The E-GIS project: European level developments of flexible learning models within Geographical Information Science (GIS) for vocational training

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Abstract

In the Leonardo E-GIS project 10 partners from 6 European countries cooperate to develop a one-year internet GIS course program. The project has a two-fold goal: production of courses and network building. In the project a model for running a 100% internet based GIS program is defined, 8 program modules are described and the module content is developed. The paper describes how this is done, and also to some degree explains the experiences mid-way in the project.

Introduction

General

The current level of understanding and skill of Geographical Information Systems (GIS) is not very high in most European countries, still GIS is implemented in many governmental and private enterprises, making the need for a system promoting education and training for undergraduate students as well as for people already active in a professional career considered high priority in many countries. In Sweden, as an example, the government has spent about 350000 euro over the past three years in order to pilot implementation of GIS in the public domain. The money is basically used for promoting networking, sharing of experiences and education of civil service staff.

The E-GIS project

The E-GIS project is a 3-year *Leonardo pilot project* under the EU/Leonardo program (for www-site: see reference list). The project started in November 2002 and ends autumn 2005. The partners in the project are listed in Annex B.

The main objective with the Leonardo E-GIS project is to establish a co-operation between European Universities and GIS user organisations and to develop course modules intended for Internet based learning. Another objective is to establish links of communications between the partners in the project to disseminate and share "best practises" in different teaching situations and for different types of students. This will provide better quality for the students and constitute a basis for creative development of new modules within special fields of competence not available everywhere. The E-GIS project mainly targets full time academic students, and private and civil service employees within the EU but also similar categories in non-EU countries.

The main advantages of Internet-based learning, is increased accessibility, also for disadvantaged groups in society. Pilot tests in Norway and Sweden show that this form of learning suits full time

employees very well. Another advantage is the possibility for attending courses at distant education institutions that may provide specific education not available at local institutions.

Aim

The final outcome of the project will be a network of co-operation between prominent GIS teaching institutions in Europe. This network would be used to develop a set of modular courses adding up to one year of full time studies in the field of GIS. The concept of using short modules will have several advantages to traditional on campus university courses:

- Flexibility to choose only appropriate parts for students already professionally active
- Spreading the modules and module parts over longer time span for full time employees
- Full time student from different fields could top their exams with selected GIS competence
- Modules and module parts could easily be adapted to fit specific training environments, e.g. third world countries, district civil service, etc.
- Standard-English modules could with relatively small effort be adapted to local languages

Another important outcome from the project will be net-based pedagogic models for conducting the modular courses in the most efficient manner.

According to the text above, the specific aims of the project are two-fold:

- Network building
    - Share competence and best practice between experts.
    - Develop international relations and 'The European Dimension'.
    - Promote inter-university co-operation in order to give higher-level education than each individual institution can do alone.
- Develop GIS education
    - Develop a system of new flexible, modularised pedagogic models for GIS training
    - Develop course modules and provide internet-based competence development possibilities for target groups spread around Europe that, for some reason, do not attend on campus education programs. Being modularised, courses may be adapted to the special need of a particular target group and for the lifelong learning perspective.
    - Further, university students become trained in the use of ICT pedagogic models. This will be of great benefit for their future employers. In a long-term perspective the fact that similar education becomes available in all European countries will contribute towards standardisation of geographical information and data handling. This issue may seem odd but experience has shown that standardisation is a key issue in data sharing and exchange between organisations as well as between countries.

Target groups

The project will focus on three main target groups:

- Employees that work within municipality, county councils, consultant offices, private surveying companies, building contractors, agriculture, forestry, road planning, real estates, private companies that deal with geographical databases, etc.
- Students in higher education. For this group, the necessity of inter-university cooperation for sharing competence and 'best practice' is the main objective. Pedagogic models based on ICT are as important for this group as for target groups already working.
- Similar categories in countries outside EU-members. Most countries have, for several years, actively tried to implement GIS in various sectors of civil service, with different level of success depending on sector and country.

A major constraint in this process is access to high quality education, most often only offered in Western Europe, the North Americas and in some Asian countries. Internet based education programs would certainly increase access and boost the possibilities for developing countries to train their staff, since travel and lodging costs will be avoided. This will enable these countries to benefit from the advantages of using GIS in e.g. different planning situations to assure sustainability and higher precision in decision-making.

