

Developing a distance learning course on WebCartography

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Abstract: ITC is facing the challenge of keeping its teaching programmes up-to-date, competitive and customer-oriented. Therefore, ITC has to build distance-learning facilities, not only traditional distance learning tools but also modern web-based courses. As one of a number of pilot projects, the development of a distance learning course on *WebCartography* has been chosen. WebCartography involves the dissemination of spatial data on the World Wide Web. Currently, little guidance is available to geoinformation professionals on this new field within their profession. The Division of Geoinformatics, Cartography and Visualisation has developed expertise in this field, and is developing several means to further disseminate that knowledge to the geoinformation community. In the distance learning WebCartography course, theoretical knowledge is transferred and applied to solve practical problems, so that at the end of the course the participant will have published his or her own Web pages. The construction of this site will be geared towards the participants own data and visualisation needs. Support for course participants is provided at a dedicated Web site which contains course materials, interactive exercises and assessment and feedback possibilities.

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1 Distance Education at ITC

The International Institute for Aerospace Survey and Earth Sciences (ITC), based in Enschede (the Netherlands), has over 50 years of experience in the field of training in a wide range of disciplines related to the Earth Sciences, Land-use Mapping, and Geoinformatics. At the ITC, knowledge of geoinformation management is amply available, and continually being developed and extended. By means of education, research and consulting, ITC contributes to capacity building in the developing world. ITC's core mission is to transfer knowledge by providing training and education to developing countries. In addition, ITC strengthens the productive, innovative and management capabilities by knowledge development using geographic information. ITC is facing the challenge of keeping its training material up-to-date and providing high-level education using modern technology.

Distance learning techniques offer the potential to provide flexible and effective means to professionals at any place of the globe. Distance learning can be defined as a method of studying in which lectures are broadcast or conducted by correspondence, without the student needing to attend a school or college. Distance education can have many forms, including:

- Self-contained course packages. Theory, examples, exercises and sometimes assessments are all included in one package. The content can be delivered as traditional correspondence courses, as multimedia packages on CD-ROM, or through the World Wide Web;
- Conveying knowledge through lectures or practicals from a distance. The delivery of the knowledge can range from sending documents, through web-based information, to live video-broadcasts;
- Supervision of individual work from a distance. The communication techniques ranges from simple email correspondence, through web-based two-way support, to live video-conferencing;
- and combinations of the above...

Many educational institutions have recognized the potential of these techniques and have started to build distance-learning facilities, not only traditional distance learning tools but modern web-based courses. If ITC wants to remain competitive and customer-oriented in its training effort it has to keep up with this development and provide interesting, high-quality, demand-driven distance learning courses to its students.

Two additional forces push ITC to offer its curriculum through open and distance learning formats. Firstly, ITC students receive fellowships to come to Enschede to follow courses within our Diploma, PM, MSc and PhD programmes. This involves a stay of several months to several years in the Netherlands, away from their working environment and usually separated from their families. Many professionals from developing countries are no longer willing to come to ITC for a year or longer. Instead, they would rather take short diploma courses or degree courses in which the stay abroad is limited to a few months.

Secondly, as scientific knowledge develops at increasing speed, the depreciation rate of knowledge acquired by ITC students increases considerably. Therefore, it becomes more and more important to keep updating the knowledge of ITC alumni who have completed an ITC course but who have to keep up with technology in order to provide sustainable development. At this moment, ITC provides 'refresher courses' by sending ITC staff to the regions in questions for a couple of weeks. Again, the students are taken out of their workspace and not available to do their job during that period. Furthermore, only a very small proportion of alumni gets the opportunity to participate in these courses. Using open learning tools and distance education ITC could provide an efficient, flexible and user-oriented educational tool to keep its alumni updated. In this way, knowledge is provided at those moments that it is needed for problems at hand in organisations. By avoiding depreciation of knowledge, effectiveness of ITC education would increase.

