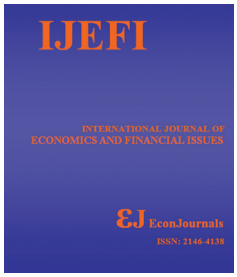

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Integrative-project Model of Environmental Education in the Training System of the Students

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ABSTRACT

During the process of transition of Russia to a model of sustainable development, environmental education and population enlightenment become the first priority. The principles and objectives of environmental education should be formulated in accordance with the social order, which is given to the education system from the whole society: The formation of a harmoniously developed personality as an ideal and a supreme value. In this case, the education of a rational attitude to nature is seen as a component of personal diversification. In this regard, an urgent analysis is required by the questions of selection of scientific material in the content of academic disciplines, methods and technical means of its transmission. The integrated education is the foundation, the heart of understanding the problems of development of both the person and the environment. We have worked out an integrative-project model of environmental education of university students, which is based on didactic principles of environmental education: Scientific, systematic, continual and consequential, integrative, linking theory to practice, problematic, the principles of professional orientation, activity, regionalization, humanization and humanitarization.

Keywords: Higher Education, Professional Competency, Integrative, Environmental Education
JEL Classifications: P36, I2, I24

1. INTRODUCTION

The modern environmental situation has created a trend of a rapid growth of different areas of modern science about nature. At the same time there are qualitative changes in the overall structure of the natural sciences. The significant shifts in the direction of scientific knowledge re-evaluation in terms of its environmental significance in modern educational theory and practice have happened. Ecological knowledge becomes the object of study for the researchers from different fields of science and serves as a necessary condition of harmonization of interaction between the nature and society. However, the dissection of knowledge into separate subjects is not balanced by the current level of their integration. The integrated education is the foundation, the heart of understanding the problems of development of both the person and the environment (Robert, 2014; Voytovich, 2014).

The foundation for understanding the problems of both the development of a person himself and the protection of environment is a qualitatively different, integrated education. Education in its essence cannot be different, but the current realities of the educational process, the strongest differentiation of knowledge,

that eliminated an integrating trend greatly, puts the mankind before the need to implement the sustainable development strategies. This process requires new knowledge about the environment, new technologies, and new norms of behaviour. The role of the compensator of the present subject teaching shortcomings and the identifier of the way of entire science education transformation - ecological and ecological-chemical in particular - should be played by such a method of learning that is based on the principles of integration.

The future teachers training plays a significant role in the system of ecological education at higher education institutions; therefore, teacher training will largely influence trends and parameters of human environment in the future (Alehin, 2014). The effectiveness of ecological education and upbringing of students depends not only on meaningful disclosure of the specified range of issues in curricula and textbooks, but also on the level of the teacher's readiness to pedagogical work in the organization of the students' ecological culture.

The science of teaching explores the content, forms and methods of environmental education. The teacher's attention is focused on the search of the most effective means of optimization of the educational process; consideration of the essence of interdisciplinary skills and integrated operations; principles of selection and presentation of scientific concepts and theories, and so on. An important place in today's research is given to noospheric education and others.

New social requirements to education establish the need to prepare environmentally clever young generation, capable to implement an environmental-oriented approach in interaction with natural objects. This area has become the purpose of our research.

The theoretical significance of the research is to identify organizational and pedagogical conditions, able to form an ecological competency of students on the basis of an integrative-project method; to justify and develop the pedagogical technology of the process of realization of the model of ecological competency formation of university students on the basis of an integrative-project method, which is designed to solve one of the urgent problems of pedagogy and is brought to the level of practical implementation by the author; to extent theoretical ideas about the role and the place of ecological and chemical perspective in the complex of sciences taught at higher vocational and secondary schools; and to expand the research improving the professional competency of specialists.

The practical significance of the research is that the pedagogical technology and the model of university students' ecological competency formation, developed by the author, will create a holistic, integrated educational process of studying the chemical foundations of environmental problems in the blocks of natural-scientific, professional and humanitarian disciplines (Nelyubina, 2005).

