Chapter 1

Aspects of GIS education and Geography in European higher education

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Introduction

The use of Geographic Information Systems (GIS) and Geographical Information (GI) plays a key role in human activities today. GIS is widely applied in everyday life by many of the services we rely on. It is one of the fastest growing uses of computer technologies and is a fundamental part of modern geography (Ramirez, 1996). GIS is a tool that is being used extensively by researchers, scientists and administrators to inform decision making about real issues (Birkin et al., 1998). The application of this technology is increasingly being found in such areas as the environment (Htun 1997), resource and hazard management and infrastructure development. GIS operates at many different scales, including whole countries and increasingly in international circumstances (Patterson and Siderelis 1998). Educators are now investigating innovative approaches to using GIS in learning/teaching environments.

GIS requires digital map information, data for the maps and software to process the maps and data. It uses powerful computer tools to bring these three things together and is capable of assembling, storing, manipulating and displaying geographically referenced information (Blake et al., 2003). GIS also provides a system of ordering, managing, manipulating and transforming large quantities of information, leading to opportunities to combine, overlay or integrate data sources, based on spatial location. GIS is also capable of high quality, complex cartographic representation and visualisation of information. GIS is applied to solve problems related to analysis, management and efficiency (Camara, 1999), for example in urban and regional planning, transportation and natural resource management and environmental impact assessment (Agrawal et al., 2003). It thus provides an effective aid to decision making and management. Typical examples include Web-based systems such as Multimap.
European developments
As GIS is based on rapidly evolving technology, Goodchild and Kemp (1990) outlined the importance of international networking in order to share materials between colleagues around the world. Major GIS education conferences have been regularly held in many different locations (Kemp and Unwin 1997; Kemp, Reeve and Heywood, 1998). There have also been a large number of collaborative projects addressing specific issues associated with GIS in the widening Europe (Petrescu et al., 2003). However there remains a need to examine some of European developments at strategic level, as well as the issues faced by European departments of Geography.

Developing a cohesive GI Strategy at European level has remained a high priority for the European Commission. The European Union has sought to establish policy frameworks and infrastructures to promote a wider use of geographic information for decision-making, business, research, and society at large (Craiglia, 2004). The main challenges were identified as organisational, institutional, and political in nature. In order to address these challenges a European network (GINIE) was established bringing together national and pan-European GI associations. European academics were also brought together through the GISDATA programme. This was one of the early European networking initiatives that sought to encourage research collaboration specifically in social and environmental applications (Masser and Salgé, 1997). It organised a series of specialist research meetings and led to the formation of an Association of Geographic Information Laboratories in Europe (AGILE). The mission of AGILE (http://agile.isegi.unl.pt/) is to promote academic teaching and research on Geographic Information Science by representing the interests of those involved in GI-teaching and research at the national and the European level, and the continuation and extension of existing networking activities. Other initiatives like the UGIS Network (Erlingsson, 1998) encouraged have eastern European countries to become involved in GIS education.

Since 1999, the further development of a European Information Society has been promoted by the eEurope initiative (Commission of the European Communities, 1999). The key objectives have been to bring all citizens,
business, and administrations on-line, to promote education, and the availability of venture capital, and ensure that the whole process is socially inclusive while strengthening social cohesion. eEurope has been acted upon through two Action Plans for 2002 (Commission of the European Communities, 2000) and 2005 (Commission of the European Communities, 2002) focusing on cheaper internet access, education and skills, and key application areas including e-commerce, health, and the delivery of government services and information. This initiative thus highlights the significance placed on GI education developments reaching out all areas of European society as well as the important role played by higher education Geography departments.

GIS in higher education in Europe
GIS really started in higher education in the 1970's. At this time were a small number of pioneer institutions where new computer algorithms and programs were developed and basic concepts useful for the computer processing of spatial information were created (Kemp, 1999). GIS technology then developed rapidly, becoming commercially orientated. The new GIS software companies began to provide training programs for potential users of their products. Curriculum developments were, by and large, centred on and orientated towards the American market and its needs, for example through the US National Science Foundation funded curriculum development project that resulted in the development of the NCGIA Core Curriculum in GIS. This was designed to assist university teachers to develop their own introductory courses. By the mid 1990's, GIS education had become well established in diverse higher education course programmes throughout northern and western Europe.