Another important factor is that the impact of courses on the graduates' *working organisation* is often limited. Many graduates do not succeed in implementing what they have learnt, because the organisation and their colleagues have not changed with them. When graduates would carry out course assignments in their own working environment, the organisation can grow gradually along with the student.

1.1 Towards a distance learning framework at ITC

In order for ITC to successfully enter this new field of education, an appropriate framework for the implementation and activation of distance learning is required. The vision is that ITC's education will move towards a modular, hybrid course programme, a combination of traditional & distance learning tools, within the next 5-10 years. The main objective of the

proposed policy is to co-ordinate the piecewise implementation of distance learning elements. The first step is to make ITC staff aware of the potential along with the development of example modules to gain experience. This experience will help to further elaborate the overall framework for ITC moving towards the new course structure.

Degree courses completely taught at a distance are not a realistic goal. It is expected that so-called 'sandwich' programs (figure 1) will lead to more impact of the courses. Students will have to start the course at ITC with an introductory period of basic theory modules in GIS and RS and in the field of the program and specialisation. Students will become a member of a peer group and will get to know the course staff. This is very important for the motivation in the distance education stage of the course. Students will also learn the skills for learning at a distance, which means that practice must be provided in distance learning methods and tools and independent study. This first period at ITC should last about 2 or 3 months.

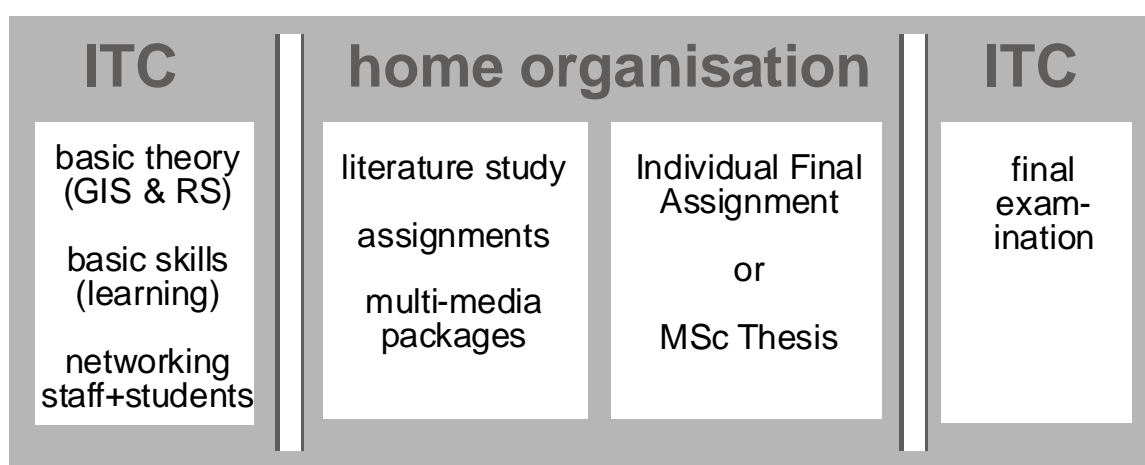


Figure 1: Possible 'sandwich' set-up of degree courses.

The next part of the course is taken at home and assignments are carried out within the home organisation as much as possible. This distance learning part of the course includes study of subjects on the Web and/or CD-ROM, literature study and assignments supported by on-line contacts with ITC staff. A practical problem is that students in some target countries would not have access to appropriate hardware and software at their home organisation. One possible solution could be local training institutes that do can provide these facilities (eg. the Open University institutes in South Africa and the Philippines). Included in this part is also the Individual Final Assignment (for PM and diploma courses) or the MSc Thesis, carried out in the own organisation and supervised from a distance and by preference supported by local training institutes.

Students return to ITC for the last part of the course: The IFA reports or Thesis is finalised and assessed and there are the final examinations and ultimately the degree ceremony. An overall final exam serves as part of the quality control and the maintenance of standards.