Figure 1. The E-GIS GIS Course programme as presented on http://www.e-gis.org/courses

Method

In the application to the Leonardo program the outline of the one year GIS courses were presented, see Annex A. It was decided to use a 100% internet based teaching methods, without physical meetings for the students.

The E-GIS way of defining the modules:

The 8 course modules of the program (see Annex A) are all made up of several module parts, each part is an isolated unit consisting of learning material and exercises. The activities in the course module parts are:

- Communication. This is done using a Learning Management system (LMS). As LUVIT AB is a pertner in the project the LUVIT Education Centre (LEC) LMS tool is used, see Figure 2. However, it is also important for low cost solutions to limit the communication to just CD-distribution and email. The communication should cover
  - Course administration
  - Chat forums / discussion groups
  - Hand ins
  - Final examination
  - Course evaluation
- Content presentation. The material is available for downloading from the E-GIS course www site, see Figure 1. As an alternative, CD-ROMs with the same material are distributed. Alternative learning material to be produced as
  - Text lectures: for printing
  - Audio lectures: text lectures with oral presentation added
  - Video lectures: text lectures with added video where teachers explain the text.
  - Interactive presentations: Presentations with interactions between student and computer. Examples of types of interactions are questions with computer response and initial hidden parts needing a click to become visible. For producing the interactive presentations *a course content producing tool* (Lectora) is used. The same tool is used for producing the self tests.
  - Self-test: questions where students can test themselves, automated grading, no reporting to teachers.

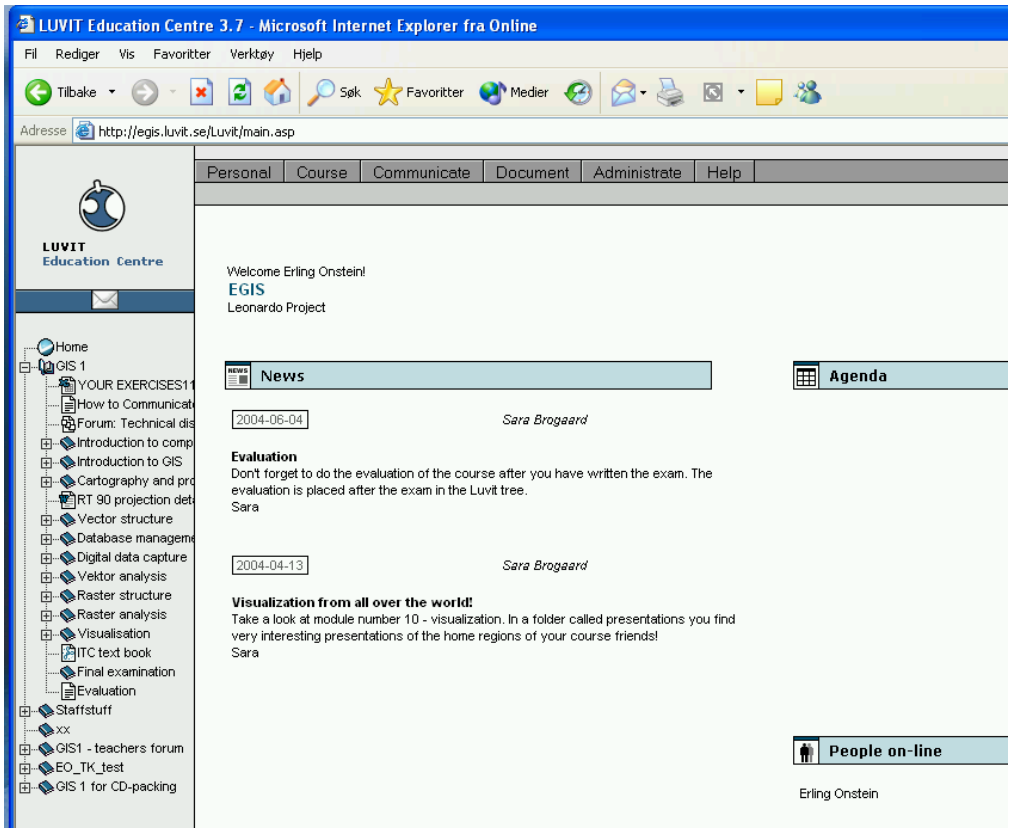

Figure 2. The startup page for E-GIS in LUVIT Education Centre

- Exercises
  - Theoretical exercises consists of theoretical questions to be answered with only "pen and paper". Each course module part shold have at least one theoretical exercise.
  - Practical exercises. To work throug these exercises, a computer and GIS software is needed. Each course module part shold have at least one pratical exercise.