The educational uses of GIS was initially strongly specialised, either in geography courses or in other more applied sciences (Masser and Toppen, 1992). However, GIS has now become a tool used across a growing number of disciplines, in more and more situations. Today, for example GIS exists in Geography, Forestry, Ecology, Landscape Architecture, Regional Planning, Geology, Environmental Science, Criminology, Sociology, History and many other areas (EEGECs, 2004). This is evidence of the power and adaptability of technology but also the growing needs of society. A major issue therefore facing GIS in undergraduate Geography in higher education is how to maintain a core subject curriculum while providing learners with opportunities to develop and apply new skills and choices in their degree programs.
Postgraduate courses in GIS are now also more widely available. They are usually related to professional needs and services, often learning how to use and apply the software by completing an in-depth research project. There are many subject areas which benefit from learning about GIS, leading to different types of careers and professional activities involving geoinformation. This diversity according to Kelly (2004) leads to a broad range of educational needs and makes it difficult to design specific GIS curricula to meet the needs of all these cases. There are thus a growing number of user-orientated GIS courses which are also targeted towards the professions. These are often provided through specific professional development courses and increasingly are made available online as they require customised courses with flexible communicative learning options (Buckley and Donert, 2004) that promote user-centred design principles (Corry et al., 1997; Cunliffe, 2000).

**HERODOT thematic network study**

In late 2002, members of the HERODOT thematic network for Geography in higher education were asked to complete an in-depth questionnaire about the state of Geography in their institutions, their work and in their countries. Responses were received from 63 partner institutions out of a total membership of 81 organisations at that time, based in 31 different countries. Of the responses received 12 organisations were only involved in teacher training, not offering undergraduate or postgraduate Geography degrees. Table 1.1 shows that courses in GIS were offered by almost 90% of universities and over 60% also provided courses in Remote Sensing and IT (Information Technology) in Geography. Two-thirds of those departments teaching GIS also undertook research in that area. 40% of the universities also provided professional development courses and one quarter provided work-based learning opportunities for their students. Therefore, technology-oriented Geography courses had been developed in most academic departments, while only one teacher training institution had incorporated GIS.
Table 1.2 shows that most departments taught these technology-based Geography courses at several levels. Frequently a basic course was introduced in the first year, usually demonstrating different data sources and some techniques, remote sensing was often also included, but also photogrammetry, cartography, surveying, geodesy and GPS. In many cases this introduction was taught as a skills-based course. More specialised courses in the use of GIS or in developing or applying GIS techniques and approaches were available later on in the undergraduate programmes, indicating course progression. As this survey was undertaken before the transformation of many European degree programmes to Bachelors-Masters systems, several institutions also provided information relating to years 4 and 5 of study. It was also significant that two-thirds of the teacher training only institutions also commented that they organised specific IT-based practical studies for their students.
The main issues involving IT-based practical work were also researched and this revealed the existence of three main situations. More than a quarter (27%) of the institutions considered themselves to be technologically well-equipped. They commented on the wide range of facilities available for study purposes. Many of them reflected that they were either centrally supported or in several cases the laboratory facilities were self-funded by income-generating activities, like research contracts, EU projects, running professional development courses or else through national funding. One department stated that they housed the national GIS research institute, thus benefiting greatly from this situation. More than half of the institutions (55%) were facing difficulties in maintaining the quality in the technology-based courses they were trying to run. They identified the main issues as a lack of up-to-date equipment, having too few useful resources (including readily available data), financial shortages and low levels or no technical support. The statements provided here identify some of the issues that were being faced:

“Equipment is very poor, we have to use the rooms and the equipment of another department (Austria).

Up-to-date laboratory provision has decreased in recent years and facilities now only allow small group work.” (Greece)

“Have different GIS labs and computer labs at university level, but there is a lack of funding to update equipment and software.” (Iceland)

“Problems to keep laboratories working due to insufficient funding.” (Estonia)

“The laboratory provision is very poor and financing zero,” (Lithuania)

“Problems of funding and time within a relatively tight curriculum.” (Malta)

A final group of institutions indicated that they were unable to offer any GIS or IT-based activities. Their comments illustrate some of the likely reasons for this.

“There are no facilities, equipment or funding for labs or practical work, therefore it is still mainly a theoretical subject.” (Italy)

“We are confronted with a lack of computer and multimedia equipment. We need specialised computer rooms within the Department of Geography).” (Slovenia)

“There is a lack of equipment and facilities and hence it is not feasible to include in curriculum.” (Sweden)

“Large numbers of students make any practical work somewhat problematic.” (Romania)

Several responses also noted that, despite the scientific and technological nature of many geographical courses, the obvious needs and student
demands for geo-technology rich learning opportunities, the status of Geography at an official level is still considered to be a non-technical or non-scientific discipline, resulting in the situation that the levels of funding supplied to the university do not realistically reflect the needs of the department or indeed of the workplace.

There was a wide diversity of course provision in GIS. This included formal university courses, introductory seminars, public events, workshops, community-based activities, distance learning and public-private partnership programs. These courses now not only address undergraduate and postgraduate level studies but increasingly technical and Continuing Professional Development (CPD) needs. It will also be vital to establish suitable training for professionals and decision makers in the use for example of analysis and visualisation approaches. Significant changes in the availability and need for information by citizens through, for example, eGovernment and eCitizen activities are likely to necessitate even more varied developments, if the general public are to be informed and educated about the role, value and importance of such information (McGarigle, 2001). As GIS education becomes even more diffuse and is directed at new audiences, so professional development becomes vital in understanding what needs to be taught and how to do it in a changing European society.

