation based on an eco-centric picture of the world.

Taking into account the listed above principles of ecological education in technical colleges it is necessary to create, in our opinion, the specialized inter-subject direction considering all principles of ecological education.

RESULTS

The concept “ecological consciousness of technical college students” can be considered from two points of view: 1) ecological consciousness as integrative personal quality which characterizes activity of the person in the social-nature environment forms the valuable attitude and the demanding motivational sphere based on the influencing the orientation of students’ professional activity who have technical specialties; 2) ecological consciousness as philosophical category which characterizes specifics of interrelation of future engineers, society and surrounding environment. This category can be expressed through system of such concepts, as ecological thinking of technical office workers, their belief and principles, their ways of getting knowledge and their activity.

We defined stages of formation of ecological consciousness and criteria of development of ecological consciousness of technical college students (table 1).

Results of skilled and experimental works showed that the general target orientation on development of ecological consciousness in the student of technical specialty is realized through the solution of the following tasks:

- formation of ecological understanding of the world, knowledge, abilities and the practical skills making a basis of ecologically reasonable activity of future technical office workers;
- development of requirements among students of technical specialties, motives, the valuable and semantic orientations initiating ecologically reasonable work in a techno-sphere (Muravyeva, 2012).

The applied techno-sphere riskology works as pedagogically interpreted system knowledge which allows carrying out a pedagogical goal-setting, forecasting and modern techno-logic of ecological training of future engineers as specialists in this area, who have to be some kind of risk managers, i.e. feel dangers of modern habitat and be able to conduct them. In this case the main methodological task of training of the qualified expert is getting knowledge by him to provide collective security while performing professional activity (Masalimova et al, 2014). In our opinion it is necessary to rely, on such didactic principles as inter-subject activity and establishment of cause and effect and logical communications between studied questions, the practical orientation of training focused on formation of culture of professional safety, an eco-centric reflection for achievement of the best result in this process.

The carried-out analysis of curricula of several technical specialties showed that elements of an applied techno-sphere riskology can be introduced into various subject matters while entering an ecological component into the higher technical education.

TABLE 1: STAGES OF FORMING OF ECOLOGICAL CONSCIOUSNESS

<i>Stages of forming of ecological consciousness</i>	<i>Methods of training-educational activity</i>	<i>Kinds of activities characterizing ecological consciousness</i>	<i>Criteria of development of ecological consciousness</i>
Emotionally motivated	Dialog, consideration of problem situations, ecological and psychological training	To analyze, to create optimal conditions to techno-ecological activity, participation in solving ecological problems	Ability to find optimal balance between developed ecological situation and production demands and demands of eco-centric position
Informatively-cognitive	Lectures, conversations, consultations, discussions, «round tables» with ecologists' participation, using of computer game programs, textbooks and manuals on applied ecology	To define, to indicate, to render, to enumerate, to explain, to name, to describe the component essence of the environment	The system of knowledge, necessary for eco-centric activity in techno-sphere
Operatively-active	Visual observations, laboratory measures and analysis, modeling of ecological situations with the help of subjectively-oriented surroundings, performing of ecological monitoring	To give examples, to count, to use ready solutions, to get skills and experience of contacts with the environment	Possession of knowledge in engineering and knowledge in ecological regularities of development of the situation in techno-sphere
Person-oriented	Consultations, diagnostics, questionnaire, testing	To estimate critically, to foretell, to predict, to take optimal decisions in extraordinary situations from the point of view of person's health	Ability to predict the influence of production on people's health
Practice-oriented	Solving creative developing tasks, business ecological role-plays, directed to solve techno-sphere problems	To transfer, to transform, to prove, to estimate the significance, to predict possible sequences of production activity, to define perspectives, to project the ways and methods of activity	Ability to conduct practical researches and make conclusions about the technology load on the environment of special enterprises and techno-sphere on the whole

TABLE 2: ELEMENTS OF APPLIED TECHNO-SPHERE RISKOLGY IN SUBJECTS OF SPECIALTY «SAFETY OF HEALTH IN TECHNO- SPHERE»

