

## Formation of the Activity Component of Ecological Culture of the Future Engineers

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### Abstract

*The problem of increase of the effectiveness of ecological training of students of technical specialties of higher schools is determined, firstly, by continuing deterioration of the ecological situation in the world, secondly, by the lack of formation of the activity component of their environmental culture in the engineers-to-be and, accordingly, their lack of preparedness for the implementation of nature conservation professional activity. In this connection, the aim of this study was to find out and substantiate the possibilities of strengthening the practical constituent in the environmental training of technical profile students. The leading research methods were: analysis of literature; modeling of environmental training of future specialists; experiment on introduction of theoretically grounded provisions of activization of the learning environment into the process of environmental training; complex of author's diagnostic techniques that allow to determine the levels of formation of the components of ecological culture in students. The article presents the results of the ascertaining experiment confirming the low level of environmental awareness and activity of the position of future engineers, gives proofs of using such forms of practice-oriented learning activity in their environmental training, as participation in the work of research departments of companies, in ecology-oriented field experience and interdisciplinary research. The results of "forming" experiment have shown an improvement in the change of formation of the activity component of ecological culture of students and confirmed the effectiveness of the use of these forms in the process of training future engineers in order to form environmental culture with a high level of activity of ecological position.*

**Keywords:** environmental training, future engineer, ecological culture, ecological position, ecological activity.

## Introduction

The problem of environmental deterioration in modern civilization has determined the focus of public's attention on the questions of environmental education of younger generation. Grasping the gravity of the current environmental situation, but realizing that non-interference in the environment at this stage of development is not possible, mankind begins to strive towards developing a new concept of interaction with nature, which will allow not only to survive as a biological species, but also to keep progressing. Those objectives are consistent with the conception of sustainable development of nature and society which is based on the theory of co-evolution and which allows people to rethink their nature and role in the biosphere. In this regard, special requirements are to the graduates who get trained on technology path, as they are the force that work the technological advances in practice; society needs the specialists with knowledge of the environmental principles of sustainable nature management and, most importantly, the prospects for the creation of technology nondestructing nature. Thus, introduction of environmental science into engineering education is considered as an important trend in modern education systems; environmental training of students of technical specialties, subject to its efficient organization, it is able to lay the foundations of ecological culture in graduates and become a fundament of their professional ecology-oriented activity.

Thus, the aim of the work was to find out and substantiate the ways of improving the effectiveness of environmental training of students of technical specialties that can build up their skills of ecology-oriented behavior.

## Research methods

To carry out the experimental research, a complex of methods was used:

- literature analysis;
- modelling, experiment (implementation of the theoretically substantiated regulations of activation of the learning environment into the process of ecological preparation of students of technical specialties);
- complex of diagnostic methods for determining the levels of formation of the components of ecological culture of the future engineers;
- analysis of interdisciplinary ecology-oriented projects and reports on ecology-oriented industrial practice;
- analytical and synthetic methods of processing and interpretation of experimental results.

## Results

Ecological culture is formed in the twentieth century as a specific kind of ethics, the moral imperative [1], as a certain type of cultural reflection occurring in an era of modernization and growth of the world's population [2], when the rising expectations of mankind in the conditions of democratization are beginning to contradict the reduced quality of the environment [3].

The term "formation" in pedagogics implies a process of development and making up of a personality under the influence of upbringing, education and social environment [4, p. 384], the conscious control of the human development process or certain aspects of his personality, qualities, traits and bringing them to the planned form [5, p. 847-848]. Therefore, to form ecological culture of the future technical expert it is necessary to realize its structure.

A maximum approaching to the definition of the structure of ecological culture of personality is the definition of the notion of "environmental culture" given by Ye. V. Muravyova who understands it as an integral part of human culture, a new stage in its development, which

includes a set of ecological thinking, ecological worldview, environmental awareness with the universal values and ideals, humanistic ideas, ways of learning and activities, moral and environmental regulations and requirements which contribute to the formation of nature-creative attitude to the world [6, p. 6].

This definition and the analysis of the works by other researchers in the field of environmental education [7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17] allowed us to structure the concept “ecological culture” and combine its elements in three component blocks:

- cognitive (ecological knowledge and abilities);
- value-orientation (environmental ideas, ideals, beliefs, attitudes, reasoning, values, environmental expectations and forecasting, environmental responsibility, environmental position, motives ecology-oriented behavior);
- activity (environmental activity and behavior).

