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DISCUSSION PAPER: EXCHANGE OF INTERNET-BASED GI TEACHING MODULES

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Abstract: Educational GI institutions have started to develop new internet-based teaching modules. Their motivation is to provide improved learning conditions for students, as well as saving human and financial resources. Yet, ongoing efforts by universities, institutions, and networks face many organizational and technical challenges. Single, non-coordinated efforts result parallel developments of similar solutions and a non-efficient use of resources. This paper suggests an international cooperation to exchange internet-based GI teaching modules. We suggest core issues for implementing an international cooperation.

1. INTRODUCTION

Internet-based learning is changing education in GI Science. This trend reflects both the political objectives (see Bologna Declaration, http://www.crue.upm.es/eurec/bolognaexplanation.htm; e-Europe action plan, http://europa.eu.int/information_society/eeurope/news_library/documents/eeurope2005/eeurope2005_en.pdf) and the needs of GI institutes and similar institutions. Many ongoing e-Learning projects and initiatives were presented on EUGISES conference 2003 (Third European GIS Education Seminar, http://www.giscampus.org/eugises2002).

GI is an international business. Many initiatives show the need for and the success of an international cooperation in business and research, e.g., OpenGIS Consortium, Global Spatial Data Infrastructure (GSDI), Geographical Information Systems International Group (GISIG), and Association Geographic Information Laboratories Europe (AGILE).

The successful introduction of the curriculum in „Geoinformatics“ at the University of Muenster, as well as similar programs at other universities, suggest an institutionalized exchange program in education. Only the exchange of information, organization, contents, students, personnel, ideas, and experience can assure high international quality standards.

From the students' perspective, intelligent interactive e-Learning improves the quality of education in this field, especially as beginners have very different levels of background knowledge. Because of this imbalance of knowledge, there are some students who are not challenged enough, whereas others cannot keep up in class. Interactive e-Learning courses provide the possibility for students to work on a topic according to his/her needs. One of the key issues is to implement the EC objective of life-long learning. E-Learning allows learning anytime and anywhere. Internet-based learning can support also non-traditional students, e.g., mothers with children. For example, a 40-year-old, employed as a landscape planner would be able to continue his studies in GI. However, he/she would not be able to attend courses in a regular program of studies. He/she would be dependent on learning at home and attending classes only short periods of time.

From the GI institute's perspective, e-Learning reduces the resources of personnel. The economisation can be used for filling gaps or to attract more students. For example, at the University of Muenster many students of other disciplines (geography, landscape ecology, economy) attend GI courses. This causes a capacity problem for our institute.

Currently, there are many single, non-coordinated efforts and parallel developments. If we assume that ten of the e-Learning initiatives presented in section 2 provide a basic GI module "GIS I", we calculate development costs of 10.000 € times ten. A sharing of teaching modules could save 90.000 €, which could be invested in

- Quality improvement, e.g., a module in location based services needs updating every year, because the state-of-the-art develops rapidly, and/or
- Additional courses; for the 100.000 € saved, you could almost develop a complete e-Learning master program.

In order to use the chances provided by internet-based learning and to overcome its impediments, we suggest an international sharing of resources in GI teaching modules. In addition to the general chances of e-Learning, a networked cooperation provides the following advantages:

- Improve quality of education by the design of modules with the combined knowledge of international partners
- Gain access to teaching topics and units that are not covered by the GI institutes' own staff
- Integrate rapidly improving and changing knowledge, i.e., in technologies
- Share resources and use synergies in the development of e-Learning environments and modules
- Use existing GI modules
- Promote e-Learning in GI Science
- Enhance internationalisation by English language modules
- Promote curriculum harmonization.

Section 2 describes existing initiatives by universities, educational institutions, and networks developing internet-based GI teaching modules. Section 3 evaluates the ongoing efforts by pointing out the impediments. Section 4 suggests an international cooperation and exchange of resources and provides general standards for implementation. Section 5 summarizes theses for the need of a shared use of teaching modules, and the implementation of an international cooperation.

2. EXISTING INITIATIVES

This section describes ongoing initiatives and projects for providing internet-based GI teaching modules. We present exemplary projects of single institutions, as well as national and international networks.

2.1 e-MapScholar

The U Edinburgh project (http://edina.ac.uk/projects/mapscholar/about.shtml) intends to enhance the usability and learning potential of spatial data resources, i.e., within the tertiary education sector, by developing three sets of new resources:

- Teaching case studies
- Software tools and customizable on-line tutorials
- Virtual placement (proof-of-concept).