1.2 Short term activities

The above set-up can of course not be realised immediately. However, to stress the importance of these forms of education, a clear road towards the development of distance learning implementations is being defined. As part of this, it was decided that during the 2000-2001 academic year, ITC would:

- continue to produce stand-alone packages with both theory and exercises whenever finances are available, aiming at increased interactivity and teaching of skills;
- design a distance education module based on literature study and assignments and test this in a simulation at ITC;
- design and experiment with modules within ITC's course programme in which students work independently and with on-line materials and support. For this, the three-week elective modules that are available for all MSc and PM programmes in April-May 2001 were chosen.

During this phase, the materials will be tested within ITC by staff and students. Later it will be offered to students elsewhere free of charge. This way, experience can be gained in implementing such type of courses, including technology and tutoring aspects. It is the intention to use existing course material in order to be able to concentrate purely on the implementation in the web environment. At the end of this experimental phase a thorough evaluation should accommodate formulation of further projects and implementation of requirements for future modules. For the later implementations, investigation into a business model should be started.

For the elective modules mentioned in the last bullet, it was decided that two pilot projects would be undertaken: Firstly, the existing elective on "Image Fusion" of ITC's division of Applied Geomorphology would be turned into a fully-fledged on-line course using an existing Web-based learning environment (WebCT, build by University of British Columbia [1]). Secondly, the existing WebCartography course of ITC's division of Geoinformatics, Cartography and Visualization would be restructured to an elective, making extensive use of distance learning techniques, but specifically not to be used as a stand-alone package. This means that an important part of the module was to use traditional class-room exercises and practicals. It was not to make use of an existing learning environment with its inherent constraints, but would be realised using standard Web authoring techniques.

2 WebCartography at ITC

Using the World Wide Web (WWW) to disseminate spatial data has become popular in a short time. But to make sensible use of this medium, one has to take into account the special design needs for information on the WWW and the capabilities and pitfalls of spatial data dissemination through Web sites. The Web allows for a dynamic and interactive dissemination of spatial data, offering new mapping techniques and use possibilities, such as *animated maps*, *multimedia maps* and *virtual worlds*, which offer an alternative view from the traditional generalised and symbolised maps. A major new field is *exploratory cartography*, which creates an environment where geoscientists can work to solve their problems and make new discoveries. It is clear that technical limitations and user needs dictate that maps on the Web have special construction and design needs. One can not simply take the maps we previously offset-printed and show them on the World Wide Web.

2.1 Web Maps

If one looks at the mapping options, it is possible to distinguish between several methods that differ in terms of necessary technical possibilities from both the user's and provider's perspective. The overview given here (see figure 2) can only be a snapshot in light of the fast-changing nature of the WWW.

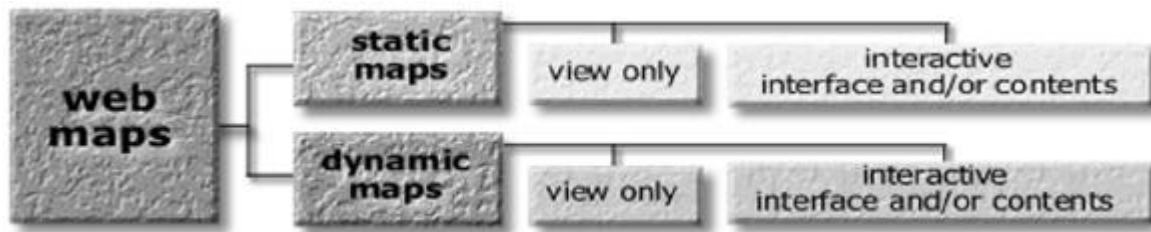


Figure 2: Classification of Web Maps [2].

An important distinction is that between *static* and *dynamic* maps. Each of these categories is further subdivided into *view-only* and *interactive* maps. The most common map found on the Web is the static view-only map. Static maps offer traditional map images, mostly stored as bitmaps. These can nevertheless be very useful, for instance to make historical maps more widely accessible, as can be seen at [3], where rare maps by the famous Dutch cartographer Blaeu can be viewed. When static maps offer more than view-only functionality, it can be to offer an interactive view to the user by offering zooming, panning, or hyperlinking to other information. It is also possible to have the user interactively determine the contents of the maps, by choosing data layers, and even the visualisation of the information, by choosing symbology and colours (see for example [4]).