**Continuing Professional Development (CPD)**

The use of GIS has already undergone rapid growth in recent years due in part to the increasing demand for high quality spatial information in private and government sectors. Now that GIS is becoming increasingly pervasive and part of the daily operation of an increasing number of businesses and government activities, so the need for change in training and professional development is even more urgent. A technical workforce which has so far had little GI-training is now expected to start working with the newly available tools. Sandelands (1998) believes that there will therefore be a massive increase in the demand for continuing professional development (CPD). Many new introductory and more advanced GIS training courses already need to be developed in Europe as more and more organisations require the information systems which are centred on GIS concepts.

The speed of change in GIS also necessitates a reengineering of the present education system. So, while traditional courses in Geography with
GIS will still be a major part of university provision, the most likely growth will be in providing professional courses and updates offered through distance learning or via elearning (Blake et al., 2003, Mooney and Martin, 2003; Sorensen, 1998), Rhind and Raper (2001) comment on the fact that GIS education and training also needs to be transformed from having a technological focus to one with a humanistic science viewpoint (Longley et al., 2001). Clearly, new types and forms of training are also required by our society, this will need to make the most of existing European ‘know-how’ and develop many new centres and different approaches to meet the expanding demands.

From a European context, higher education and qualifications have not until recently been the subject of common European policy. Such activities still tend to be organised at national or even organisational level. Professional associations like the AGI (http://www.agi.org.uk/) have attempted to provide a CPD programme based on their analysis of national needs, leading in many cases to professional certification (Kemp, 1999). The significance of validating such qualifications, thereby ensuring transparency is demonstrated by the Bologna Declaration of June 1999, which called for the establishment by 2010 of a coherent, compatible and competitive European Higher Education Area (Commission of the European Communities, 2003), adding specific European dimension to higher education. The development of centres of excellence from networks of European experts that will encourage life-long learning must then become a priority in order to encourage the benchmarking of standards for professional qualifications.

**Professional Development of Academics in Higher Education**

In Europe, apart from some notable exceptions, there are few professional development opportunities available for academic Geographers in higher education to learn about new technologies and innovative teaching strategies (Donert, 2003). Despite the obvious needs, professional development also remains relatively unattractive to many academics working in European higher education. Research priorities continue to dominate over teaching in terms of status, and significantly in funding. With this context in mind and to meet some of these important needs, the European thematic network for Geography in higher education (HERODOT) was established in 2002 with the aims of:

- developing strategies and methods to strengthen forms of cooperation between education organisations
• contributing to descriptions, analyses and comparisons of Geography and geographical education programmes and policies
• strengthening links between research, professional training and geographical education

In order to do this, the HERODOT thematic network reports on the impacts of curriculum change, promotes excellence in the teaching of Geography and training of Geography teachers, it performs a coordinating role, disseminating information, good practice while raising awareness of the need for pedagogical considerations in curriculum development by developing a framework for organising higher education professional development.

As HERODOT seeks to meet the professional development requirements of its partners, so a review of the concerns and training needs of partners formed an important part of the initial network survey (Table 1.3). Subject and departmental status was said to be an issue in several countries as there were more rewards in salary and status for research and publication rather than for time spent on course development and teaching. Nevertheless from the survey, pedagogical aspects were of greatest concern to academics. These included the need to provide student-centred approaches, though the shortage of study resources was cited as a major limiting factor in this. Active approaches, critical thinking, communication and co-operative opportunities were mentioned as key aspects of learning, whereas constructivist pedagogy and maintaining the inter-disciplinary subject nature of course developments were seen as important in teaching terms. Innovation and change was of significant concern in many replies.

“...... after 30 years of teaching ..... I remain interested in trying new ideas.”
(UK)

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<tr>
<th>Main professional concerns</th>
<th>CPD needs</th>
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<tr>
<td>Pedagogy issues 45%</td>
<td>International 43%</td>
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<td>Resources 31%</td>
<td>research 26%</td>
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<td>IT 23%</td>
<td>GIS 26%</td>
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<td>Subject issues 19%</td>
<td>Pedagogy 20%</td>
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<tr>
<td>GIS 17%</td>
<td>IT 17%</td>
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<tr>
<td>CPD of staff 5%</td>
<td>Others 12%</td>
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<td>Research 5%</td>
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<td>Subject status 5%</td>
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<td>Time 5%</td>
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<td>Lifelong learning 2%</td>
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“I am concerned about how to develop and teach Geography as an exciting and core subject.” (Norway)