Web-based products of OS (Ordnance Survey), software tools, tutorials, and learning materials support learning. Geospatial data, exemplar case studies, and customizable modularized resources support lecturing staff.

The project started in January 2001. e-MapScholar is embedded in the national JISC (Distributed National Electronic Resource), providing internet-based resources for many educational fields.

2.2 ESRI Virtual Campus

ESRI Redlands provides teaching resources in the Virtual Campus (www.campus.esri.com). They support users in the implementation of ESRI products. Twenty courses in GI Science, GIS application, and GIS technology are provided, twenty more are planned. A course provides 18-24 hours of content, and consists of six modules of

2-3 lessons. The first modules of the courses are free. In addition, a virtual library is accessible.

2.3 FreeGIS

FreeGIS is not an e-Learning approach itself, but it could serve as an input for e-Learning environments. FreeGIS is an open source platform for free GIS software and geographical data (http://www.freegis.org/index.en.html).

Interesting software are MapServer, OGC-conformant Web Map Server, PostGIS (spatial extension of PostGreSQL) and OpenGis (java-based desktop GIS).

2.4 Freestyle

Freestyle Learning is a multimedia learning system developed by the Department of Information Systems at the University of Muenster (http://pcwi1022.uni-muenster.de/fsl/e_index.php). It provides software and processes to enable teachers to integrate content in an e-Learning unit.

Freestyle Learning consists of two different platforms:

- The offline platform, an end-user product for the learner, provides working with complete learning units. Everybody can create these learning units with a professional and comfortable authoring tool. This platform is the base to provide knowledge and is supposed to support individual types of learning.
- The collective way of learning is supported by the online platform. Learners can share their knowledge through discussion boards or direct chats. Archives and links provide various enhanced and interesting resources and materials.

2.5 GIMA

GIMA is starting a new Masters program in “GI Management and Application” (http://www.giscampus.org/eugises2002/pdf/2_5.pdf). It is a project by the Dutch institutions ITC Enschede, TU Delft, U Wageningen, and U Utrecht. Courses are expected to start in September 2003. GIMA is not only recruiting regular domestic bachelors, but foreign students and professionals as well. Therefore, the M.SC. program obtains three characteristics:

- English language
- Education on a part-time basis
- Distance education.

The program takes 1,5 years, carried out over a period of three years. In the first two years students will take three modules each year, each module taking thirteen weeks. Two-week attendance is planned at the start and the end of each module. In the third year students will be working on a M.SC. thesis.

2.6 GI-Multimedia for a new interdisciplinary course of studies

The project consortium consists of nine interdisciplinary German partners. The mission is to introduce multimedia to GI courses (www.geoinformation.net).

Components are

- Fourteen teaching units, i.e., lectures. Each teacher can individually compose generic slides.
- Project environment for the provision of geo-data and geo-services. It provides the possibility to design and execute ongoing projects.
- GeoCafé for communication and learning interaction.

2.7 GISIG/Centro Interregionale

GISIG and Centro Interregionale, both in Italy provide a GIS long-distance education for officers of regional governments (www.gisig.it/cir/). The multi-media CD-ROM provides lectures for personal use, and some tutorial GIS software. Tutoring and three one-day workshops complement the 3-4 month long course.

2.8 GITTA

Swiss Virtual Campus aims to cover 75 % of the capacity of academic courses in Switzerland. The goal is to reduce presence in classrooms by 50 %. GITTA, the GI-related sub-project, is embedded in the national effort (http://www.geo.unizh.ch/virtualcampus/gitta/). The levels planned are basic, intermediate, case studies, and advanced. The project is scheduled 07/2001 – 01/2004; first testing of modules is planned in spring 2003. GITTA faces the challenge of offering its courses in four languages: German, Italian, French, and English.

A modular design (modules, lessons, units) supports teachers to choose needed materials according to his/her requirements. For students, e-Learning is seen more than putting lecture notes on the Internet. GITTA puts emphasis on self-learning units (including data and tools) and on communication among students and with teachers.

GITTA integrates its modules into the universities' curricula. A virtual training centre allows students from different disciplines to complete standardized learning units, earning transferable credit units. GITTA targets all levels and types of academic curricula; it offers courses for core GI disciplines as well as hosting application disciplines, which do not have the resources to implement their own GI courses.

