

GIVING SPECIAL ECOLOGICAL COURSES WITH INTERACTIVE APPLICATION OF CARTOGRAPHIC MATERIALS AND GIS-TECHNOLOGIES AT ALTAI STATE UNIVERSITY

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During several years Environmental Mapping Course, with laboratory and practical training, is given for geography and ecology students of Altai State University. The course given within a semester covers studying main directions of nature management and environmental mapping using GIS-technologies. On laboratory studies students are trained to make maps using model situations for abstract territories as well as real data for territories of Altai Krai. Map-making teaching is based on the landscape approach to study land-use problems and to assess the terrestrial environmental conditions. Ways of map representation of anthropogenic and industrial impact on landscape for different forms of nature management are worked through. Methods of making map of natural resources, their usage and conservation are under study as well. Successful perception of the course by students occurs due to complex usage of many subjects, such as physical geography, biogeography, earth research, landscape study, basis of nature management, economic geography, ecology, etc.

At present we are making perfect a complex practical training which combines environmental mapping with practical studies on a few special subjects, namely landscape planning, quantitative methods in geography, the basis of informatics, etc. Students will be able to apply knowledge acquired when they carry out projects for term paper and diploma thesis.

Spatial relations between nature and society, their dynamics and prediction of situation development are best studied with the use of cartographic materials. Any map is the unitized graphical-symbolic model of spatial data organization and at the same time an information source for territory analysis, therefore cartographical information is actively introduced into educational process and various disciplines.

Initially the environmental mapping is based on theoretical, methodical and practical developments of such "hottest" in modern geographical cartography research trends as nature protection, landscape- ecological, medical- geographical, water-ecological, recreational, nature management ones, etc. The priority-driven conceptual lines in environmental mapping are biocentric, anthropogenic-and demo-centric, geosystem and synthetic ones.

Current development of environmental mapping is realized in various thematic fields and manifested in the construction of different types of maps, i.e. from inventory up to integrated and synthetic maps of evaluation and predictive content. The present-day interpretation of ecology (that is the relationship between any organism and the environment, and the position in the system of geographical cartography and geographical studies on the whole) determines the environmental mapping structure. At the same time, the environmental-geographical mapping development is closely linked to the formation of geoinformation cartography as a new stage in cartography that allows to state that ecological-geographical geoinformation cartography defines state-of-the-art means and modes of representation of studied regularities of any geographical object, process or phenomenon development. For the last 20 years numerous ecological maps that represent the world, continents and states, different regions and political units have been constructed. A set of ecological atlases and maps devoted to studying the environmental problems were created. Special courses on environmental conditions are taught to students from Geographical and Biological Departments of the Altai State University. Giving lectures on various ecologically-oriented disciplines is supported by ecological maps that are perfect visual aids. During seminars and practical works maps are used as an information source, as an element

of prevailing cartographic method for studying and analyzing the spatial situation, as well as a systemized and visualized representation of the quantitative assessment outcomes at geocological analysis of a territory.

When teaching special ecological courses, it is reasonable to use cartographic method for the environment study. For instance, successful perception of a special course "The environment state" by students accounts for not only the integrated knowledge of all previously studied disciplines (physical geography, landscape science, nature management, economic geography, etc.) but also due to active-interactive use of information represented on ecological maps. Interactivity implies the cartographic method application. Practical training on "The environment state in Russia regions" course taught at Geographical Department were elaborated on the base of the ecological maps constructed, i.e. "Integrated zoning of Russia territories by ecological and social-economic situation", "Ecological map of Russia", more than 50 maps specified in A.G. Isachenko monograph "Ecological map of Russia" including maps published in atlases, research and educational editions. Practical works' goal is the fulfillment of complex study works on the description of ecological situation in Russian regions, practice-oriented tasks on the comparative analysis of environmental problems in various administrative and natural territories.