Dynamic maps are about change; change in one or more of the spatial data's components. On the WWW several options to play animations are available. A set of bitmaps, each representing a frame from an animation are positioned after each other and the WWW-browser will continuously repeat the animation. Slightly more interactive versions of this type of maps are those to be played by media players, in AVI, MPEG or QuickTime format. Plug-ins to the WWW-browser define the interaction options, which are often limited to simple pause, backward and forward. These animations do not use any specific WWW-environment parameters and have equal functionality in the desktop-environment. Animations created via VRML or QuickTime VR offer interactivity to the user, e.g. the user can define the travel path, and make decisions on directions, height, etcetera. This is possible because these formats store a true 3D model of the objects, not just a series of 3D views. A nice example of this is the VRML model of Schiphol Airport [5].

2.2 WebCartography at ITC

It is obvious that WebCartography offers an important new channel for the dissemination of spatial data. Therefore, ITC's Division of Geoinformatics, Cartography and Visualisation, has developed teaching and research activities in this field. It has summarised the expertise gained in a recent book on WebCartography [2]. The Web site that accompanies the book [6] provides a dynamic environment for demonstrating many of the principles set out in the text.

Apart from introducing Web mapping techniques in the regular courses of Geoinformatics at MSc, Professional Master and Diploma levels, a specialised short course in WebCartography was developed for ITC students and others. This course is tailored to people who have a background in geoinformation technology, but have no or little experience in publishing their maps on the Web. It is focused on cartographic design and publishing techniques to create interactive Web maps. By offering theory and practicals on web maps, from simple static bitmaps, up to automated database-driven web maps and by gearing the practicals towards participants' own data and visualisation needs, we hope to offer a solid base for students to

start disseminating their maps on the WWW in a professional and effective manner. As mentioned in 1.2, this course that has now been restructured to a three-week elective, making extensive use of distance learning techniques.

3 A distance learning course on WebCartography

As mentioned before, the course does not make use of an existing learning environment with its inherent constraints, but has been realised using standard Web authoring techniques. Support for course participants is thus provided at a dedicated Web site [7] which contains course materials, interactive exercises and assessment and feedback possibilities. The structure of this site can be seen in figure 3.

