Information Technologies and Environmental Education - Mutual Influences

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Abstract

In this paper the ideas and the results of a Joint European Project conducted at the Technical University, Sofia, Bulgaria, Sofia University, Bulgaria, Institute for Science Education, Kiel, Germany, King's College, London, UK, International Aerospace Institute, Enschede, the Netherlands are presented. It includes the implementation of remote sensing, satellite images processing and interpretation, weather forecasting, and geographical information systems. These were integrated into the environmental educational program at Sofia University, as well as into the information education program at the Technical University at Sofia. The initiatives and changes in environmental and informatic curricula are presented.

Keywords

Information technology, environmental education, remote sensing, satellite image, geographical information system, local and global monitoring, information support centre.

1 INTRODUCTION

This paper discusses the common purposes, organization and first results of the Joint European Project "Environmental Education and New Information Technologies", initiated at the beginning of the 1994/1995 academic year.

The main aim of the project was to create an environmental understanding among the students of the both Bulgarian Universities - Sofia University and Technical University using the innovations associated with new information technologies. The project had four tasks:

- Development of curricula, syllabi and courses.
- Joint local and global (satellite) environmental monitoring.
- Organization of an inter-university centre for data processing.
- Development of computer-based courseware and teaching materials

The common inter-university work was organized as shown in Figure 1.

1 Common organization of environmental educational process according to project.

It is clear that the educational process is of a mainly inter-disciplinary character. The educational results of one group of students and often of one university are utilized by other educational groups in the other university. The local monitoring data in comparison with global satellite monitoring lead to the complex application oriented approach in the environmental area. All project activities are realized in and through an educational process using team work, project work, and field work.

2 IMPROVEMENT OF ENVIRONMENTAL EDUCATIONAL PROCESS

2.1 Technical University activities

Engineers in all specialties (mechanical, electrical, electronic, management) are trained at the Technical University in Sofia (TU). The environmental education in TU is inter-disciplinary and the main objective of the project for the TU is to foster interest in environmental studies by those studying engineering. The project activities were developed in two main areas:

- modeling and environmental analyses of different technological processes in the technologically oriented disciplines;
- processing of data from global monitoring include satellite imaging and geographical information systems in the informatic oriented disciplines.

In each of these areas, new environmental knowledge is obtained comparatively easily. In the modelling of technological processes different parameters are used. These processes characterize environmental pollution and pollution measurement techniques.

The influence in the informatic oriented disciplines is two-fold. On the one hand all processed data have an environmental character and this leads to a simple definition of the parameters, quick characterization of the environment, and development of efficient methods of environmental measurement. The other area of influence leads to new informatic knowledge regarding global environmental monitoring. Satellite image processing is conducted using algorithms for filtering, natural pattern recognition (eg rivers, forests, dams, etc.), georeferentiation, and classification of natural objects.

The use of geographical information systems is needed for the purpose of environmental analyses. These systems were used for illustrations with geographic maps and for mapping analyses with spatial operations (Aronoff, 1993; 1995). These operations utilized correlations, interpolations of different points, and trends and forecasts for future processes.

Environmental information analyses indicate that special characteristics of environmental phenomena constitute changes in time and space with regard to the defining parameters. That is why three dimensional tools are needed for visualization and modelling - see Figure 2.

Figure 2 Three dimensional model of environmental parameters.

Sophisticated data models utilizing information technology should provide the opportunity for quick three dimensional visualizations. According to Rao (1995) and Balownew (1995) up til the present time such models did not provide for a quick and easy illustration of the the problems at hand. Therefore a need for research on the development of relevant data models arose. As a result of our studies, models which used in object oriented data bases and nested relational databases were devised.

A three dimensional visualization model using general nested relational databases were suggested as a saliet solution to the problems relating to visualization (Tsankova, 1991). For an example of the utilization of such a model in the analysis of parameter changes, such as river and lake water-pH, temperature, dissolved oxygen, turbidity, heavy metals and many others - see Figure 3.

Figure 3 Dissolved oxygen change in the flow of Iskar river.

2.2: Sofia University activities

The application of information technologies for more precise assessments of the environment is performed in the training of the students who studied ecology and environmental protection in Sofia University in two main areas.

The first area is that dealing with the application of conventional informatic systems for analysis and evaluation of environmental data. Students at Sofia University are thus able to understand multifactoral complex relations between the factors of the environment and the reactions of biological systems. These technologies allow the students to study the influence of one anthropogenic factor (eg. heavy metal pollution) under non-biotic (soil, water, air) and biotic (pollution in vegetation, animals) on components of the eco-systems, and to view these relations in the realm of time and space. Students from SU are able to evaluate data obtained from technological processes with different ecological meanings provided to them by the students from TU. Thus an effective ecological process can be quite easily understood as well as analysed.

The second area is that concerning application of more advanced and complex informational technologies which are used for global environmental monitoring. Satellite image processing and interpretation using the IDRISI system helps the students learn and apply an easily understandable and applicable method for satellite

image processing for environmental purposes. The process of preliminary preparation of satellite images, which includes header recognition, conversion of image format and the creation of document files, is carried out both by students at TU and the students who studied ecology. Geocoding and image interpretation are done mainly by the ecology students but the training process is a cooperative one. Data interpretation allows for understanding of changes in environmental components (soil erosion, forest and water quality, urban level, landuse) to be learned and viewed in time and space.

According to Albertz (1991) interpretation has three stages. First the students have to recognize different object types - land, water, soil, vegetation, urban areas - see Figure 4. During the second stage, supervised reclassification is carried out in order to define and recognize important objects with similar characteristics. The third stage includes specification of the differences measured in the previous stage. Thus visual object parameters (forest homogeneity) as well as results of the interpretation (type of wood found in the forest) can be described.

Figure 4 Object types recognition using IDRISI system.

3 CONCLUSION AND RESULTS

Despite the organizational nature of the tasks performed during the first year of the project, initial results are already available and some preliminary conclusions can be reached:

- The interdisciplinary approach in environmental education using informational technologies naturally turns into a trans-disciplinary and even into a inter-university approach. This process is defined by the global character of environmental education and suits it to social needs and practice.
- The trans-disciplinary approach leads to the use of new organizational forms in education which promote social practice: team work, project work, field work, information support centre.
- Environmental education and information technologies can be methodically merged into one inter-disciplinary field of study.
- The technologically sophisticated demands of each of the above mentioned fields leads to a need of further inter-disciplinary research.

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5 BIOGRAPHY

Roumiana Tsankova graduated in engineering and completed her Ph.D. in information systems. She is currently an associate professor in computer science at the Technical University, Sofia. Her research interests focus on database design and information systems, with an emphasis on the use of these systems in environmental studies. She is a member of IFIP and ACM societies.

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