2.9 Internet for GIS

The LEONARDO-EC project provides a web-based platform for distance learning on GIS. Ten international partners are a combination of universities, (U Girona, U Barcelona, U Nancy, and U Lulea) private institutes, and local and regional communities. The languages in use are Spanish, French, Swedish, and English. Internet for GIS targets university students, and personnel of administration and companies.

The education targets professionals employed by public authorities and private companies. Internet for GIS provides three platforms:

- Teachers' platform for developing and adding courses
- Students' access
- Intersites GIS (collection of information, e.g., library).

2.10 ISEGI-UNL e-Learning

ISEGI-UNL, University of Lisbon, offers a Master degree in GIS & Sc. (http://www.isegi.unl.pt/ensino/e-learning/default.asp). Two semesters of courses, including exams, are almost exclusively internet-based. E-Learning targets geographically dispersed persons in Portuguese speaking countries. Forty students already participate. The course is offered within the UNIGIS network. Some of the modules are provided by UNIGIS, and were some developed by ISEGI-UNL.

The two-semester program contains modules of GIS introduction, geospatial data (basics, models, operations, acquisition, quality), GIS applications, GI models, data mining, GIS management, and remote sensing.

2.11 MGI – City University of London

U London simultaneously provides both modes of learning in its Master program: distance and face-to-face GI education (http://oldspice.soi.city.ac.uk/mgi/intro/). In the distance-learning mode, students don't have to see the university at all. For those students, online communication is crucial and is provided.

Full time students take all courses in one year; part-time students need two years to complete their studies. Modules are GIS, data representation and management, visualization, information law and policy, application of GI, information management, research, evaluation and communication skills, GI practice, GI technologies, spatial programming, and research dissertation.

2.12 NCGIA Core Curriculum

The Core Curriculum in GI Science is currently in the developmental stages, (http://www.ncgia.ucsb.edu/giscc) will be composed of over 150 units of materials organized

as lecture notes and supporting materials. All materials are available free of charge. They are meant to provide fundamental course content assistance for educators to be adapted by each instructor. There is no comprehensive textbook for students, nor materials designed to be used as distance-learning materials. The materials focus on four branches:

- Fundamental geographic concepts for GIS
- Implementing geographic concepts in GIS
- Geographic information technology in society
- Application areas and case studies.

The report of IGE 98 (International Workshop on Interoperability for Distributed GIScience Education) provides many challenges and suggestions for sharing resources (see http://www.ncgia.ucsb.edu/ige98/).

2.13 OpenUSS

OpenUSS is an open source project for e-Learning environments (see http://openuss.sourceforge.net/openuss/index.html). OpenUSS targets developers as well as users. The users are universities, faculties, institutes and students that use OpenUSS as their publishing and information centre system (portal). They should have a simple system to deal with lectures, documents and exercises. The portal should be a communication centre for all members of such an organization. Universities, faculties and institutes that do not have the capability to run the system can use the reference implementation and outsource it to OpenUSS. This is important because many faculties have neither the know-how nor the possibility to set up such a publishing system.

OpenUSS is based on a component-oriented architecture. “Foundation Components” represent the e-Learning domain-oriented components like Assistant, Student, Enrolment, etc. OpenUSS implemented domain-neutral functionalities as “Extension Components”, e.g., lectures, discussion, chat. The separation of component types makes it easier to develop more functions separately from the whole system.

2.14 UNIGIS

UNIGIS is a network of fourteen European universities cooperating in GI distance-learning modules (www.unigis.org). UNIGIS members offer a postgraduate Certificate, a Diploma, and Masters courses. The network also works together in research and curriculum development activities.

UNIGIS provides distance-learning modules: spatial data modelling, databases, spatial operations, data acquisition and quality, spatial thinking, visualization, project management, project analysis, remote sensing, and professional GIS software. The modules target. professionals.

There are no examinations; the students are assessed via the assignments that they return for each module. Communication is mainly via Email.

Most of the materials are only available to UNIGIS students. UNIGIS has a system of royalty fees and concept payments for using the materials.

2.15 Others

More examples were presented on EUGISES 2002, Girona, Spain (see http://www.giscampus.org/eugises2002/.

3. THE NEED OF SHARING RESOURCES AND ITS IMPEDIMENTS

E-Learning is more than putting lectures on the web. E-learning requires the development of an e-Learning environment. Consequently, needed resources are high. Single efforts face many challenges, e.g., costs, lack of personnel, technical problems, conceptual problems, and lacking knowledge to cover all needed topics of a program of studies.