However, resource limitations and lack of time led to obvious concerns. “The growing number of students and the nature of classes impose certain strategies. I prefer to use active methodologies…. but due to the great number of students per class, these cannot be put into practice.” (Portugal) “We are …..limited by the numbers with whom we have to deal. This means that development of interactive/innovative teaching/learning is hard to implement. It does, however, mean that there is frustration at times - the students feel they need more time/attention, while staff feel exactly the same!’ (Ireland) “We have too many students to teach to have small practical groups at undergraduate level.” (Romania) “My main professional concern remains the survival of my department as increasing and retaining student numbers are an issue ....” (UK)

The CPD needs of academics demonstrated an important role for HERODOT in providing international collaborative opportunities to share pedagogical approaches, resources and research developments. “I wish to develop international contacts and projects in teaching area as well as research. The opening of the university to international collaboration must be a priority and I would like to be involved in this process.” (France)

This was also the case in the replies from the new member states and accession countries. “We need support to attend on conferences, funding for research, IT equipment- because … support for higher education and scientific research is extremely restricted” (Bulgaria) “More support and greater involvement in EU projects and international programmes... “ (Estonia) “… need active international connections (exchange of teaching and learning experiences, techniques, resources etc.).” (Slovenia)

The identification of significant professional development needs in GIS and in IT (including elearning and distance education) was also important, though as academic careers remain mainly judged by research activities and publications, the lack of time for CPD and the need to obtain funding for research were also important aspects to consider.
In was under the above context that the HERODOT network, with the Geography Department of the University of Malta and the GIS Software Company ESRI organised a professional development workshop on the theme of GIS for European higher education Geographers, on which this publication is based. Twenty two members of the HERODOT network from 17 institutions and 12 countries applied for and attended this event. Their contributions are presented in this publication as preparation for them to implement GIS in their own academic context in their institutions and to also help them meet their need to research and publish.

Loucks-Horsley et al. (1998) suggest that there are five factors which determine whether professional development is effective. These are:
1) expert knowledge through a leader or facilitator
2) time away from the workplace
3) a curriculum or syllabus to inform the participants about the content
4) access to resources and materials, such as classroom materials, texts, and software
5) incentives for teachers to integrate GIS in their classrooms.

These features were addressed in preparation for the GIS workshop and seminar. ESRI provided expert knowledge, resources and an expert facilitator of the event (Ann Johnson, ESRI) The University of Malta enabled the activities to take place in an expert European context. The event took place in one of the new countries of Europe, at a venue where an ESRI-sponsored laboratory could be provided as a high quality venue, with suitable up-to-date and relevant software, with local and international data and other valuable resources. The curriculum was tailored to meet the needs of the audience and suitable resources and materials, including free books, software, publications and data were provided for the delegates by ESRI. Finally, the European Commission sponsored the event through the HERODOT thematic network, which enabled less experienced academics to benefit.

Conclusions
Geography is the study of places and their relationships with each other. Thus, geography provides a conceptual link between local cultural and environmental spaces, the surrounding region and the world beyond. Geographers study the ways that people interact with their environment and with each other. Geography is therefore rich in material that relates to spatial location. Tools and techniques used in Geography help us
understand people and places. Through geography we can understand the relationships between places, people and local, national or international policies and we can use geographical knowledge to make informed decisions regarding the best use of landscapes, land uses and resources. Geography also provides important clues to the past. Landforms and climate are related to the rise and fall of civilizations. How people use the land has a strong bearing on the economic progress of regions. Studying Geography can thus help us to be better citizens and to participate actively and meaningfully in civil society.

Geographers have developed theories about how location impacts different aspects of the human and physical environment. Geographers describe changing patterns and seek to unravel their meaning and likely implications. Digital technologies for analysing the impacts of location are very recent. In the United States the study of geography is enjoying resurgence partly on the wave of GI technologies (Bednarz, 2000). This is not so far the case in Europe, where Geography remains a threatened discipline (Donert, 2003).