The use of technology of ecological competency formation has raised the level of environmental knowledge of students from different areas of training, increased their interest in studying environmental issues, human health, the practical implementation of received knowledge in future professional activity.

The methodological foundations of the study are: (1) Philosophical theory about the evolution and philosophical theory of activity; (2) philosophical foundation of education; (3) principles of psychology and social psychology; (4) theory of education for sustainable development – desmoecology; (5) differentiation of education and the organization of creative activity of students; (6) the idea of humanization of education and its humanistic orientation; (7) the theory of the system approach; (8) the theory of students' education and pedagogical integration; (9) the concept of modeling and design of the pedagogical process; (10) the idea of personally-centered professional education; (11) the theory of selection of educational content.

2. MATERIALS AND METHODS

While solving stated problems and checking assumptions we have used such methods as:

1. Theoretical, that includes the analysis of literature; the study of legislative, normative and program-methodical documents and materials in the field of environmental and ecological-chemical education; forecasting, design, simulation and others;
2. Experimental: Direct and indirect pedagogical observation, questionnaire, pedagogical experiment, studying the best teaching practices at schools and universities, tests and creative work (projects) and others;
3. Quantitative and qualitative analysis, processing and integration of data: Methods of mathematical statistics, component analysis, digital, graphic and verbal presentation of information, methodical data analysis and others.

3. RESULTS AND DISCUSSION

The current state analysis of the problem of environmental and ecological-chemical content of education in the context of the processes occurring in the system of national education showed a change of aims, objectives and the content of environmental and ecological-chemical education in the late 90-ies of the 20th century (Galkina, 2014). The role and the place of ecological-chemical education in the process of professional training of future specialists were analyzed, and also the questions of professional competency of the graduates were considered (Kivlyuk, 2014). Thanks to this system analysis it was proved that the basis of formation of the future specialist's ecological competency should be the integration of educational content (Kuznetsova, 2014).

It should be emphasized that environmental education in higher education is conducted in several directions today: (1) The teaching of ecology as a separate discipline, (2) the consideration of environmental issues in basic science courses, (3) designing interdisciplinary courses according to the students' choice, examining some issues of environmental protection in details (Nelyubina, 2005).

Environmental education is impossible without attraction of data of a wide range of scientific disciplines, first of all, chemical, because chemical interactions are the basis of life processes (Stetsenko and Yaschuk, 2014). The knowledge of the chemistry of environmental processes is a necessary and a very important part of environmental education (Galkina, 2014). Constant chemical reactions and transformations in nature connect all the items within it into the organic whole (Chebykina and Bobkova, 2014). Every environmentally literate person should be clearly aware of the fact how his environment is arranged from the chemical point of view; understand the risk degree of human chemical work in the biosphere; be able to estimate the ecological-chemical problems soberly and adequately and find reasonable solutions. These tasks may be solved within the framework of the ecological-chemical education as a required structural component of the entire environmental education complex.

The integration of scientific knowledge plays an important role in environmental education and training (Kivlyuk, 2014; Robert, 2014). The main forms of integration of ecological knowledge can be realized in a single subject, a multi-subject and mixed models of environmental education. The mixed model of environmental education is the most favourable for the formation of the integral system of environmental knowledge. It involves the ecologization of subjects according to their functions in environmental education and further study of integrated environmental courses. The successive realization of the stages of ecological knowledge integration is very important. In developed countries a common form of integrated approach in environmental education is the use of conceptual educational models (a "modeling" in a broad sense). It opens a great prospect of knowledge integration in the area of monitoring studies, which include a wide range of methods: Observation, estimation, forecasting and designing environmental conditions.

The changing concept of education, which determines the new content of education, the introduction of new subjects make a teacher adapt quickly, learn new content, master different innovative technologies, create his own versions of organization and methods of education and training according to socio-psychological, cultural and economic changes, typical of Russia in the 21st century (Mukhamedzhanov, 2014).