The work to develop the 8 course modules (2 of which are already completed) is organised in similar manor for all courses. One of the partners is maintaining the overall responsibility for both content and implementation of the course and most often two other partners are also involved in the actual development. The workload is often divided 50 % - 25 % - 25 % between the three partners.

Challenges using E-learning

The challenges with E-learning may be divided into several categories:

- Distribution of course material – technical aspects and student assimilation of the material
- Loneliness of the student – difficult to feel part of a group
- Communication with teachers and fellow students
- Requires higher degree of self-discipline to actually sit down and work

Other common problems are that the development of Internet based courses is seen as a means of saving money (i.e. reducing the number of teaching hours per student), courses are developed by teachers lacking previous experience from e-learning and lack of communication between e-pedagogic experts and traditional teachers. A main mistake in e-learning is also that the course developers over estimate both computer literacy and technological infrastructure at the student end of the process.

Despite what we may believe, most "ordinary" Internet connections are still based on modems, that is, rather slow in terms of data exchange and many people are still quite unfamiliar with computers, particularly when talking about operations that requires knowledge beyond simple "surfing" and clicking on the Internet. When it comes to software installation, file downloading, e.g. FTP communication, file handling and directory tree organisation, at least many of the generations born before 1970-1980, but also younger people, has rather low experience. To a certain extent on campus students' computer literacy also

differs between faculties, technical and science students generally have more training already at high school and college, while social science and humanities students have less experience.

Challenges with E-learning and GIS

Teaching GIS can be seen in different conceptual ways, but to generalise some particularities are bound to be present. GIS is a methodology or a tool to be used in different problem solving situations. To master GIS, the student will have to master the tool, in most cases being the same thing as being able to master a GIS-software. At the same time, GIS is based on theories about geomatics (e.g. spatial relationships and cartography) and to some extent on statistics and mathematics. Thus the student will have to learn both to practically handle problems using software and to theoretically understand what lies behind the different techniques. This is not unique, but it put specific requirements on the pedagogical tools to use and has some endemic problems that have to be solved.

In line with what has been said in above the rather high technology dependency of GIS poses particular problems in a teaching/training situation. One of these is quite interesting and creates a position that is directly opposed to the fundamentals of GIS itself, at least psychologically. GIS is often marketed as a tool that will increase efficiency in data handling and information flow. Having learnt this at the introduction lecture, the frustration of a student faced with a stupid computer that does not obey command can be considerable. In such situations, the on-campus teacher can immediately intervene and respond to the student's problem. But in an e-learning situation response is always delayed, in some cases by days. This may be accepted by the students attending Internet courses in other field, having a less rapid and efficient "image" (e.g. 1700 century philosophers), but not by a GIS student. It is like selling a quick game of poker to a person and then giving that person a game of chess.

Results

The result is partly produced material and partly the experiences from the production. In the following selected parts of the experience from the project work are commented.

Impressions and comments on project activities

The major issue that has been inflicting on the project activities is the cultural differences in teaching between partner countries. It is not a problem but poses challenges that have to be taken in order to achieve the project objectives. One might imagine that e.g. two neighbour countries as Norway and Sweden would teach in very similar manors, but also here differences can be found between partners e.g. the Gjövik University College has a different approach to pedagogic than Lund University that in one sense is more traditional. Similar comparisons can be made between all project partners.

Another example of differences is the balance between theory and practical in teaching. In a discussion one partner may argue that it is better to teach the subject entirely theoretical, since this avoids getting into e.g., software specific issues, while another partner stands at the point that the students will eventually face real world problems as employees and thus needs to be able to practically handle a given situation.

