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ISSN 2080-9069
ISSN 2450-9221 online

„Edukacja – Technika – Informatyka" nr 1/23/2018
www.eti.rzeszow.pl
DOI: 10.15584/eti.2018.1.25

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The Methodology of Professional Competencies Formation for The Specialists in Environmental Monitoring on the Basis of Synergistic Pedagogics

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Abstract

The issues of professional training for future environmental engineers training are considered in the article. The methodical bases of teaching environmental monitoring have been developed and substantiated for the application in the learning process through the implementation of interdisciplinary approach. The basic components of training future environmental engineers have been defined and analysis of the formation of professional system-modeling competencies in environmental monitoring have been conducted.

Keywords: integrated education, professional competences, interdisciplinary connections, environmental monitoring

Introduction

To prepare future professionals with advanced environmental system thinking, ability to solve environmental problems quickly it is necessary to improve the technology of training that will increase the quality of education. The implementing multidisciplinary approach to learning will promote development of professional competencies of future environmental engineers. Rational use of the potential of fundamental natural sciences courses will lead to systematic, consistent, continuous learning and acquiring necessary competencies and thus to increased volume of knowledge, obtained by students. The course "Environmen-

tal monitoring" is a synergistic complex of natural sciences and professional practical training. Thus, the formation of professional competencies of future environmental engineers using interdisciplinary connections within the course content of environmental monitoring is important.

Main part

Theoretical and methodological issues of interdisciplinary connections integration in structural and logical scheme of the content of theoretical and practical professional training are considered in the work by Goncharenko (1999), Zverev (1981) and others.

The problem of the application of the interdisciplinary connections integration in the study of natural sciences and humanities was studied by Maksymova (1981) and others. The issues of the specialists' competencies formation, implementation of competence approach in higher education standards were covered in the papers by Ridey (2014) and others.

Introduction of fundamental courses in education is aimed at thorough students training under the conditions of mobile market of intellectual labor that determines the level of competitiveness; transition from the information-disciplinary approach to interdisciplinary knowledge, to mastering the methodology of the course, and to the intellectual foundations of future professional activity; intelligent educational and information technologies application; obtaining high-quality fundamental results (Biletska, 2014). The international community also drawn attention to this issue, as it was noted in the joint declaration of four ministers (Sorbonne, 1998), the Ministers' communiqué (Prague, 2001), the Berlin Communiqué (Berlin, 2003) and other European integration documents (Ridey, 2011).

The article is targeted at the substantiation and development of methodical principles of interdisciplinary interaction in the specialists training to obtain multifunctional professional competencies in environmental monitoring.

The course "Environmental monitoring" is of primary importance in the training of future environmental experts, in the process of this course mastering the students acquire professional competence – the ability of an individual to acquire professionally profiled knowledge and practical skills, to determine the environment quality parameters and conduct the environmental analysis based on these results, substantiate the direction of usage and optimization of natural eco- and geosystems; identify and evaluate the efficiency of environmental activities in order to prepare reasonable regional programs and projects as well as for making appropriate management decisions (Bordiuh, 2016).

While developing of the course "Environmental monitoring" the courses, which provide previously generated knowledge and skills and interdisciplinary links between them were defined (Fig. 1).

During structural and logical analysis four main content blocks of interdisciplinary implementation:

1 – fundamental – "Physics with Fundamentals of Biophysics", "Biology", "Chemistry", "Environmental Science", "Hydrology", "Soil Science", "Topography with Fundamentals of Cartography", "Geology with Fundamentals of Geomorphology", "Meteorology and Climatology" that form general natural scientific competencies, including the ability of ideological orientation and structural and functional interaction within the system "man-society-nature" through chemical, physical, biological, social and political processes and phenomena; and ability to assess critically the safety of scientific and technical progress of the society and on the global scale (Ridey, 2014);

2 – evaluation – "Higher Mathematics", "GIS in Environmental Studies", "Standardization of Anthropogenic Impacts on the Environment" that develop mathematical, axiological, quality assessment ability to solve certain environmental problems, in particular to assess the reliability and detect changes; acquire skills of collection, critical analysis, adequate assessment of information and mapping using modern GIS technologies;

3 – applied – "Technical Ecology", "Urban Ecology", "Agroecology", "Environment Protection Technologies", which form the ability to assess the impact of hazards on the environment, identify and develop measures on the protection of natural resources and greening of industrial production;

4 – system-modeling – "Modeling and Forecasting of the Environment Condition", "Fundamentals of Scientific Research", "System Analysis of the Environment Quality", which provide the ability to use an ecosystem approach for analysis, diagnosis, prognosis of environmental issues, development and justification of measures to prevent hazardous situations and events; practical development of socio-economic and environmental monitoring systems; implementation of environmental system analysis components for the purpose of modeling different scenarios of natural and anthropogenic processes.