One of the factors of improving the quality of education is the professional competency of a graduate. The concept of a professional competency is multifaceted and multidimensional, it changes in accordance with the changes in society, education; it is seen from different points of view (Bobkova et al., 2015).

The relevance of ecological training of the future specialists allows us to conclude that the environmental competency must be one of the elements of the graduate's competency. The problem of formation of ecological competency refers to the outstanding problems both in the pedagogical science and practice. The concept of ecological competency, the content, nature and structure, the developed system of criteria of efficiency of process of ecological competency formation are not defined (Bobkova et al., 2015).

We believe that the main focus of the training should be a practice-oriented activity-based approach, which implementation is possible in the framework of the implementation of the project-based learning.

The ecological competency creation, in our opinion, should govern the study of the whole complex of scientific, professional and humanitarian disciplines of the curriculum, and requires the development and implementation of new teaching technologies that are appropriate to the current objectives of environmental education. Solving ecological education problems is indispensable to fulfill the main task of teaching which is to provide students with deep, solid professional knowledge.

An integrative-project method is an integrated interdisciplinary methodology, emerged at the intersection of pedagogical, didactic, natural, technical and social sciences (Nelyubina, 2005).

The core of an integrative-project method during the study of chemical principles of environmental problems is the system of leading ideas (informatization, technologization, computerization, integration, differentiation, optimization, continuity, humanization, individualization).

We have developed a model of an integrative-project method of ecological competency formation of high education establishment students in the study of chemical principles to environmental problems (Figure 1).

The model was based on the following main didactic principles of environmental education: Scientific, systematic, continual and consequential, integrative, linking theory to practice, problematic, the principles of professional orientation, activity, regionalization, humanization and humanitarization (Nelyubina, 2005).

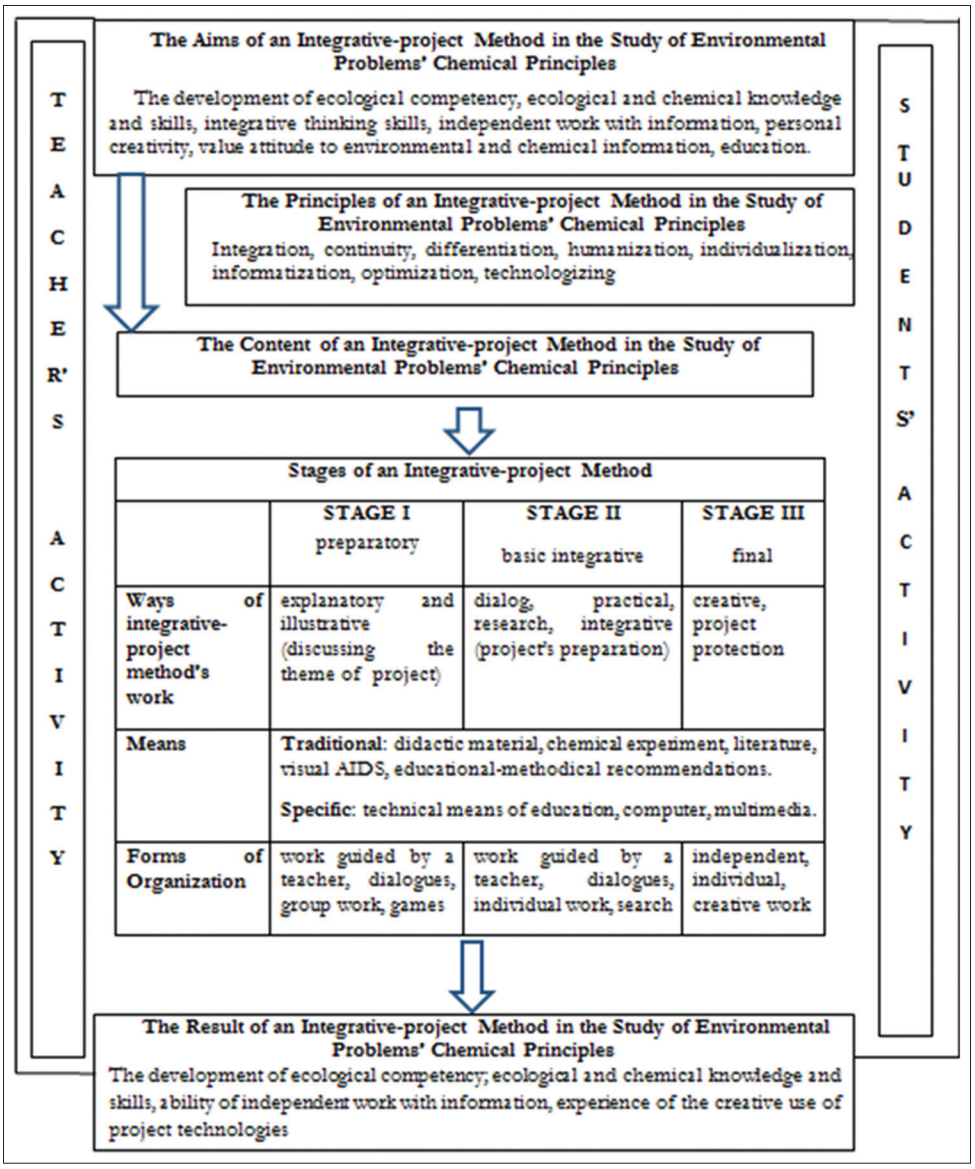
The model includes: Target component, principles, contents, organizational and methodical complex, the activities of a teacher and students, effective evaluation component, program-methodical support.