As stated above, these issues are not problems. Rather, they can be seen as strengths in the project since all partners contribute the best part of their teaching traditions (given the number of partners, and the democratic set-up of the project, bad suggestions are not accepted when voting). This is one of key success factors for this type of project. But the outcome is naturally very sensitive to the involved partners ability to listen to others, accept facts and, not least important abandon their standings when convinced that others ideas are better; in other words – having true academic qualities.

Quality issues' is a third facet of the project that required long discussions. What is quality for you, what is quality for me and, very important – What is quality for the student? This is may be the trickiest of issues, since it is difficult to know the answer to the last question in advance. And actually, experience from student evaluations of on campus courses shows that 25 % like your teaching more than average, 25 less than average and 50 % gives you an average note. This implies that the students' perception of the same course differs depending on the student. This may be due to different reasons, the students' background being one of them. In this project, one aim is to try to systematically examine if differences between different student categories are possible to detect and hopefully proof.

A major problem during the project so far has been the communication between partners. This has been very instructive to the project team since it has clearly demonstrated the students' situation. The lack of communication is due to several reasons but can in a majority of cases be tracked back (the ultimate cause is) to seek in the fact that the team is dispersed and communicate mainly via e-mail. LUVIT was suggested and used as a meeting room for a shorter period but was then unfortunately abandoned and communication reverted to ordinary e-mail. This is not inefficient, but gives less flexibility compared to a

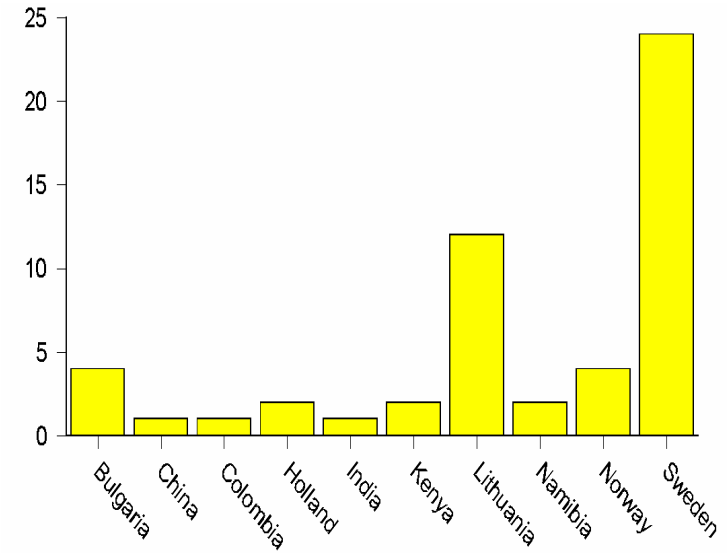

Figure 3. Country of origin of the 53 students in the first E-GIS course

LMS. Communication is not optimised in the project, often messages are sent only to key persons, omitting the people actually working with a specific task. This reduces speed of reaction and slows down progress. More investigations into this could have been of interest, searching the reasons.

Another major challenge has also been that several of the partners already conducted on campus and to some extent Internet distance learning covering similar fields as the courses to develop. Adapting the existing material with a minimum of effort was naturally the first option, but it proved to demand much effort than if the courses would have been developed entirely from scratch. This demonstrates that adapting existing teaching material to the Internet platform is not the obvious solution in all cases. Adapting content to new learning environments, adjusting content to fit new target groups and adjusting content according to partner discussions demands a lot more work than initially expected.

Impressions and comments on the pedagogic concept

Experiences from producing learning material to the GIS 1 course module can be summarized: Defining the interactive presentations is the most challenging part. In the work with GIS1 the presentations were produced of a very few persons using Lectora. The other teachers defined the interactivity using a text.based template. Filling in this Lectora template forms is boring and difficult to visualize. It is urgent to get feed back on work filling the forms:

- Comments on the actual content and the way the message is presented to the students
- Feed back in the form of a draft Lectora presentation, at least the first time one has filled the template forms, to help the individual to visualize the results
- Possible conclusion is to ask everybody to write their own Lektora presentations

Evaluation of the courses

A total of 53 students were accepted for the first course in the programme. They came from ten different countries, the majority (24 persons) from Sweden. The students' country of residence is illustrated in Figure 3. The mean age of the participants is 37 years, ranging from 23 to 65 years. The majority of the students have passed higher education, many of them at least to a bachelor level, only ten are still in the education system, the rest has stated that they are employees. About one third of the student have modem connections, the rest use broadband, most of them ADSL.