GIS is now becoming firmly established in school and college curricula. In some cases partnerships are emerging between schools and institutions of higher education to tackle the challenge of developing useful tools and relevant GI learning approaches (Sawle, 2004; McClurg and Lerner 1998; Lyon 1997). Learning with GIS has rapidly changed in recent years (Petch, 2000). So, while a core set of GIS content could be identified (Kemp, 1998) and a single accreditation system could be established (EEGECs, 2004), it is also necessary to recognise and respect that there are many different individual learner needs (de Bakker, Goldsborough and Meyles, 2002). In Europe, the first extensive, in-depth study to determine the necessary components for a European international post-graduate course on GIS was undertaken by GIS experts from different disciplines in 1993. Their proposals suggested the use of a subject-centred approach to GIS course curriculum (Kemp and Frank, 1996). However, an in-depth analysis of what higher education departments should teach to meet the needs of European society should be undertaken, in order to then design an appropriate curriculum to fit the varied needs (McAlpine and Weston, 1994). So, there are clearly many different challenges facing European higher education Geography departments in their quest to use GIS as an exciting and highly innovative learning tool (Thurston, 2001).
GIS education initiatives and related research has been extremely piecemeal in Europe. Thematic networks like HERODOT bring academics with similar interests but different experiences together to learn from one another by demonstrating good practice in the broad variety of institutional characteristics and cultures. This publication thus seeks to demonstrate that there is considerable variation but also fragmentation in the education, training and use of GIS in European higher education. There are many different attitudes and approaches employed across different educational levels. Whether they are successful remains to be seen. There is thus remains a real need to comprehensively examine what GIS education is taking place in Europe, where and how. In this book, some aspects of the wide spectrum of existing GIS education in different European higher education institutions is presented. Some of the driving forces which have led to the development of these GIS courses and their approaches are examined and in some cases what is taught and how it is accredited is explored. Professional development is also specifically highlighted. Some suggestions for matching education needs to education strategies are outlined. Finally some likely future educational needs are identified and in some places, plans proposed without attempting to provide solutions.

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Chapter 2

Teaching and Research Activities within the Faculty of Geology and Geography at the Sofia University “St. Kliment Ohridski”, Geography and GIS Degree Programmes, Sofia, Bulgaria

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Sofia University “St. Kliment Ohridski”
Sofia University "St. Kliment Ohridski" is the first school of higher education in Bulgaria. Its history is an embodiment and a continuation of centuries of cultural and educational tradition in this country. Organized education activities in Bulgaria date back to the second half of the 9th century. During the period of the National Revival a new idea for opening a School of Higher Education was born. The authority of the School of Higher Education grows with the cultural and educational mission it acquires after the Liberation of 1878. Year by year the Sofia University turns into an academic and scientific center on the Balkans which is a fully developed academic institution with European prestige. Today the Sofia University "St. Kliment Ohridski" is the largest and most prestigious educational and scientific center in the country. At present the academic structure of the University consists of 16 faculties teaching 75 major subjects to more than 20,000 students, 1,400 of them from abroad. Sofia University maintains traditionally good contacts with the major universities of Europe, the United States, Asia and Africa.

Faculty of Geology and Geography
The subjects Geology and Geography were introduced in the Sofia University “St. Kliment Ohridski” at the end of the 19th century. They are
the basis of education and science of Geology and Geography in Bulgaria. There are about 1200 Bulgarian and foreign students at the faculty. The teaching staff comprises about 90 high-qualified Professors, Associate Professors and Assistant Professors. Educational and research projects are supported by 46 specialists with higher education. There are 3 degree levels – Bachelor, Master of Science and PhD. The school year is separate in two semesters, 15 week each, ending with examination session. The educational process comprises lectures, seminars and individual forms like reports, tasks, and laboratory practices. There are educational practices – at one place, or excursions to selected geographical tourism and geological objects. The Faculty of Geology and Geography gives opportunities for additional education and post-graduated qualification. In our faculty we have 4 specialties: “Geography”, “Tourism”, “Geology” and “Regional Development and Policy” (from 2005 year).

**Geography**

University Geographical education in Bulgaria started at the beginning of 1898. At that time the Department of Geography and Ethnography was founded in the History and Philology Faculty. Nowadays education takes place in five departments. Bachelor degrees take 4 years (8 semesters). Their aim is to prepare broadly-educated specialists in Geography. The students can achieve pedagogical qualifications, which allows them to work as teachers at secondary and high schools in Bulgaria.

A Master Degree in Geography takes 3 semesters, totalling 45 weeks. The candidates are ranked after the mean marks from the state exam, or diploma work and the arithmetic mean of all semester’s exams. The Master Degree Education is specialized and is conducted in different profiles. The choice of a profile is done at the application stage. When the candidates apply, they should rank profiles after their preferences. The following profiles for the Master Degree in Geography are proposed:

- Geographical Information Systems (GIS) and Cartography
- Geomorphology
- Hydro-climatic Resources Management
- Physical Geography and Landscape Ecology
- Regional and Political Geography
- Regional Development and Management
- Human Resources Management
- Civil Registration and Administrative Servicing
- Geographical Education
The Doctorate Program (Ph.D.) in Geography is a three (or four) year program and requires a pre-approved area of specialisation. The following profiles are proposed:
- Geographical Information Systems (GIS) and Cartography
- Regional and Political Geography
- Regional Demography
- Geography of population and settlements
- Physical Geography
- Social and economic geography

Geographical Information Systems (GIS)
Geographical information sciences are well presented in the Faculty of Geology and Geography. A new department called GIS and Cartography was founded in 2000.