<i>Subject</i>	<i>Year</i>	<i>Elements of applied techno-sphere riskology</i>
Introduction to specialty	1	Need of knowledge of the theory of risk for future profession, its role in health and safety is explained
Physics	1-2	An idea is of a minimization of risks in power balance of the biosphere is given
Economics	1	An idea of economic risk, its interrelation with technological, ecological, social risks and risk in environmental management is given
Higher mathematics	1-2	Acquaintance to mathematical apparatus for calculations of risks, a method of mathematical modeling
Philosophy	2	An idea of risk philosophy is given
Sociology	2	An idea of social risk, its interrelation with technological, ecological risks and risk in environmental management is given
Ecology	3	An idea of an environmental risk, its interrelation with other types of risks, possibility of management by an environmental risk is given
Medical biological fundamentals of health and safety	3	An idea of toxicological risk, its interrelation with other types of risks is given
Physical and chemical processes in a techno-sphere	3	An idea of physical and chemical processes in production as integral part of knowledge in the analysis of identification of technological hazards and the risk of emergence during physical and chemical modeling of emergency situation is given
Reliability of technical systems and technogenic risk	3	Bases of the theory of risk, risk analysis, management of risk, admissible risk
Undergraduate's thesis	4	The obligatory section by risk calculation, creation of treelike structure
Safety of labor	4	An idea of an assessment of professional risk for health of workers is given. Elements of management of professional risk
Academic year project on safety of technologies	4	The obligatory section by risk calculation, creation of treelike structure
Safety in emergency situations	4	An idea of risk of emergency situations and its interrelation with other types of risks is given. The risk of synergetic influence in emergence of emergency situations is considered. Management of risk in emergency situations
The system analysis and modeling of processes in a techno-sphere	4	An idea of transfer of uncertainty to category of risks for possibility of management by technogenic danger is given.
Environmental management	4	An idea of risk in environmental management, its interrelation with other types of risks is given. The risk of synergetic impact of intervention in natural objects is considered. Management of risk in environmental management

cont. table 2

<i>Subject</i>	<i>Year</i>	<i>Elements of applied techno-sphere riskology</i>
Economy and management in techno-sphere	4	An idea of risk in a control system of health and safety, an ecological situation and safety in emergency situations is given. Risk in insurance
Information technologies in management of safety of activity	4	Use of computer and information technologies in a control system of risk in the field of ecological and industrial safety is considered
Habitat monitoring	4	The risk of environmental pollution in monitoring system is considered
Examination of projects	5	An idea of need of calculation of risks of emergence of problem situations in the course of design of objects and in the course of examination of safety of the equipment and technological processes is given. The obligatory section by calculation ecological and other risks in the section "Assessment of Impact on Environment". Management of an environmental risk and risk in environmental management
Undergraduate's thesis on ecological safety	5	The obligatory section about calculation of risks, creation of treelike structure
Potentially dangerous objects	5	Calculation of risk of getting of emergency situations at potentially dangerous objects. Possible synergetic influence on arising of emergency situations at dangerous objects. Management of risk at potentially dangerous objects
Systems of protection of habitat	4-5	Equipment selection for the purpose of decrease in risk of technogenic influence on surrounding is considered
Academic year project	5	The obligatory section about risk calculation, creation of treelike structure
Final interdisciplinary qualification work	5	The obligatory section about calculation of risks, creation of treelike structure

The questionnaire answers of which let judge about the level of ecological consciousness of students was offered, and also how their eco-centric and technocratic thinking correspond for an assessment of level of ecological consciousness of technical college students. These questions were grouped in three directions: the first one characterizes an ecological orientation in future professional activity; the second one shows social-and-ecological activity; the third checks understanding of interrelation of an ecological situation and health. Levels of development of ecological consciousness by number of points are characterized on the following scale: 20–30 – low; 31–37 – below average; 38–43 – average; 44–50 – above average; 51–55 – high; 56–60 – very high.

At a stating stage it was necessary to prove kinds of activity and the criteria characterizing ecological consciousness that was made in chapter III for identification of influence on training programs development and on pedagogical technologies of technical college students realized from positions of eco-centrism. The purpose of this stage was studying of an initial level of development of students'

ecological consciousness which diagnostics showed that it approximately identical in both controlled and experimental groups.