The examples of ongoing projects and initiatives show a non-efficient use of resources. Institutional resources, and national and international funding are often used for parallel

developments. Concepts, technical solutions, e.g., access and communication platform, as well as modules, e.g., basic GIS courses, are simultaneously developed by several projects. E-Learning projects lack a coordinated and efficient process.

Cooperation in development of e-Learning environments

- *Reduces costs*, because existing solutions, e.g., teaching modules, communication platform, learning software, can be used with few adaptations by many educational GI institutions.
- *Improves quality*, because the common development combines the know-how of several partners. For example, an educational institution providing ten internet-based modules cannot update them; improvements and knowledge is changing too rapidly in GI. Ten partners, each responsible for one module, could do that. In addition, even small institutions could cover needed topics, e.g., GI business, without having the specialized personnel.

However, institutions in GIScience education have different requirements to e-Learning environments. Cooperation in and interoperability of internet-based GI teaching modules face impediments:

1. Institutions in GIScience education address different students. Bachelor, master, and doctorate students with different goals, background, and curricula attend GI programs. Some institutions focus on a comprehensive education in GI, some on application of GI by other disciplines such as landscape planning, geography or water management. More and more universities recognize the idea of life-long learning and address professionals. They start competing with private institutes and companies; the differentiation between education and training gets weaker. Due to different user groups, different organizational frameworks, modules, and didactical concepts are needed.
2. International networks have language problems. Even national e-Learning projects, e.g., GITTA project in Switzerland, face the challenge of providing courses in four languages. If I as a German speaker had access to a French GITTA module, I could not even begin judge whether I could use it. Another consideration is translation costs for making it usable for German students.
3. European curricula still differ widely. Different requirements impede streamlining the development of international GI modules. Yet, harmonization is starting and influences national curricula. Technically, GI is improved through interoperability. This results in interoperable business models as well as interoperable education. GI is now used in many fields; a M.SC. in Geoinformatics has to know much more than just how to program a GIS. Topics like GI business have to be added to the programs of studies.
4. All projects consider student/student and teacher/student interaction to be crucial. “Isolated students” is one of the major dangers in distance learning. Virtual communities among students need detailed concepts and different solutions according to the users’ needs. Also teacher/student communication differs according to requirements for the various programs. Some assure contact by email, some accomplish distance-learning modules by attendance times. This affects different structures and content of GI modules.
5. Many GI modules are not ready-to-use for external teachers. Personal talks with colleagues can be summarized as follows: If I have to adapt an internet-based lecture to what I want to teach, and additionally have to conceptualise an exam, it is less effort to plan a teaching unit from scratch by myself. Interactive learning and using real software and data is generally accepted as an effective learning method and it reduces attendance of teaching staff. Yet, it is difficult and expensive to implement this kind of teaching modules. Therefore, offered lectures are many, and interactive modules are few. Currently, it is rarely possible to integrate a new topic into the program of studies by using an e-Learning module

without having an in-house expert who adapts the module and provides supervision.

6. Business models are different. For example, typical German universities do not charge fees, Portuguese university charge moderate fees, and other institutions completely exist through fees. Some larger institutions could contribute to a network of knowledge and solutions for an e-Learning environment, whereas some smaller institutes could contribute little or nothing.
7. Intellectual property rights limit the exchange of content. Using rights limit the use of data and software for educational purposes.
8. Quality assurance of teaching modules is not solved, sometimes not even discussed.

4. IMPLEMENTATION OF AN INTERNATIONAL COOPERATION IN INTERNET-BASED GI TEACHING MODULES

Educational GI institutions can profit by providing internet-based GI teaching units. Many projects and initiatives already provide promising solutions. Currently, there is little need to promote new developments. There is a need to combine existing efforts and results and share resources in a common framework. For example, student-student interaction is accepted as crucial for the success of e-Learning modules. Several solutions (concepts, content, technical implementation) have been developed. Adapting an existing student communication platform would ease the establishment of an e-Learning environment by saving resources. In the case of smaller educational institutions, it would even enable them to introduce e-Learning.