The training in creation and use of environmental maps is one of the difficult-to-formalize processes of learning. The special course "Environmental mapping" is aimed at theory and practical skills acquirement in construction and application of practice-oriented maps. The taught course is based on the knowledge of the disciplines previously studied, i.e. physical geography, earth science, biogeography, landscape science basics of nature management, economic geography, ecology, cartography, etc. When mapping ecologically important processes (atmospheric emission, river pollution by waste waters, soil cover degradation), one can get a visualized representation of ecological situations formed in different regions. It should be noted that many methods applied to assess the environment state of territories are at the same time the methods for the construction of some maps or series of maps or atlases.

Initial acquaintance with ecologically- and nature protection -oriented maps is made through the use of maps currently constructed for various administrative regions of Russia , the territory of the Russian Federation and foreign countries. The plan for maps' description and analysis including key points of their content has been developed. The plan has a detailed system of headings with brief comments and explanatory notes to achieve better map analysis. The plan includes the following sections:

- output data;
- legend study including its type determination, construction peculiarities, graphic design techniques, scales use, color design;
- description of map's content generation modes;
- choice of the method for specific map construction;
- map arrangement by subject area, information generalization level, general or component type of the given map including other classifications (basic maps; maps of pollution and the environment disturbance; evaluation, predictive, recommended, etc. maps);
- map information perception with further revealing general regularities of the mapped object occurrence;
- revealing the problems related to material description, good and poor representation.

To describe thematic content of a map, the independent detailed structure including the issues of incorrect info representation for characterizing of the nature phenomena and conditions, population and economy, component-by-component description of resource use and state,

pollution, sanitary-hygienic assessment of a territory, nature-protection strategy and integrated environmental assessment of a territory is used.

Such an acquaintance with map content along with concurrent analysis of the available maps gives a visualized notion as on the environmental mapping, as on the approaches to map construction including practical application trends.

The teaching experience allows us to adapt the "Environmental mapping" course given for geographers and biologists-ecologists, though some problems do exist. For example, this course is given to geographers just after studying the basic subject "Cartography", however according to the curriculum it is taught before or concurrently with other disciplines closely related or even basic ones for environmental mapping, e.g. landscape science, geoecology, nature management problems, etc. that complicates the understanding of ecological peculiarities of geographical objects and making analysis. Therefore, some time is found for initial acquaintance with terms and basic concepts of ecology as a science, and geoecological analysis as a general-purpose approach to the assessment of the environment state.

A special course "Ecological Mapping" is included into the ecological practical training session for biology students within the 8th semester (the fourth year). By then the students have a sound knowledge to carry out the practical work on ecological mapping. This allows the practical work to be interpreted and complicated according to the students' interest to the assessment of the environment state of the territory or single geospatial objects, the revealing of ecologically stressed events, etc.

The study of map-making is based on the training to create maps using the model situations for abstract territories involving natural elements, impacts, load, information on natural environmental changes and their intensification under the anthropogenic load, and the occurrence of unfavorable events. The subject for mapping can be air pollution, water- and ecology-related problems, the state of land and soil resources, the correlation between nature management and nature potential, medical-ecological situation, etc.

All conditional ecological situations are considered in the context of the landscape approach to the assessment of the ecological state of the territory and the study of nature management issues. Ways of map representation of anthropogenic and industrial impact on landscape under different forms nature management are worked through. The approaches to the mapping of natural resources conservation and their use, the dynamics and interrelation of phenomena are considered.

For instance, the practical training on the course "Industrial systems and ecological risk" for biology and ecology students includes the mapping of the abstract model territory including the different economic objects as the sources of pollution and the objects subjected to the anthropogenic impact. The students determine the correlation between the ecological potential and anthropogenic load under the given conditions, calculate the indices, create the maps of air pollution by industrial emissions and estimate the pollution impact on the adjacent territories. Besides, they evaluate the volume of effluents and the hygienic state of the surface water; the conservation and usage of soil resources, vegetation cover as well as the changes in natural complexes.