A number of significant scientific projects completed under the guidance, or with participants from the department include:
- MICCPAM: Modules for International Countryside Conservation, Protection and Management
- GIS and REMOTE SENSING MODULE” (1999-2001),
- SOCRATES grant for the Open Distance Learning Project № 70976-1-1999-1-UK-ODL-ODL; “Harmonization of the Bulgarian environmental legislation with the EU requirements” (2000-2001), financed by the Regional Environmental Centre for Central and Eastern Europe
- “Assessing Bulgarian deforestation using remote sensing, GIS, and survey techniques” (2002-2004); NATO SCIENCE PROGRAMME Cooperative Science & Technology Sub-Program, COLLABORATIVE LINKAGE GRANT № EST.CLG.978637; participants: Assoc. prof. Anton Popov, PhD, Assoc. prof. Ivan Tcholeev, PhD, Assoc. prof. Anton Filipov, PhD, assist. prof. Stelian Dimitrov.
- “Pan-European geographic network HERODOT”, project financed by the European Commission
- “Assessment of the moisture condition in Bulgaria” (1994-1997 r.);
- “Landscape map of Bulgaria in scale М 1: 200 000 (1995-1998), under the guidance of prof. Petar Petrov, PhD;
• “Satellite map of Bulgaria in scale M 1: 300 000”, project financed by “CIELA”;
• “Satellite atlas of the Republic of Bulgaria”, project financed by “CIELA”;
• “GIS based spatial analysis and modelling of the accessibility to services in Sofia”, financed by the Bulgarian Science Fund;

The project “Assessing Bulgarian deforestation, using remote sensing, GIS, and survey techniques” was awarded first prize at the autumn fair in Plovdiv, 2003 for scientific achievements.

The Cartography and GIS department was awarded in 2003, for its scientific achievements, “GIS University of the Year” by ESRI Inc. Bulgaria.

The main teaching and research activities include the following areas:
• Environmental management and assessment
• Thematic mapping
• Geographic Information Systems
• Spatial analyses and modelling
• Remote sensing

Education and research work in the department is done using sophisticated computer equipment housed in a geoinformation centre which is equipped with Intranet and broadband Internet. The Cartography and GIS department is licensed to use the following specialised software products:
• For vectorisation and data entry - MapInfo Professional,
• For spatial analyses and modelling - ArcView GIS 3.2; ArcGIS 8.3 Desktop,
• For analyses, interpretation and integration of satellite imagery into GIS environment MicroMSI, PCI Geomatics, ERDAS Imagine 8.6;

The Department is equipped with the following specialized hardware: multimedia projector PHILIPS, plotter HP DesignJet 350 C, printer-copier Work Center XE 84, scanners A4 ACER S 2 W 3200 V, copier XEROX XC 23, projector 3M 9050, state of the art personal computers, etc.
The Cartography and GIS department is involved in the following main activities:

- GIS databases creation, integration and manipulation (incl. digitalization of hypsometry, hydrography, transportation networks, settlements, land-use, land cover, recreational features, industrial zones, pollution sources, etc.);
- Generation of digital models, representing natural and anthropogenic geographic features;
- GPS, registration and rectification of spatial data in GIS environment;
- Object-oriented GIS database development, for environmental management;
- Analyses, interpretation and integration of satellite and aerial imagery;
- Development of multimedia products based on virtual environmental models, incl. digital elevation models, etc.
- Creation of different cartographic products

Table 2.1: disciplines offered in GIS and cartography

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<tr>
<th>Disciplines</th>
<th>ECTS credits</th>
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<tbody>
<tr>
<td>1. Geoinformatics</td>
<td>5 /compulsory/</td>
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<tr>
<td>2. Theoretical Cartography</td>
<td>5 /compulsory/</td>
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<tr>
<td>3. Topography</td>
<td>5 /compulsory/</td>
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<tr>
<td>4. GIS</td>
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<tr>
<td>5. Fundamentals of Geodesy</td>
<td>5 /compulsory/</td>
</tr>
<tr>
<td>7. Research Project</td>
<td>14 /compulsory/</td>
</tr>
<tr>
<td>10. Map Publishing</td>
<td>9 /optional/</td>
</tr>
<tr>
<td>11. Cartographic Fundament of Cadastre</td>
<td>9 /optional/</td>
</tr>
<tr>
<td>12. Spatial Modelling</td>
<td>9 /optional/</td>
</tr>
<tr>
<td>15. Analysis, Interpretation and Application of Satellite Images</td>
<td>9 /optional/</td>
</tr>
</tbody>
</table>

Table 2.1 provides an overview of all disciplines offered to students in GIS and Cartography. All those taught within the Faculty are compatible with the ECTS standard. An academic year consists of 60 credits and a semester – 30 credits. MSc in GIS is organized in three semesters (90 credits).
Future plans of the Faculty, related to GIS