Due to the forward and backward linkages knowledge and skills of the students are deepened, systematized, generalized, and combined to form single, coherent system for environmental specialists training.

Professional training of future environmental engineers on the course "Environmental Monitoring" will consist of the following components:

1 – formed basic competencies in related disciplines, including: general scientific, social and individual, environmental, mathematical and computer literacy, intellectual;

2 – competencies that are formed while studying environmental monitoring – instrumental, general applied, legal, environmental, workable and creative, which are system-forming;

3 – based on system-forming links, the study of the 3rd block courses will form applied competencies;

4 – at the final stage of future environmental engineers training, system modeling links will be generated and the following competencies formed: analytical and forecasting, research, specially-professional.

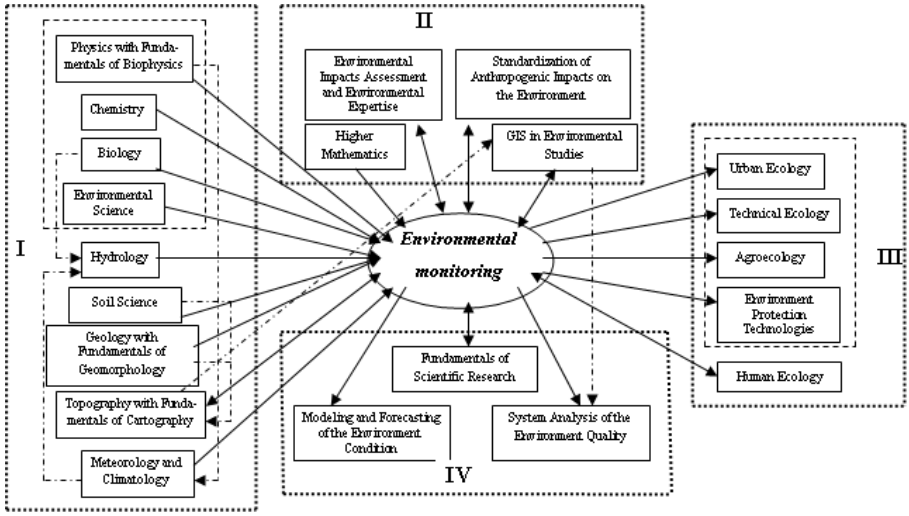

Fig. 1. Interdisciplinary connections of the course "Environmental Monitoring"

I – fundamental; II – evaluation; III – applied; IV – system-modeling;
direct links feedback links relevant links
multilateral relations

Every theoretical lecture and laboratory or practical work on environmental monitoring should be started with systematization and generalization of previously acquired knowledge, skills, and abilities of the previous topics to provide implementation of intercourse links. All topics, discussed in the intercourse relations are interconnected, creating the structure of new knowledge and the formation of professional outlook, future environmental responsibility. In order to prevent the introduction of the general courses or very specific courses into the training process, one must use various technologies and methods of integrated education.

For holistic perception of educational material by students it is appropriate to use an integrated approach, including organization and conduction of binary classes. By combining related material from several courses, it is possible to integrate knowledge from different courses to solve a problem. The conduction of these types of studies will facilitate systematization, generalization of previously obtained knowledge from related courses, acquisition of material and expansion of the information received that enhances learning and development of the skill to apply them in practice, increased cognitive activity, creativity, communicative ability and motivation to learn. Educational purpose of these types of studies is to develop professional applied, special, system-modeling competen-

cies in monitoring of sustainability through the interdisciplinary implementation of relevant courses of continuous training of future environmental engineers in the process of theoretical study, individual practical activity, reasoned dialogue and joint research of professor and students.

Ability to scientific knowledge acquisition and creativity of future ecologists will manifest in the performance of interdisciplinary term paper on environmental monitoring on the subject "Homeland" which includes not only environmental and geographical description of the area under investigation, but also development of the natural environment components monitoring system and determination of the diagnostic methods and instruments for the given parameters of environment components in the developed system, formation of legal, methodological and information support of the system. Later this term paper will be the basis for writing diploma thesis.

With this approach to the training of specialist in environmental monitoring, future environmental engineers will have formed ability to use the ecosystem approach for analysis, diagnosis, prognosis of environmental issues, development and substantiation of measures to prevent hazardous situations and events; to develop systems of socio-economic and environmental monitoring; to perform environmental components systems analysis for the purpose of modeling different scenarios of natural and anthropogenic processes; to analyze and develop measures to reduce the impact on the environment.

Conclusions

Thus, this study contributes to the development of methodological principles of providing content of training future professionals to obtain multifunctional professional competencies in environmental monitoring as a result of interdisciplinary integration. Professional competencies of each content-thematic modules of natural science and profession-oriented cycle of teaching environmental monitoring have been specified. The established types of intra- and interdisciplinary links should be accounted in the process of teaching environmental monitoring to the future specialists in ecology with scientific and methodological support.

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