For better study of ecological mapping as a complex approach to the analysis of environment state a program on practical courses assuming the practical training on a number of such special disciplines as landscape planning, quantitative methods in geography, the basis of informatics including the creation of ecological maps is worked out for geography students.

In addition, the students are trained to study the ecological informativity of different source materials, to use the aerospace information and the outcomes of the remote environmental research.

Because of the lack of educational workbooks on special disciplines, the students' self-education including the study of ecological papers and the independent work with involvement of obligatory research elements is essential; it is the integral part of education process. As this takes place the use of ecologically important information on the region is of considerable importance.

In parallel with the situation on the abstract territory with the given conditions the data for the creation of maps of Altai Krai on the whole, or the specific natural and administrative units are used. High level of economic development in the region followed by a vivid manifestation of such negative anthropogenic factors as water, air, and soil pollution, salinity, erosion, deflation, etc. promotes the processing of the "fresh" regional ecological data. Most of the practical trainings are performed with the use of true information on Altai Krai on the whole or its natural or administrative units. The test task involves the creation of the detailed matrix legend and the map of the assessment of Altai Krai natural complexes change.

During practical studies prominence is given to the cartographical maintenance of the programs on the development of the region and its administrative-territorial units, and to the performance of ecological assessment of the region. This contributes to the development of the practice-oriented trend in ecological education.

The introduction of ecological maps in educational process should be considered as an important component for creative quest in the field of higher education.

The independent working of students with the involvement of obligatory research elements is extremely important. In this case the following triune problem is solved:

- the development of ecological mapping as a connecting complex approach to the environment study;
- the use of information not only of geographic character as the object for cartographic research;
- systematized (in the best way) education of students, perfection of teaching methods and the possibility to apply them during the practical courses and practical trainings.

The study of ecology-oriented courses should contribute to the training of ecological awareness, to base on the fundamental ecological knowledge and deep involvement in research. The course program assumes a sound knowledge in such subjects as physical geography, landscape science, fundamental nature management, economic geography, etc.

The active introduction of information techniques in ecological-geographic research, the creation of cartographic and thematic data bases, the use of information technologies, the development of geoinformation systems (GIS) find application in the process of learning. Such subjects as "Informatics" and "Geoinformatics" are included in the special courses "GIS in applied landscape research" provided for geographers, and "GIS in ecological research" – for biology students. Every method of ecological mapping is perfected with ArcView, ArcGIS, and MapInfo software products. The students acquire skill in working with interactive information systems, develop data bases, vectorize the traditional cartographic material, and perform the geoinformation analysis.

To combine the theoretical and practical knowledge the unity of training and research is required. Nowadays it is implemented through the establishment of the branch of the Physical Geography and GIS department of Altai State University at IWEP SB RAS. The unity of education, science and involvement into the solution of environmental problems is exemplified

by the students' field and practical training arranged by the Institute for Water and Environmental Problems SB RAS as well as the inclusion of students in research teams to study the topical issues of nature management and environment conservation. The students have a good chance to show their knowledge in practice and to carry out projects for term paper and diploma thesis based on the research done under the supervision of specialists. At the same time the lecturers can conduct the scientific investigations. The studies of geography and biology undergraduates take place at the Institute labs.

The work with the students from Altai State University is rather effective. While giving the ecological courses the researchers of the Institute have a possibility to devote much attention to the regional nature management problems. The students can exhibit their knowledge in practice. This allows the systematization of information and knowledge obtained and their use under the solution of regional nature management issues. In doing so a chain "student-undergraduate-postgraduate-researcher" is formed. Such a unity allows IWEP SB RAS the practical approval of the research outcomes be carried out.

The improvement of teaching any subject is a quest of complex solution of problems the lecturer should solve. As for the lectures, these are the interactive lessons that give new knowledge; at the same time the information already known is generalized and comprehended. In the course of teaching the use of regional information on nature management problems is of considerable importance. Regional information promotes the optimum combination of training and research, studying in groups and individually. It can be implemented through the active use of the available ecological material, the study of scientific ecological publications, in particular, the practice-oriented ones.