Each stage of the model of integrative-project work has its own specific aims, objectives, content, and appropriate comprehensive methodology.

To achieve the objectives of the first educational stage one can use a complex of traditional methods and tools. An integrative-project method is stated as the main method of integration. It is based on explanatory and illustrative mean at the first stage. It involves the consideration of chemical-transforming human activity from the perspective of implementation of fundamental knowledge in chemistry. There is a reliance on scientific knowledge acquired by students during the study of systematic courses of chemistry and ecology. Prescription and search empirical methods are used as subsidiary ones. They are applied at the stages of realization of project ideas.

A complex of methods is used to manage integration processes of learning. They are the methods of demonstration experiment

Figure 1: The model of an integrative-project method of students' ecological competency development in the study of the chemical principles of environmental problems



and practical work, didactic games, abstract journals, creative experimental tasks.

Trying to achieve the objectives of the second educational stage a complex of traditional ecological and chemical education methods is also used, and specific methods and tools (interactive, practical) are used as well. As the main method of integration one uses an integrative-project method, envisaging an examination of the possible diversity of qualitative and quantitative tasks at this stage, which solving helps to overcome environmental problems. In this case, one relies on the knowledge of thermal effects of chemical reactions, quantitative chemistry, qualitative and computational challenges in ecology, environmental laws and regularities (Nelyubina, 2005).

The third educational stage of an integrative-project method is exploratory in nature. This phase flows into a project protection. Conclusions of the project are a tool for mapping existing and planned phenomena and processes. The activity at this stage is based on ecological and chemical knowledge and project knowledge acquired at the previous stages of education.

The main method of educational process management is an independent learner-motivated integrative-project activity of students, carried out individually or as a part of a project team. The teacher plays the role of a colleague and a consultant. The project activity of students, which is mostly imitative at the first stages, gradually becomes independent and truly creative. There is a logical development from imitation and copying to truly creative work through the creative imitation and imitative art. Between the extremes there are intermediate, transitional forms of activity through which the imitation and creativity become interrelated and mutually penetrate each other. The students' ability to apply an integrative-project method in their further professional activities is ensured by the achievement of the previous stages; first of all, the emergence of students interest in chemical and

environmental transformation of the world, readiness to form the idea of ecological and chemical-project opportunities' space.