During a forming stage lectures in ecological orientation for students of controlled group were giving according to traditional programs (subject “Ecology” – 17 hours of lectures, 17 hours – laboratory works; subject “Health and safety” – 34 hours of lecture, 17 hours – laboratory works”), students of experimental group of an ecological orientation subject were given lectures according to the programs developed by the author of dissertation from eco-centrism point of view (subject “Ecology” - 34 hours of lecture, 17 hours – laboratory researches; subject “Environmental management” - 34 hours of lecture; discipline “Examination of projects” - 51 hours of lecture, 17 hours – a practical training, a term paper; discipline “Natural hazards” - 34 hours of lecture).

The experiment showed that the 3rd year students had approximately identical level of ecological consciousness in controlled and experimental groups. Students of the 5th year showed absolutely other results. In experimental group any person didn't show the level “below average”. Besides, “average” level 22,2% was showed, the level “above average” – showed 55,6% of students, and 11,1% – a “high” level of development of ecological culture. At the same time in controlled group of 5th year students rather low results of development of ecological consciousness were shown. The level “above average” was the highest level, and only 4,8% of students showed it, “average level” was shown by 28,6%, and “below an average” was showed by 47% of respondents.

DISCUSSIONS

In psychological and pedagogical literature various directions of ecological education are presented. Integrative approach to ecological education is stated in detail in L.V. Legostayeva (1995), V.P. Maksakovsky's (2005) researches, and others. Value-oriented approach in ecological education as the most productive direction in modern pedagogics, is confirmed by V.N. Kholina (2005) and L.V. Moiseyeva's (2004) researches, etc.

In researches of scientists-ecologists A.S. Volkov (1990), A.A. Gorelikov (1996), N.N. Nikolaykin (2005), etc., different aspects of ecological education are considered.

The analysis of the maintenance of forms and methods of ecological education, the recommendation about formation of ecological knowledge, abilities of skills are submitted in S.V. Alekseev (1998), D.N. Zamyatina and A. A. Zamyatin's (2006) works.

The analysis of psychological and pedagogical literature allows drawing a conclusion that the very educational system mainly forms personal qualities and that resource which is realized in the subsequent human life is put. So, it depends on quality of education what place will people claim for in the world and by what

values will be guided. And formation or a perspective look at a course of world development, or orientation to an instant moment also depends on quality of education. Thus, education plays an important role in overcoming of ecological crisis. However value and a role of its function are underestimated.

CONCLUSION

According to the analysis of theoretical approaches and concepts of ecological education it is revealed that a basic component of overcoming of ecological crisis eccentric approach in ecological education of technical college students as is defining.

The research showed that realization of ecological education as a basic component of strategy of ecological crisis overcoming is impossible without formation of ecological consciousness among students. In this regard the necessity of introduction of an applied techno-sphere riskology as integrative factor is proved in the article when modeling the content of vocational training in a context of ecological education at the higher technical institution. Applied techno-sphere riskology is the inter-subject direction synthesizing theoretical and practical works of sciences about surrounding world in development of conscious use of knowledge of cooperation of technological, ecological, social and other factors in a risk management of difficult techno-sphere complexes.

The made experiment showed that introduction of elements of an applied techno-sphere riskology in subjects of the specialty "Health and Safety in a Techno-sphere" promotes increase of level of students' ecological consciousness.

Existing practice of teaching in many respects doesn't provide purposeful formation among technical college students the system of professionally significant ecological knowledge, questions of selection of the contents are insufficiently studied and conditions of formation of system ecological knowledge in the course of natural-science theoretical and vocational training aren't defined. Therefore, the organization of such pedagogical process which would not only form a basis for expansion of knowledge about surrounding world is necessary, but also promoted formation of eco-centric consciousness of technical college students.

Taking into account results of this research it is possible to define a number of scientific problems and the perspective directions. First of all, this deepening and a specification of some provisions stated in research (for example: application of the theory of risk in subjects of an ecological cycle among students of technical college, application of information technologies in ecological education of technical college students, etc.).

RECOMMENDATIONS

Materials from this article represent value for teachers in technical colleges who teach ecology and for those researches, who is dealing with problems of ecological education.

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