

Teaching EIS Development - The EU Canada Curriculum on Environmental Informatics

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Abstract: This presentation is for the implementation of a course concerning environmental information systems. The course consists of: a concentrated set of lectures; a World-Wide Web follow-up; decentralized authority for credit; and, the re-use of modules from other courses and programs. The project ECCEI (EU-Canada Curriculum on Environmental Informatics) is funded by the EU-Canada Cooperation Programme in Higher Education and Training and has been conducted since 1997. Eight partner universities in Europe and Canada, from Environmental Sciences and Computer Science, developed the curriculum.

1. INTRODUCTION

As environmental protection is unthinkable today without the use of information systems and software tools for complex decision making processes, the question arises as to how students can obtain the necessary know-how in the Information Technology (IT) and environmental domains.

Due to the complexity and wide ranging aspects of such systems, we are still heterogeneous in our teaching activities, which can be thought of as a basis for Environmental Informatics education. The extreme broadness of the application area (environmental monitoring, remote sensing, compliance, supervision by government agencies and other authorities, environmental research, planning, lifecycle assessment, etc.), and the many possibilities of

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software support (scientific databases, visualization, modeling and simulation, artificial intelligence techniques and information retrieval and delivery over networks like the Internet), means that no single person can effectively teach an Environmental Informatics course.

Our initial goal was to cooperate in teaching (environmental sciences and computer science), as well as between the countries in the EU and Canada. ECCEI (EU-Canada Curriculum on Environmental Informatics) addressed this goal by implementing a multi-disciplinary and multi-national teaching activity, which included developing a highly innovative curriculum and an organizational framework to teach Environmental Informatics, both for Computer Science and Environmental Science. A modular course structure was designed which included multi-media teaching material delivered on CD-ROM and via the Internet.

The impact of this project will be felt not only by students in Environmental Science and Computer Science, but also by governmental planning department and other environmental authorities as well as industry. Students will be better educated and be able to utilize their expertise through electronic media. The market for this knowledge is vast and the teaching material available is severely limited due to the broadness, complexity and novelty of this subject area.

2. MODULAR COURSE STRUCTURE

Our modular course structure attempts to make the most efficient use of prepared materials by making it easier to apply the modules and parts of modules in different levels and types of courses. For instance, system analysis can be applied in an introductory mode, satisfactory for beginning environmental students, and then basic principles can be re-considered in higher level courses. In addition, differences in the approach to systems analysis can be discussed at an advanced level as well.

The courses can be at any required level, but can also be taught as a base graduate course in environmental information systems for both specialists in computer science and environmental science. The two groups have different backgrounds and requirements from the course and so the course is designed to take these differences into account. The pedagogical difficulties from combining such heterogeneous groups under one course may be offset by the increased level of co-operation between them. As long as not all courses are of such a bifurcated nature, the learning outcomes of such a structure are considered beneficial.

The typical modular course format will read more like a curriculum. Rather than delineating the topics and the learning objectives for a 36 hour course in a 36 hour layout (for example), it will contain rather more than

what is required. The proposed course has, at the moment, 64 hours of material, including a 6 hour parallel core for two completely different audiences (engineers or planners) and 32 hours of optional material. Each four or six hour slot is the responsibility of a person who is a recognized leader in the field. Lecture delivery is either live, by CD-ROM or by World-Wide Web support

The other element of the course structure is that some modules or module components can be used in other courses. For instance, a professional level course (for consultants or other professionals) in some aspect of environmental information systems could use some of the modules for the graduate level course described above and additional materials could be added. The modules could also serve as a basis for undergraduate level courses by adding more basic and explanatory materials.

Students will be encouraged to select one of two central topics (planning or software engineering) and a number from the remaining list. The size of the individual's topic list depends on hours of credit required. Each individual's topic list would have to be approved in advance.

Individual students should have registered for this course in advance. A significant research project, to be completed within a time limit determined by the individual's home institution, should be attempted under the supervision of a local instructor. Additional Internet-based tutorials from other participating instructors would be used in this curriculum. State-of-the-art presentation and organization tools would be used for preparation and presentation. Students will be required to present their project reports on the World-Wide Web.

3. ACTIVITIES IN PROJECT ECCEI

3.1 Core Activity - The Short Course

We began with a short course covering a full range of informatics. It was held in conjunction with the International Symposium on Environmental Informatics, in Whistler, B.C., Canada. Difficulties arose in assembling the courses, gaining co-operation from roughly ten instructors, and the long hours of class time. A good course-text might have been produced from this course, but there was not a spirit of co-operation amongst all of the instructors.

A more satisfactory approach, concentrating on only a small subset of the materials (and leaving the students to self-pace through much of the remainder, or to work at their home institution) was instituted in subsequent courses. Several of these courses were held in Mössna in Austria, Saarbrücken in Germany and in Canada. Students were encouraged to

continue study back in their home institution. In Guelph, for instance, a course entitled “Topics in Environmental Informatics” was formally approved and offered eight times subsequently, with 22 students eventually taking it. Students were fully briefed that the intent of the course was to develop curriculum materials. They participated enthusiastically, on three levels: as consumers of the informatics; as participants in the complementary disciplines; and, as developers of legacy materials for future courses.

3.2 Pedagogical Approach - The Common Example

Our common example has been chosen from the courses held in Austria. The Sölk Valley, the site of the course, has a complex set of problems in an eco-region of moderate size. Even then, we can only begin to examine a few issues, but the explanations, the inputs, the outputs, and common threads in the common example are more simply described than in a complex urbanizing setting, for example. All the while, we are maintaining some complexity. We have three or four small settlements, a major water diversion from several decades ago, competing land use, degradation from usage practices, regulatory activity, economic issues, pristine locales within areas under stress, etc, all within a few square kilometres.

To date, we have conducted field tours, collected benthic organism samples in the main stream (as an exercise in bio-indicators and in sampling protocols), performed cursory soil sampling and vegetation surveys. We have developed a plant species database, a multilingual species database for the river, a simple mass-balance model for the pasture with a web visualization, a non-point source model implementation for the agricultural activity, an inventory of maps of soil, land use and vegetation and other complementary data. The construction of a terrain visualization was initiated for fly-through of the valley in order to illustrate the types of informatics that can be developed for analysis and demonstration of environmental issues.

3.2 Development of Course Modules

Starting with an initial set of 16 topics, we taught the short courses mentioned above. After 2 ½ years of development, we now have a revised list of topics and a completely different grouping of the topics, covering around 35 topics.

3.3 Ongoing Student Exchange

Our student exchanges over the past three years have reinforced our activity. Students introduced to the partner institutions through the course

have worked in each other's country. Six students from Germany have had extended work-placements in Canada. Some were directly involved with course development, and some worked on follow-up projects. Two students held extended externships in Germany and several attended and conducted seminars. It is hoped that this thread of the project will survive the end of the funded period.

4. SUMMARY

Developing an EIS curriculum under the given circumstances is a huge task, in particular under the paradigm of the "Common Example", which requires courseware and software to be built for the key topics. After 2½ years, we were able to make significant advances in the areas of what we wanted to develop, but the major step of integration is still ahead of us. The fact that the contracts do not allow for funding of personnel we will have to work on ECCEI as part of other research projects. With a total of six courses over three years, the time we spent on the project was absolutely at, if not over, our limits. Also, the organization of the courses in different places with varying groups of students is easily underestimated. Although the ECCEI funding ends at the beginning of the year 2000, we will go on with the curriculum development. The ECCEI concept and the courseware have proven to be very valuable for our teaching and we are convinced that this project is a major step towards EIS education.

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