The course evaluation is under way and only seven students have filled in the evaluation form so far (2004-06-23). The following section is based on these seven evaluations. Naturally this material is too small to draw extensive conclusions but it may be used to illustrate at least some of the advantages and disadvantages that students see in E-learning.

Of the seven students five have never attended an Internet-based distance course before. All of them consider E-learning as a very valuable way of education due to the freedom of choosing when and where to work with the course material. They are generally satisfied with the information received before the course start and with the content of the 9 course module parts, on a five level scale (1 = very good, 5 = very bad) the average score is 2 (good) and only few parts gets any grade 4 or 5.

As stated above, the course material was made available both on the Internet and on a CD-ROM. Surprisingly, 4 students preferred using the CD-ROM instead of accessing the material on the Internet. The theoretical material (i.e. the "lectures") was available as text, audio and video combined with slides (same slides and same content for all three versions. The students' preference was the written text and

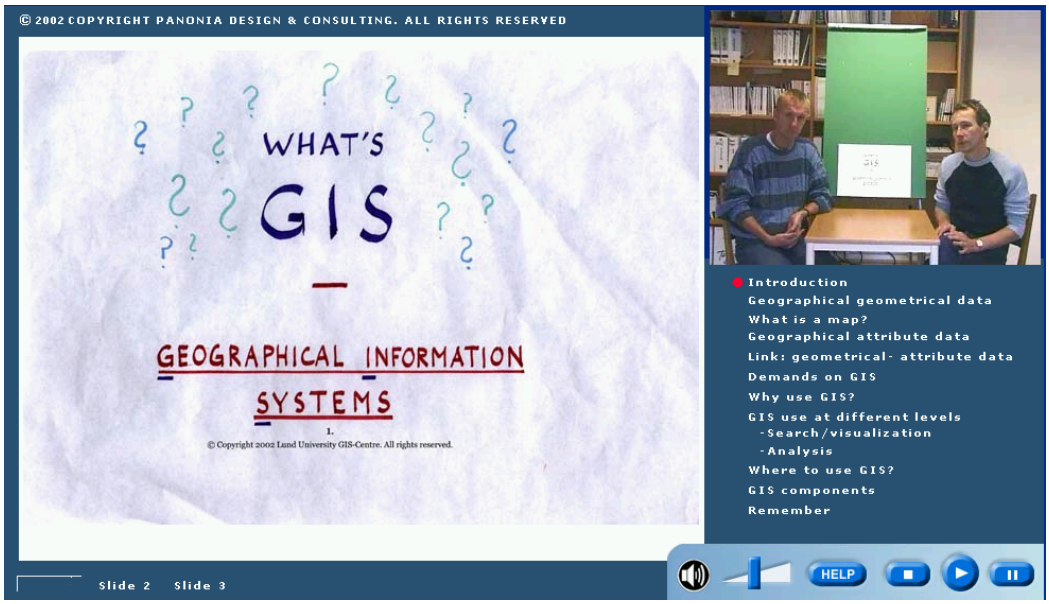

Figure 4. Example of screen layout of the video/audio lectures

slide material. Comments to this were that this material could be printed and read anywhere, at any time. Some also experienced problems with the "heavier" audio and video versions.

Another comment was also that the video is unnecessary since the way it is used (just showing two persons talking) do not add anything to the content (actually the sound track from the video recording is used for the audio version). A part from the material cited above, an on-line textbook was also supplied to the students. This PDF-document was however in an unprintable version, something that several students has commented as negative since they claim it is straining for the eyes to read on screen, and that it is difficult to find a subject that is not clearly listed in the index.

The seven students are generally very satisfied with the teacher support throughout the course; they comment that the communication with teachers has been rapid and reliable. On the other hand, none of the seven students have used the opportunity to interact with other students, neither via e-mail or using the forum and chat facilities that are available in the LUVIT e-learning platform. One student also suggested to have fixed "contact" hours for easier contact on line with the teachers.