According to T.Z. Mukhutdinova, modern technosphere requires the formation of a specialist to have a high ecological culture, show his worth in nature conservation activity [18, p. 31]. Then the environmental training of engineering students should become the process of their preparation for professional ecology-oriented activity. Such activity may be the introduction, adoption and creation by the specialists of new technologies, new materials or products requiring scientifically substantiated evaluation of their ecological compatibility. Therefore, we believe that the above structure of ecological culture should be expanded: one of the elements of the value-orientation component must become expert judgments that express an attitude of a specialist to the procedures of implementation of certain technical and technological projects, and an element of the activity component - environmental examination (evaluation) that represents a scientific investigation of these issues and requires special knowledge of ecology, engineering, technology, economics and others in contrast to the environmental forecast and expectation [19].

Unfortunately, ecological culture of the future engineers continues to be characterized as an anthropocentrism. This is confirmed by three years ascertaining experiment (2007, 2010, 2013) with the participation of 2262 students enrolled in the engineering and technical specialties universities (Kazan State Technical University, Naberezhnye Chelny Institute of Kazan Federal University, Kazan State Power Engineering University, Udmurt State Technical University). The complex of the author’s diagnostic techniques that assesses the levels of formation of ecological culture of 13 components of the future engineers allowed to refer it as a whole only to a low level.

Diagnosis of the activity component of ecological culture of students based on the activity of their environmental position has shown the following results:

- nature occupies an important place in the lives of the students but most of them are not ready to give even 1% of their income to prevention of ecological calamities;
- 81% of the future specialists are ready to ignore the facts of negative impact on nature;
- 53, 3% of the respondents do not have confidence in the possibility of personal solving environmental problems;
- 78% of the respondents have a passive consumer position in the relationship with nature;
- 87.2% of the students have never undertaken anything to solve the environmental problems; among possible behavioral patterns 98% of them see their taking part in the activities on the landscaping of the city areas.

The weighted arithmetic mean allowed to refer formedness of the component of students’ ecological culture only to a low level.

Thus, at a high level of importance of environmental problems, students’ concern about state of nature has predominantly emotional character affecting little their actual behavior. Environmental inactivity of the future engineers is largely determined by the generated stereotypes in society about the need to address environmental issues to the narrow specialists. Therefore,

practical component must be strengthened in the environmental training of students; it will help to form the skills of environment-oriented behavior and learn to foresee the consequences of their professional activities.

We have carried out the formation of the activity component of ecological culture of the future experts within their environmental training in higher school in the following areas:

1. Participation in the works of research departments of the enterprises. This kind of activity can integrate the efforts of the future experts and the representatives of enterprises to solve real industrial environmental problems. Our students were involved in the activities of the research departments of the industrial establishments such as PC «PO EIAZ», LLC «SOLLERS-Yelabuga» and OGPD «Primkamneft».

2. Carrying out ecology-oriented practice in the production environment. This practice is essential, as a serious study of ecological problems of technosphere is not impossible without the students' familiarity with and knowledge of modern production. The materials materials during practice allowed the students to fulfill the tasks on preparing ecological compatibility passports, individual departments or enterprises on the whole, that is, form expert judgements and conduct an initial examination.

The result of this practice was defence of the projects. They were developed by the future engineers with the assistance of the teachers of ecology, economics, statistics, informatics and engineering disciplines, that is, interdisciplinary. The students learned to identify economic, engineering and technological compatibility of their projects for the realities of time, tried to change the elements of the project for more appropriate, justify cost-performance of innovations, carry out their primary ecological assessment.

The forming experiment was conducted for 8 years (2007-2014). For its implementation, the students grounded in the three engineering specialties were divided into two groups: control (CG) and experimental (EG). The realization of ecological training of the students of engineering specialties of higher school in the EG was carried out on the author's program including the items discussed above. The basis of the experiment was the Yelabuga Branch of Kazan State Engineering University (Yelabuga); the total number of participants - 960 students.

The levels of formation of the activity component of ecological culture of the future engineers were determined according to the activity levels of their environmental positions, the results of the defence of ecology-oriented interdisciplinary projects, on the basis of the examination of technical and technological systems, the involvement of the students in the activities of the scientific departments of industrial enterprises.

The data reflecting the results of formation of the students' activity are presented in Table 1. The detailed analysis of the results has shown that at the highest level of the meaningfulness of environmental issues (78% of the respondents) the concern about the state of nature among students from the CG has mainly emotional character, affecting little their actual behavior. The ecological position of the students from the EG the volitional component proves to be developed and expressed in concrete actions (87% of the respondents), which can be attributed to their reading environmental problem solving. The activity of their environmental position is also affected by the fact of disappearance of the stereotype of the environmental problems to be solved by narrow specialists.