The project work has the following organizational stages: Initiative, organizational, informational, design, executive, theoretical and reflection, project protection.

The result of the use of an integrative-project method is the formation of ecological competency of students, which includes new personal qualities as a system of specific knowledge, skills, reproductive and creative project activities' experience, value orientations in relation to the objects of nature and processes in the environment that underlie the design, traditions, innovations, morality, responsibility for developing projects and actions of their realization, considered as the elements of ecological competency.

None of the traditional disciplines can take the responsibility for the formation of ecological competency, since each subject, deepening the environmental component, only fragments a holistic scope of environmental education; that is why the interpenetration and interaction of social, biological and ecological, chemical, social-ecological, didactic and pedagogical-professional knowledge define the structure of the content of environmental education.

In this case it is necessary to study the global environmental problems: Climate changes, energy problem and its adverse impact on the environment and humans, conservation of biodiversity and biological productivity, population growth and food problems, as well as the ecological conditions of Russia and the region. An important research area should be the study of environmental problems of atmosphere, hydrosphere, lithosphere and human's health. One should draw attention to the distribution and accumulation of different kinds of anthropogenic pollution in natural objects and human body, first of all, the most common and dangerous ones. It is important to show the chemistry of the radionuclides migration routes in ecosystems and landscapes and chemical mechanisms of their penetration into the human body.

The most appropriate way of study of these questions is the use of an integrative-project method.

Such organizational forms as an experiment, environmental monitoring, laboratory and practical work are very important in the design and study of ecological and chemical questions. Considering the importance and value of laboratory training, we have worked out a system of laboratory and practical activities.

Using the model of ecological competency development of students we have worked out educational-methodical complexes (programs, factual material, laboratory and practical work, the system of test tasks, tasks with environmental content) for the students of the Department of Natural Sciences and Geography of Samara State Academy of Social Sciences and Humanities and Samara Cossack Institute of Food and Business Industry.

Students of non-chemical specialties have some peculiarities in theoretical course and practical work due to the lack of biological training.

Since most global and regional environmental problems have a distinct geographical character, the training of future specialists needs practical approach of the acquired knowledge in addition to learning theoretical issues of the general geochemistry, geology, ecology, biogeochemistry, soil science. In accordance with the model a significant role in solving this problem is given to the chemical and ecological environmental monitoring and the application of various physical-chemical methods of research of water, air and soil environments (Nelyubina, 2005).

The study of all disciplines is impossible without the active independent work of students in extracurricular time. As you know, independent work of students is one of the most effective means of active self-education of personality, the formation of independent creative thinking, further self-education. An integrative-project method is one of the ways of formation and development of ecological knowledge, abilities, skills and raise of the level of the students' readiness to apply the acquired knowledge in future professional activity. It uses various forms of extracurricular independent work:

- Study of basic and additional material in books and tutorials,
- Reading and study of original literature at the library,
- Working on the computer,
- Writing research papers,
- Working out and execution of projects.

More than 500 students were engaged in a pedagogical experiment to determine the effectiveness of the learning material according to the developed model of ecological competency formation of students. The study was conducted using longitudinal methods: All groups of students were considered as experimental. Therefore, in most cases, their achievements have not been compared with control groups, but only the dynamics of personal achievements was tracked; its nature allows judging the effectiveness of an integrative-project method of teaching.

According to the structure of ecological competency we have chosen means and have formulated criteria for the diagnosis of the formation of the elements of professional-content, professional-active and professional-personal components. A diagnostic role was played by the tasks on reproduction and implementation, valuable choice tasks, "neutral" and "independent" tasks, the solution of problem and research objectives, questionnaires, tests, interviews and observation.

Current, intermediate and final assessment using tests were carried out for monitoring and evaluation of the level of students' ecological competency formation. The initial and the target qualities of the knowledge level were investigated using the test tasks with self-designed and sample answers.