Evaluation of the text/video concept for GIS E-learning

Besides the evaluation provided by the seven students that have passed the E-GIS course, a test of the video concept was done using a group of on-campus GIS students as a test group. The students where from human geography and they attended a video lecture about Interpolation, for them an alien subject since it is quite mathematical. The frame used was the original video presentation concept, with the video top right and the navigation tree to the right, see Figure 4. The questions and answers are:

1. **General aspects of the layout, placement of different objects (video window, navigation tree and slide) and size of different windows.**
   Everybody was satisfied with the layout, etc. One would prefer computer drawn illustrations to the hand drawn. One wished larger font in navigation tree. Very convenient to be able to see what slide that is running. Important to keep the information on slides quite sparse, too much makes reading difficult when listening and watching the video.

2. **Is the discussion clear and easy to understand?**
   Generally it is clear and easy to understand and interesting to listen to a discussion between two persons. Some parts are difficult, particularly the mathematics. Avoid unnecessary hand movements and sounds and also try to avoid hesitating when you speak. The quality of the sound is not perfect.

3. **Impression of hand drawn illustrations, clarity of the message**
   Simple and very clear, pedagogic and the small persons are funny. The images are more like decorations than pieces of information. The spoken text is really needed to understand them fully; this combination of image and sound is very good. Could be computer drawn but still they are very informative.

4. **What is your opinion about the video – does it contribute to the total impression or could it be replaced by a photograph or even omitted?**
   The video gives a live impression and creates a feeling of presence. The video is probably better than a photograph. The combination sound-illustration-video is very good. The video give a personal touch and add to the pedagogy of the material (hand movements when explaining things). The video assures better learning for the student (but can never replace a live teacher). The video is good, sometimes helps understanding and makes the package more interesting.

Furure plans

One immediate result from the E-GIS project is that Lund University GIS-Centre has launched an International Master's programme in GIS (LUMA-GIS) based on an extension of the courses that are produced in the E-GIS project. The master is equivalent of two-year fulltime study tempo and requirements are that the student has a bachelor in any field and a proven skill in English. The programme is totally Internet based (no encounters) except for the thesis presentation at the end of the programme.

This programme has without any active advertisement drawn a lot of international attention and the first group of students is composed of about 65 persons from no less than 28 nations. Cultural differences between this very international group and the Swedish dominated E-GIS students can already be detected. The student-student communication has been very lively from the first day; students comment on course details to the teachers and to fellow students, discuss different course related subjects in forum and apparently uses the chat facilities to a much higher degree.

In the second course of the E-GIS programme, the E-GIS and the LUMA-GIS students will be mixed in the same virtual classroom. This is partly due to practical reasons (the Lund University is running the two first courses in the E-GIS programme) but is also an experiment to see if the student activity among E-GIS students will increase when facing the very dynamic contact climate of the LUMA-GIS students.

Apart from this, the Gjövik University College will run one of the E-GIS courses as an on campus course during autumn 2004, thus providing for more refined evaluation of the concepts. Several partners are also involved in discussions in order to offer parts of the course programme as dedicated training for organisations and companies. Some of the partners has also started to cooperate in other fields that not focus on GIS but uses GIS as a tool, e.g. courses in environmental sustainability.

Conclusions

The Leonardo E-GIS project has offered the cooperating partners an unique opportunity to exchange training concepts and personal teaching experience. Sometimes this exchange has not been without effort but the general impression expressed by the partners from six countries is that the process has been very positive and profitable for everybody. The partners have different orientations in their GIS applications, e.g. the Bulgarian partner is a Forest research Institute while the Portuguese partner is a Technical University. Their field of expertise is thus completely different, but all have the GIS as a common factor. The project partners themselves is consequently a brilliant illustration of the flexibility of GIS – it can be used in almost any field for general data handling and as a refined research tool.

The project has been well received by the potential user community and students attending the course so far are generally very positive. The project has also created links between several prominent GIS institutions in Europe.

