Computer based environmental education as a mutual challenge

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ABSTRACT

This paper discusses the mutual influence between informatics and environmental sciences as educational subjects for secondary school and university students. The results presented here were achieved within the Joint European Project COBES (Computer-Based Environmental Studies) under the European Community TEMPUS scheme. The aim of COBES was to increase the environmental understanding of selected categories of Bulgarian students by means of integrated education involving environmental studies and informatics. As a result the motivation, the activity and the awareness of students have been improved, and an active position about environmental problems has been built. A decision about forming a transdisciplinary subject 'Environmental Informatics' is under discussion.

Main conference themes: informatics as study topic

Educational areas: secondary education, higher education

Study topics: computer science/informatics, environment

Secondary keywords: interdisciplinary, information handling,
programming, database, spreadsheets

INTRODUCTION

Information technology developments change the aspect of traditional computer based education. Application areas, curriculum design methodologies, teaching methods and materials, as well as educational environments are also stimulated to evolve. The wide diffusion of information technologies through curricula increases the necessity of high-level computer literacy of students. Disciplinary education based on computers now needs some basic knowledge from informatics and therefore involves elements of interdisciplinarity.

Environmental studies, like a lot of other applied subjects, integrates a complex of multidisciplinary knowledge and skills. Understanding of the complexity of environmental systems, concepts, issues and policies, as well as expertise in environmental monitoring, modelling and analyzing require an integration of informatics into different subject areas. In the process of integration informatics and environmental subjects are mutually influenced.

This paper discusses some features of this mutual influence. The results presented here were achieved within the Joint European Project COBES (Computer-Based Environmental Studies) developed in collaboration between the Technical University of Sofia, Bulgaria, the Institute for Science Education at the University of Kiel, Germany and King's College at the London University, United Kingdom under the EC TEMPUS scheme.

COBES STRATEGY

The aim of COBES was to increase the environmental understanding of selected categories of Bulgarian students by means of integrated education involving environmental studies and informatics [1]. For the needs of this integrated education new and improved curricula have been developed, lecturers have been trained and an educational software was created and adopted.

The educational process started with environmental monitoring. Secondary school students supplied with special laboratory equipment and supervised by multidisciplinary teachers did field work to collect data about river quality according to the GREEN Global River Environmental Education Network) methodology [2]. The data collection from a wide range of locations founded a national educational database. Figure 1 shows a screen dump of an input data software.

The acquired data was then examined, processed, analyzed and interpreted in a sequence of computer based learning activities. Some informatics and environmental courses played a role in this work and it involved students from both secondary and higher schools.

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Съдържание на кислород	18.36	%	5.50
БПК	22.5	мг/л	3.82
РН стойност	6.6	-	83.0
Нитрати	3.8	мг/л	
Фосфати		мг/л	88.60
Твърди частици	670	мг/л	100.00
Прозрачност		см	
Колибактерии			

Дата на измерване : 06.04.1989

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Fig. 1 Input data software

As an expected result students improved their understanding and awareness about environmental issues, and gained a high level competence in information technologies. As a side effect a mutual influence between informatics and environmental subjects was observed at different stages of the process.

Informatics influence on environmental subjects

The contents of the environmental modules mainly concerned water quality monitoring and analysis. The application of computer based methods and tools for monitoring, measurement and data analysis required the introduction of new topics in the basic courses on Chemistry, Biology, Biotechnology, Environmental Engineering and Environmental Control and Ecology. Students had to learn about data types and presentation, spreadsheets, data bases and data visualization.

The implementation of information technologies had also an effect on the learning practice. Since a computer network was available for remote data entry, students from all over the country were stimulated to collect local data and to transmit it to the global database. The large size of the available data samples allowed the application of various statistical methods for data analysis and forecasting.

This educational approach established new forms of collaboration between schools and out-of-school educational institutions. Regional centres for out-of-school activities were interested in the field work and river monitoring, and supported school teachers in their work. Regional and national conferences were organized to allow students to disseminate their experience. As a result the issues of the environmental studies went beyond schools into society at large [3].

New teaching methods and tools implemented in environmental subjects improved the motivation of students [4]. They felt challenged and personally involved in the educational process. A lot of them joined informal groups for additional research work.

Environmental subjects influence upon informatics

The new possibilities which information technologies gave to the environmental subjects, later reflected on informatics subjects as well.

First of all the application oriented approach of studying informatics was underlined. Traditional courses like Computer Programming, Data Structures, Data Bases, Computer Graphics, Practice on Programming Languages turned out to be inappropriate for giving adequate applied knowledge to students.

In the beginning environmental data processing was implemented in existing topics concerned with teaching of algorithms, data types, data structures and data bases. The data collected during the learning practice within environmental subjects was effectively stored for further use. GREEN data parameters turned out to be quite appropriate for modelling by nested relations [5] as these could be presented as nests in relations, built for different time and space points, and describing different objects (rivers).

In addition to the initial programme special attention had to be paid to data control and validation. Environmental interpretation of both initial data and calculated results made the introduction of topics on data control methods necessary.

Another accent was put on spreadsheet models and data visualization. Since the environmental data items were presented by three parameters: space point, time point and value, 3-D computer models of data were implemented. A software tool for this purpose was designed and developed by the students themselves (see Fig. 2).

Because of the implementation of new technologies for gathering environmental data, some aspects of digital image processing have to be implemented in the basic informatics courses, in order to give initial knowledge about remote sensed data handling and interpretation.

Fig. 2 Environmental data modelling

The existence of global data collection about large areas and long time periods, together with geographical information, presumed a study of spatial and time operations typical for Geographic Information Systems (GIS). For the needs of environmental subjects, a limited knowledge about GIS was included in an informatics curriculum (see Fig. 3).

The topic of expert systems in environmental studies was also introduced and a software environment for its illustration was developed (see Fig. 4).

Use of computer networks and electronic mailing was directly provoked by the practice of environmental data collecting. The simultaneous processing of textual, graphical and visual data collected around the country and during the time presupposed the implementation of hypermedia and multimedia technologies. A demonstration of these technologies was given.

Fig. 3 Geo-ecological data processing

CONCLUSIONS

According to our three-year experience in computer based environmental education we can state that the integration of different educational subjects with informatics is a successful solution for better achievements in terms of student results.

In particular the interest, motivation and environmental awareness of students could be improved by means of:

- interlinking of on first sight very different subject matters, like environmental subjects and informatics.
- discussing methods of research and practice, applied in environmental studies within informatics lessons;
- implementing teaching materials of one of the subject areas in the other for supporting and activating the learning process;
- involving of new, integral forms of education and training.

Including new items into the educational content of one background subject improves the methodology of teaching and learning of this subject. New ideas and more complex criteria for evaluation arise. As a result a transdisciplinary subject area could be formed.

Fig. 4 Educational Advising Information System

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