One of our future intentions is to develop an introductory course in Geodemographic Information Systems. This course will be offered to students in the following postgraduate programmes - “Citizen Registration and Administrative Service”, “Regional Development and Management”, “Human Resources Management”, “Regional and Political Geography”. By developing the above course students will be able to perform various population and housing related spatial analyses and will gain experience in solving real world problems through various case studies. Students will explore demographic information for countries of the world, visualize historical events and explore demographic trends over space and time. Special attention will be paid on the application of spatially distributed demographic data for business applications (location-allocation analyses, suitability analyses, etc.). Our vision about how the discipline should be organized definitely involves the use of territorially referenced quantitative demographic and other data, analyzed through various statistical and geostatistical techniques.

Students will, by using Geo-demographic Information Systems be able to describe geographical areas in terms of the number and characteristics of persons, households, labour force, farms, and many other related spatial phenomena. After pre-processing, students will manage to analyze trends and spatial patterns, rank-order attributes and profile the key characteristics of these areas, to segment and classify the territory, to predict or estimate a vast scope of aggregate and individual human behaviours and conditions. Mapping of population related phenomena is also foreseen.

A course in Geo-marketing is to also be offered to postgraduate students soon. After successfully completing the course they will be able to produce data series giving geo-demographic estimates of sales. By afterwards integrating those estimates with other relevant data they should be able to delimit promising retail site locations. Students can also perform geodemographic analysis of retail or direct sales of consumer goods, sample survey models measuring individual consumers’ behaviour, attitudes, expenditures and preferences for specific products and services, responses to political polls, health data, and vital statistics.
Another course to be developed within the Faculty of Geology and Geography for the undergraduate educational level addresses the behaviour of the major ethnic groups in Bulgaria. The main purpose of this course is to analyze the spatial behaviour of the major ethnic groups in Bulgaria (Bulgarian, Turkish, and Roma) during the transition period from 1989 onwards. Existing courses do not pay enough attention to this important, yet interesting scientific problem. There is still no single course, defining patterns of spatial behaviour and comparative analysis of the mobility of the different ethnic groups. Factors, conditions, cause and effect of the migration of ethnic groups also need detailed analysis. Analysis of the behaviour of the ethnic societies in space will reveal new aspects of their ethno-cultural characteristics and will allow formulation of concrete actions for conducting an informed and adequate demographic and social policy. The expected result includes the formulation of a new course for spatial pattern analysis of the spatial behaviour of the different ethnic groups. The transition of the Bulgarian post-communist economy to market economy has resulted in difficult social and economic conditions in particular for the minority ethnic groups like the Roma and Turkish. The process of integration to the united European structures leaves unsolved many problems, related to minority integration. Different ethnic groups have to be studied thoroughly so that better decisions addressing social cohesion can be taken.

Creation of a postgraduate degree programme called “Digital Geography”, responding to the growing demand for qualified GIS specialists is foreseen in the 2006/2007 academic year. The programme focuses on the geographical fundament of GIS. The programme will be structured to provide professional education in the areas of geographic information systems, spatial analysis, spatial modelling, mapping and remote sensing. Graduates will receive a broad knowledge on geographical concepts that underpin geographic information technology, as well as the necessary geoinformation literacy, letting them become more educated, skilled and employable.

From 2005 onwards our Faculty starts a new four year bachelor programme – “Regional development and policy”. This will be the first such program in Bulgaria.
References
Slaveykov, P. (2003): *40 Year Anniversary of the Faculty of Geology and Geography*, Sofia (in Bulgarian)

Relevant web sites
Sofia University “St. Kliment Ohridski http://www.uni-sofia.bg/
Faculty of Geology and Geography http://www.uni-sofia.bg/faculties/geo/
Cartography and GIS department server http://www.gis.gea.uni-sofia.bg/en/
Bulgarian Ministry of Education and Science http://www.minedu.government.bg/
Chapter 3

Towards “Digital Geography”: teaching GIS through Geography

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Introduction
This chapter attempts to outline the main problems of GIS education which are mainly related to the excessive ‘technologisation’ of the discipline. It also presents our vision for the implementation of a new masters program in GIS at the Sofia University “St. Kliment Ohridski”, aiming to offer to students a more “geographically” orientated GIS knowledge and skills.

‘Instead of Introduction’: Brief history and state of the art of GIS in Bulgaria
GIS has become popular in Eastern European countries, including Bulgaria, relatively late when compared to the rest of Europe. The main reasons for this were political: GIS was part of something which used to be referred to as “bourgeoisie” geography. At the same time the technological components, needed by any GIS were developed in the “Western world”, and therefore were not very accessible for the countries form the former “Socialist Block”.