References

www-sites:
E-GIS project: http://www.e-gis.org

The Leonardo da Vinci Community Vocational Training Action Programme (2000 – 2006):
http://europa.eu.int/comm/education/programmes/leonardo/new/leonardo2_en.html

Lectora (Course content development tool) : http://www.trivantis.com

Appendix A : The E-GIS Course program

Below you will find the names and a short objective for each of the course modules in the E-GIS program. The course modules are:

Course module name	Module objectives:
Basic GIS I	On completing this module, the students will have an understanding for GIS and be able to identify operations that are suitable applications when solving problems using basic GIS concepts. The students will have capacity for general handling of both spatial (map) and attribute (e.g. tabular) data.
Basic GIS II	The student will learn how to build a geographical database from scratch and will be able to handle data collection methods as on-screen digitising, table data import, etc. The module will also train the student in using advanced data analysis for solving spatially related issues and to discover and correct basic problems related to digital databases.
Specification of GIS in an Organisation	On completing this module, the students will be able to identify a user/organisation's needs for geographical information, fit these needs into the current framework (internal and external) and formulate the needs in a specification.
Physical Planning	After finishing this module, the students will have a clear understanding of the challenges in using GIS as decision support systems in physical planning, handling land use changes and building permissions. The students also have some knowledge about how these challenges can be handled: the organisational, technical, data availability and data access parts
Resource Planning	The module aims to introduce to the student GIS as a planning tool for resource management. As resource management inevitably involves handling multi-source data (e.g. including aerial photographs and satellite images) the module specifically focus on issues related to combining databases. It also covers basic modelling tools that are usable in resource management.
Environmental Planning	After accomplishing this module, the student will be used to handle environmental data in a GIS environment. She/he will be able to analyse interactions between different spatial variables and will have some experience in dynamic spatial modelling (e.g. hydrology). The module will also discuss environmental data sources and data quality.
Geographical Data Modelling and Management	On completing this module, the students will be able to use conceptual schema languages to describe (simple) information models. The students also will have knowledge of how to convert the models into databases suitable for geographical data, how to manage the database, including the user access to databases.
Internet GIS	On completing the module the students have knowledge on how to visualise geographical data, both as traditional maps and as perspective views. The students will also have experience on how to distribute and use geographical data over Internet. The students should also be able to set up an Internet service for access to geographical data using relevant software.

Appendix B : The partners in the Leonardo/E-GIS project

Below you will find the names of the partners and a short description of the role the partners have in the project. The partners in the Leonardo/E-GIS project are:

- **Teaching institutions:**
  - **Gjøvik University College - GUC**, Gjøvik, Norway (http://www.hig.no). *Role: project coordination and involvement in the design of modularised, netbased GIS course modules, development of ICT-based pedagogic models, evaluation and dissemination.*
  - **Lund University - LU**, Sweden (http://ww.lu.se)
    Role: involvement in the design of modularised, netbased GIS course modules, development of pedagogic models, evaluation and dissemination. LU, will also participate in the Project Management Group.
  - **Forest Research Institute - FRI** (Институт за гората,), Sofia, Bulgaria (http://forestin.bulnet.com)
    Role: participate in the development of netbased modularised courses, providing target groups for test courses, evaluation and dissemination of results.
  - **Vilniaus Gedimino Technikos Universitetas - VGTU**, Vilnius, Lithuania (http://www.vtu.lt)
    Role: contribution to the development of netbased course modules, provide target groups within and outside the university for test courses, evaluation and dissemination of results.
  - **International Institute for Geo-Information Science and Earth Observation - ITC** , Enschede, Holland (http://ww.itc.nl)
    Role: participate in the development of course content, in particular within environmental modelling, evaluation and dissemination.
  - **Instituto de Engenharia de Estruturas, Território e Construção - ICIST**, Lisboa, Portugal (http://www.civil.icist.utl.pt)
    Role : contribution to the development of modularised course modules, development of netbased pedagogic models, providing target groups for test courses, evaluation and dissemination.

- **Other partners:**
  - **Foreningen Geolok, Lillehammer - FG**, Norway (http://www.geolok.no)
    Role: provide contacts with target groups and participate in evaluation of courses.
  - **Nettskolen AS - NAS**, Gjøvik, Norway (http://www.nettskolen.no)
    Role: participate in the development of ICT-based pedagogic models and development of ICT-based learning material.
  - **LUVIT AB**, Lund, Sweden (http://www.luvit.se)
    Role: to support the project with licences for pedagogical and administrative use, at strongly reduced prices.
  - **Utvecklingsrådet för landskapsinformation- ULI**, Gävle, Sweden (http://www.uli.se)
    Role: test, evaluate, and disseminate the results from the project.