Based on existing e-Learning initiatives and its impediments, we suggest the following core issues for the implementation of an international cooperation in internet-based GI teaching modules (the numbered paragraphs refer to the impediments identified in section 3:)

1. Educational GI institutions are as different as their users. Consequently, their requirements for internet-based teaching units differ widely. International e-Learning standards are not in sight. We vote for a pragmatic approach: A European consortium of GI e-Learning providers, including current projects and initiatives, establish basic standards for their cooperation, e.g.,
   - Processes of organization and decisions
   - Description of offered modules by metadata
   - Basic technical standards of an e-Learning environment
   - Application of European Credit Transfer System (ECTS)
   - Provision of education, not training modules
   - And the following suggestions in 2.-8.

   Details of GI modules should not be standardized. Requirements, e.g., duration of a course, technical requirements of students, or curricula, differ too widely to make further standardizations useful. The consortium has to accept, that some of the provided modules can only be used by some of the other partners. This is no problem if the consortium is large enough.
2. E-Learning modules are internationally developed in many languages. A Spanish module cannot be used without translation in Switzerland. A Swiss lecturer cannot even decide if he could use the module and if it is worth translation, because (typically) he does not understand the content. A shared use of resources can only be organized efficiently in English language. In addition, we need more education in English: In all sciences, new results are mostly published in English. International consortia increasingly conduct research and industrial projects in English. This is especially true for a young science like Geoinformatics.

3. Although there are many efforts to harmonize European curricula, standardization is still far away. European initiatives, as the announced European GI Master Curriculum by UNIGIS, can be used to improve and adapt institutional curricula. A shared development and use of GI teaching modules can be used to overcome national or institutional barriers. An “ideal” common curriculum facilitates in-house argumentation for adding needed new topics, e.g., GI Business, or skipping old ones. However, an agreed curriculum should not be a requirement for a shared use of teaching modules.
4. In an e-Learning environment student-student and student-teacher interaction in a virtual community is crucial. Some programs complement e-Learning with long periods of attending classes. In other programs students hardly see the university. Standardization does not seem to be useful. A practical approach could be that a consortium provides two or three already existing solutions, including concepts, content, and technical implementation, for common use.
5. The emphasis of developing teaching modules should lie on ready-to-use modules. Lectures on the web are rarely ready-to-use. There is a need for interactive, self-directed small units and modules where students work with GI software and data. Ideally, modules contain supervision and exams, e.g., by the developers of teaching modules on exchange basis. Only the completeness of modules provides the opportunity to offer new courses without having an in-house expert on that topic.
6. A business model for an e-Learning consortium has to integrate the different models of its partners. Institutions that cover their costs by fees can more easily pay for e-Learning modules than institutions that offer free education. Larger institutions pay more easily than smaller ones. We suggest a credit point system which counts input in form of money as well as developing modules, evaluating, updating, and improving courses, providing a technical solution for a virtual student-student community, etc. It also should consider each partner’s resources, comparable to how the EC works.
7. Usage rights impede the common use of e-Learning modules. Developers should use materials not bound by intellectual property rights within the consortium. They should integrate free data as well as open source software or at least software that can be supposed to be generally used in educational GI institutions. Open source platforms, e.g., FreeGIS, OpenUSS, and Freestyle should be exploited.
8. Basically, cooperation should rely on trusting on the quality of colleagues in a consortium. We suggest a quality control of teaching units by its use. Each partner who uses a module evaluates it, which becomes a metadata of the offered module. In addition, each user updates a module.

5. CONCLUSIONS

We conclude three theses for the need of an international cooperation in internet-based GI teaching modules and eight theses for its implementation:

Needs:

1. Internet-based GI teaching modules can improve quality of education.
2. Internet-based GI teaching modules can reduce costs for educational GI institutions.
3. Shared use of - often already existing - GI e-Learning solutions is the only or at least the most efficient way to achieve cost reduction and quality improvement.

Implementation:

1. Form a European group of many GI e-Learning providers with few basic standards.
2. Develop modules in English language.

3. Take the opportunity to harmonize curricula by a curriculum model, but do not make a standard for cooperation out of it.
4. Provide three existing solutions for student-student and teacher-student interaction for common use.
5. Develop ready-to-use teaching units that minimize personnel resources of receiving institutions.
6. Create a business model that integrates large and small institutions as well as fee and non-fee oriented institutions.
7. Develop modules, which do not contain intellectual property rights, and very limited using rights of data and software access.
8. Control quality of teaching modules by evaluation of its use.

As a next practical step we suggest to use existing resources and apply for an EC project. Its goal is to create an organizational and technical framework for the exchange of internet-based GI teaching modules, and integrate existing content.

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