Table 1. The levels of formation of students' active ecological positions according to the results of experimental work in comparison with the data of the ascertaining experiment.

Students (%)	Levels of formation of active ecological position				
	Very high	High	Average	Low	Very low
Control group (%)	6	50	34	7	3
Experimental group (%)	22	71	7	0	0
Ascertaining experiment (%)	0	12	32	42	11

The weighted arithmetic mean allowed to refer the ecological position of the students of the CG to the average level of activity, and the EG - to a high level (by 43,7% higher).

Evaluation of working knowledge of the strategies and technologies of the nature conservation activity was carried out on the results of the defence by the students of ecology-oriented interdisciplinary projects. Innovations offered in the project were given scores of 2 to 5. Score 2 characterized the strategy of the traditional use of natural resources, score of 5 - innovations, will not which implied the non-use of traditional natural resources and technologies having a strong man's impact on nature. The weighted arithmetic mean for this indicator was equal to 3,4 in the CG and to 4.5 in the EG, which confirms having by the representatives of the EG of the working knowledge of the means of ecological applicational transfer to the activity in the real life and work situations (for example, the development of environmentally friendly paint film of sedimentation tanks of drinking water, the management of waste treatment in the enterprise, the analysis of the product life cycle, and measures to increase it, the development and research of foamglass as a way of recycling glass waste (foam concrete as a way of economy of raw materials) and others).

Environmental examination by the students of their own projects, as well as technical and technological systems based on the results of the field ecology-oriented practice, evaluation of objectivity of the results of ecological impact assessment of real projects have shown that the representatives of the CG have practically no ability to assess environmental objects of the technosphere, while many students from the EG are able not only to assess their own projects but also to give a scientific assessment of the environmental expertise of the existing projects and identify some shortcomings in them.

In the research departments of industrial enterprises of the city for the experimental period none of the students of the representatives from the CG were not occupied; 27 students from the EG were their members (14 of them worked in the departments on a contractual basis).

### Discussion

The analysis of the data of ascertaining experiment and dynamics of change of the students' formedness of the activity component of ecological culture allows to note that the representatives of the EG:

- there have been major positive changes in the levels of formedness of activity of ecological position, in the ability to operate ecology-oriented technology and apply ecological knowledge in real activity;
- a system of knowledge and skills to implement the environmental impact assessment procedure has been formed.

These results allow to insist that those students working according to the pilot program are characterized by a deep insight into environmental problems, the ability to predict their development and make recommendations to reduce their negative impact.

The values of standard deviations of indicators on all exploratory procedures were in the

range of 1,77-2,20 scores, which indicates a slight spread of features and capabilities to compare them with each other. The Rosenbaum criterion for the levels of formation of the activity component of ecological culture of the students from the EG and the CG exceeds a critical value and confirms their essential difference and conditionality of these differences by innovations in the educational process. The duration of the experiment confirmed the repeatability of results.

### **Summary**

1. Modern society needs engineering specialists in the field of technology who are ready and able to carry out professional ecological activities. Therefore, the process of environmental training in higher educational institutions should have a practical orientation.

2. The results of the ascertaining experiment confirm a low activity of ecological position of the future engineers, their detachment toward the environmental problems and reluctance to participate in preventing them, which required the modernization of the environmental training process.

3. The practical component of ecological preparation of the students of engineering specialties of higher schools can be intensified by having been included ecology-oriented industrial practice, interdisciplinary designing, as well as the involvement of the future engineers into the work of research departments of industrial enterprises.

4. Such changes in the structure and content of ecological preparation of students have improved their activity of ecological position by 43.7% (compared with the control groups), formed their vision how to apply the acquired environmental knowledge in the professional activity.

### **Conclusion**

The key category of engineering environmental education aimed at the formation of a specialist who is engaged in ecology-oriented profession, is an ecological culture. It is the result of man's impact on his habitat and his desire to avoid the negative results of this impact. This desire may find expression in the formation of specialists able to create technology ecologically friendly to natural environment. Educational institutions can turn out such specialists provided the changes of content and environmental training structure in them; it should be professional and practice-oriented and engage the future expert in solving real environmental problems. Under these conditions, a graduate will not be a passive observer of environmental degradation, but on the contrary, be able to express his environmental position in specific professional activities.

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