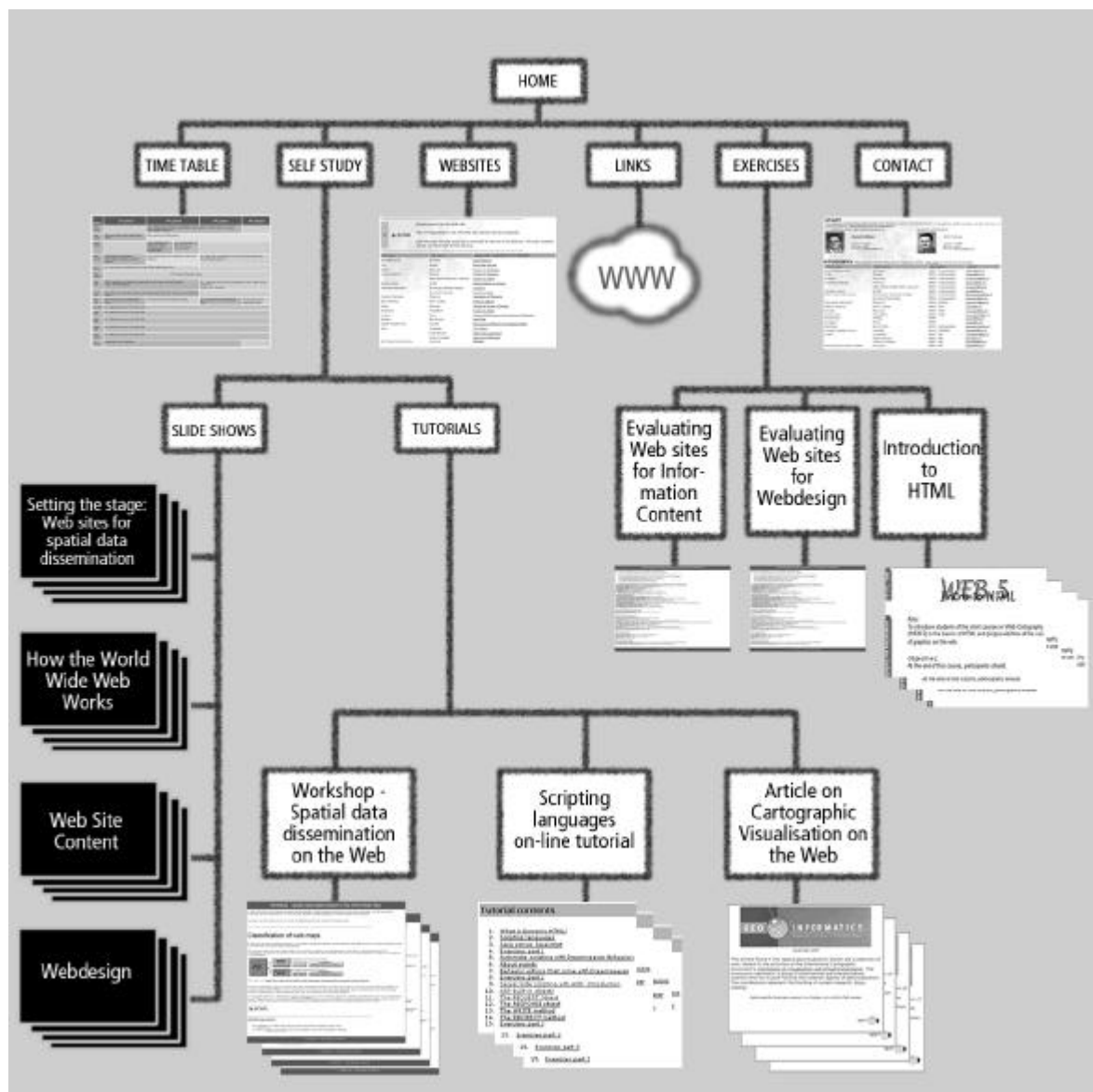


Figure 3: Site map of the support Web site [7].

The site has been authored using Macromedia's Dreamweaver UltraDev HTML editing software. It is hosted on the division's Web server, a Windows2000 Server running Internet In-

formation Server 5. As these kind of course sites should be useable by a multitude of users in a variety of places, care was taken to minimise the requirements put on the clients hard- and software configuration. Therefore no use was made of elements that require plugins, other than the pages that link to examples of WebCartography on the WWW. All interactivity and dynamic elements were realised either by using server-side technology (Active Server Pages) or by using client-side JavaScript optimised to run on any third generation Web browser.

The course was built using four types of educational elements :

- *Lectures + Practicals*: these are a mixture - theory and concepts are introduced and demonstrated by the teacher. Students can try them out immediately. All teaching materials used (slides, articles) can be found on the Self Study page;
- *Practicals*: for a more in-depth hands-on trying out of techniques using traditional practical descriptions. The instructions can be found on the Exercises page;
- *On-line Exercises*: following on-line instructions, students will make exercises and assignments;
- *Individual Assignment*: all students will individually publish a web site with content of their own choice. Requirements and instructions can be found on the Websites page.