The results of the final test studying the training-content component of environmental competency showed that the level of student's knowledge increased in all blocks of the proposed questions (Table 1).

The students' readiness to environmental education and cultivation of the qualities necessary for practical environmental activities,

Table 1: The average grades of the student's executed tests

Knowledge level	Average data t_{cr}	Academic year			
		2011-2012	2012-2013	2013-2014	2014-2015
Ecology and environmental management profile					
Initial	3.28	3.18	3.24	3.29	3.32
Final	3.51	3.27	3.43	3.54	3.53
Biology and chemistry profile					
Initial	3.33	3.24	3.32	3.39	3.33
Final	3.58	3.25	3.48	3.67	3.81
Geography and biology profile					
Initial	3.23	3.25	3.23	3.27	3.32
Final	3.43	3.46	3.40	3.47	3.53

is a crucial criterion of their ecological competency. Therefore it was necessary to search out the presence or absence of motivation for environmental education of students, their aspiration to comprehension of ecological knowledge, i.e., to study the initial level of vocational-activity component of environmental competency.

At the first research stage the study of professional and personal component of environmental competency included the clarification of value orientations of students and motivation in the choice of occupation.

The study of motivation in the choice of occupation was carried out using the method of questioning based on the principle of opposites, which reveals the "weight" of the various motives in their general scheme within the general orientation of the student to the values, goals and ways of achieving them. The analysis showed that the 1st year students expressed the motives of activity the most clearly, which incite to consume spiritual and material goods. They are "to see the results of one's work," "work suits my nature." For senior students the most important features in future work are presented as "the consciousness of the public importance of one's work," "creativity," "opportunity to do what one likes," i.e., for graduate students a position of a professional is typical.

Value orientations, characterizing the graduate's degree of assimilation of human values, are expressed in his selective attitude towards reality, public relations, people and himself; are the backbone for humanistic - including environmental - orientation of the future specialist.

The study of value orientations was conducted on the students of the Department of Natural Sciences and Geography of Samara State Academy of Social Sciences and Humanities and Samara Cossack Institute of Food and Business Industry. It can be stated that during the training at high school students have a change of values. Weather at the first place the freshmen have their self-esteem by the criterion of expressiveness in the world of the mastered culture in the area of their value qualifications, the graduates already understand that a full life is possible only in a "healthy" environment.

4. CONCLUSIONS

The analysis of the research results confirms the hypothesis fundamentals and allows us to formulate the following conclusions.

Being based on the comprehensive analysis of the main environmental education trends there have been revealed a mismatch between the society demands to modern level of specialists' ecological knowledge and upbringing of the young generation at the high education institution. The study of the students' initial competency level of environmental issues showed an extremely low level of their knowledge and preparation for the study of chemical principles of environmental problems.

A model of ecological competency formation of university students, basing on an integrative-project method in the study of the chemical principles of environmental problems, was developed. The pedagogical technology of this model's implementation was developed and tested. An optimal set of organizational-pedagogical conditions and means of students' ecological competency formation was identified and determined.

The possibility and expediency of the use of project method as a part of the system of students' academic work during the classroom and extracurricular activities in the students' ecological competency formation were justified.

The specialized educational-methodical complex for the process of formation of ecological competency of the future specialists was developed and tested.

The results of the pedagogical experiment confirmed our hypothesis and showed the effectiveness of the technology of implementation of the model of the university students' ecological competency formation by means of an integrative-project method, its positive effect on the quality of knowledge of environmental and chemical issues and positive changes in personal relationships to the environment, as the basis of human life.

The research does not cover all the aspects of such a complex and multifaceted phenomenon as ecological education and education of the youth, as the future development is required by:

- Interconnectedness of all academic disciplines of university students' training;
- Complex instrumental monitoring of quality of the comprehensive training of future specialists on environmental issues;
- Relationships between the governmental and executive organizations, media and numerous public organizations that can provide educational services to all categories of citizens.

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