The elements of the support Web site are:

- *Time-table page*: An interactive schedule of the course;
- *Self Study page*: this page holds links to various study materials, such as:
 - Slide shows on “Setting the stage: Web sites for spatial data dissemination “, “How the World Wide Web works”, “Web Site Content” and “Web design”;
 - A Workshop on “Spatial data dissemination on the World Wide Web”. In this workshop you are invited to explore the possibilities of cartography on the WWW. You can try out the examples that have been published on this Web site and the interesting features on the WWW that have been linked to;
 - A web version of an article “About Maps, Cartography, Geovisualization and Other Graphics”. The article is part of a selection of work related to the activities of the International Cartographic Association's Commission on Visualization and Virtual Environments. This dossier shows the frontline of Cartographic Visualisation on the Web.
 - Scripting tutorials: on-line descriptions of the technical and theoretical features of client- and server-side scripting. Here one can study the materials, see examples and be directed to the connected exercises.
- *Web site page*: This page holds the requirements for and description of the Individual Assignment and links to the websites made during the Individual Assignment. The web sites were assessed and marked by the staff at the end of the elective.
- *Links page*: This page provides links to the various Websites that can be of use for the students. The categories include Technology and history, HTML and Dynamic HTML, JavaScript and Active Server Pages, Clipart (free example graphics) and Web page design.
- *Exercises page*: Descriptions of the classroom practicals and on-line exercises. The latter includes a ‘Basic HTML authoring’ course [8]. This is a self-contained Web based teaching package constructed in 1999 as a preparation tool for the ‘traditional’ WebCartography course. It teaches the basics of the HTML coding, including theory, many examples and practicals, but no formal assessment. The Exercises page also includes two evaluation exercises, where students are asked to judge selected Web sites on information content and to fill in a check list to evaluate for web page design rules;

- *Contacts page*: On this page the students find possibilities to contact the staff and their fellow students (through email) and provide the staff with feedback and questions.

3.1 Results

At the time of writing, the first 'run' of the electives has ended. The students and staff of the WebCartography elective have been asked to evaluate various aspects of the courses.

There was no full evaluation made by the group that supervised the "Image Fusion" elective (using WebCT, see 2.1), but some general remarks can be made. There were a total of 32 students, of which 28 were located outside ITC. Of these latter only 11 finished the elective, apparently due to technical problems with the Digital Learning Environment (WebCT). The server for the site was located in the USA, which made access sometimes extremely slow, and not flexible in the sense that staff could not easily change settings, etc. The DLE was deemed not "open" enough, that is it was impossible to add functionalities outside the standard ones offered. As this course was to be fully online, theory was provided in the form of video lectures (digital video of a lecturer in the classroom, combined with Powerpoint slides) and also as audio lectures (slides with just the sound of the lecturer added). The former were considered useless, because of the low quality and lack of synchronicity, the latter were judged slightly better. Furthermore, it was found that the configurations of client computer were often not sufficient to use the on-line materials.

Several remarks can be made about the Web support for the WebCartography course. Firstly, the students (21 students, all inside ITC - all finished) have indicated that they enjoyed and appreciated the interactivity and feedback possibilities of the on-line exercises, the on-line Time-table and Contact pages and the Links page. 90% found the website a "major improvement over traditional means". They furthermore found the teaching materials offered on the Self Study pages offered a handy and up-to-date source of teaching materials. But for serious study of these materials, and especially the practical descriptions, most students preferred paper copies to on-line reading. Indeed, most students printed out the before mentioned materials. The effort needed to convert them to on-screen reading materials had thus been largely wasted, the provision of the 'raw' files would have sufficed.

67% finds that "some kind of face-to-face teaching is essential", more so if the subject is abstract, theoretical or conceptual, less so if it's technical or practical. 72% preferred on-line exercises and workshops over practicals in the traditional sense, where the supervisors are present and the time allotted for the practical is fixed and limited. Especially the self-paced nature of the on-line exercises and the availability of the materials for later reference was appreciated. 85% found the on-line feedback and assessment "satisfactory".

Staff members have found that the effort needed to change the existing materials to a web based format was limited. It has to be noted however, that the people involved were already quite experienced in web authoring techniques, and that for non-trained staff this effort can be a substantial one. The payoff is a set of materials which can be easily kept up-to-date, is re-useable in many situations and very flexible in its application.

All in all, the experiences gained with this experiment has strengthened ITC's determination to continue on path towards incorporation of distance learning techniques in its curriculum.

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