In the beginning of 1990s, when the totalitarian regime ended in Bulgaria, GIS technology started to evolve very slowly in this part of Europe, and naturally the academic community was among the first, to start using and implementing GIS solutions.
Despite the initial interest, GIS was not very well known, not only within the academic community, but also in the newly formed IT market, until the mid 1990s. GIS started to rapidly evolve after 1995, primarily due to the needs of various Governmental agencies. The ‘era’ of state funded GIS initiatives, similar to the one in the Western countries during the 1970s had started in Bulgaria. This led to a serious ‘push’ of GIS development and stimulated the establishment of the first GIS courses taught in the Bulgarian Universities.

The first GIS course, taught within Sofia University began in the academic year 1995/6. It was an elective course which was initially not very popular among students. Gradually, geographic information sciences found their place within the Bulgarian educational system and today GIS courses and programs are found in most Universities and relevant academic institutions.

Contemporary problems for the implementation of GIS

Geography was in the past often regarded to as a purely descriptive science. Our science is doubtlessly quantitative instead of qualitative from the beginning of the 1970s onwards. Today, it is also one of the most rapidly developing disciplines, by explaining, analysing, managing, and predicting spatially related problems in a quantitative manner. Furthermore, we might even consider modern geography to be a high-tech discipline. The main reason for making the above statement possible is the existence of GIS and all related geoinformation disciplines (remote sensing, spatial econometric analyses, GPS, etc). Moreover, the rapid development of GIS and their ability to solve real world problems, leads to an increased demand for educated GIS operators, developers and users. This has become one of the major challenges for Geography departments worldwide. It is however easily noticeable that most GIS courses consider GIS purely as a technology and are frequently software specific, i.e. GIS has become business and as a technological area needs trained ‘workers’, being simply technical persons.

Although GIS is widely used in Bulgaria, and despite the fact that there are certain positive results from the implementation of GIS, there are still many unsolved problems. The most important of them were stated by Kotsev and Dimitrov (2004), as:

- **Awareness of GIS:** Geographic information systems can, as mentioned above, be considered to be relatively new to transitional countries like
Bulgaria. Potential users are not fully aware of the GIS functionality that they can benefit from.

- **Irrelevant Legislation:** Probably, one of the biggest problems for implementing GIS in Bulgaria is the absence of an appropriate legal framework, regarding spatial data, the rules for dealing, distributing and processing such data. The absence of an adequate institutional infrastructure for the implementation of GIS is also a very serious problem.

- **Lack of experts and expertise:** A problem, typical to the country is related to the education of the GIS specialists. There is an obvious lack of capacity in the institutions to work with contemporary geoinformation systems, and the current education situation is the main reason for that. The established practice to train, instead of educate GIS specialists in Bulgaria resulted in a lot of problems: varying from inadequate geographic data production to jeopardizing multi-million euro projects.

Taking into account all that is stated above, a group of geographers, working in the sphere of GIS, decided to establish a geography based GIS degree programme within the Faculty of Geology and Geography at the Sofia University, which aims to replace the existing MSc program in GIS and Cartography. This new degree program, informally called “Digital Geography” has to not only offer GIS and technological skills, but also the necessary geographical knowledge fundament.

**The drafted MSc program - “Digital Geography”**

The leading motto of the program was inspired by the role, which geography plays in GIS, namely that it consists of the scientific fundamentals of GIS and the technology only provides a framework. Despite the fact that, operations in GIS appear to be largely technical in nature, one of the most important issues for the GIS operator or user is to be aware of the geographical concepts that inevitably underpin any GIS operation. This is what we believe differentiates GIS education from any other IT discipline.

We have therefore formulated five basic principles, to express our vision about how the proposed program should be designed:

1. Fundamental to understanding GIS is the recognition that the GIS model is not only specialised computer model as in conventional databases. It is an interpretation of geographical space, and the
modelled objects and phenomena need to be as close as possible to the real world.

2. GIS is ‘as different as it is similar’ to traditional geographical analysis and mapping, meaning that the GIS education should be organized in close relation to the core Geography program of the department or faculty.

3. Taking into account the above principle, it should be pointed out that there are different types of GIS specialist, such as GIS users, GIS developers, GIS “architects” and managers. The level of their geographic competence should be different for each type of specialist. The program should be designed to serve either a specific level of GIS specialists or gradually to build knowledge from GIS user to GIS “architect”. The latter should be familiar with all the geographical concepts that GIS technology is built upon.

4. The didactic, two-stage educational approach (introduction, followed by an advanced course) is simply not efficient in GIS education. A case study approach with extensive hands-on experience provides better focus, but also puts a greater burden on individual instructors and facilities.

5. GIS is no longer a cameral discipline – modern GIS and geoinformation are mobile and thus a significant part of GIS education might be organised in the field.

Conforming to these basic principles, the MSc program in GIS at Sofia University is designed in four mutually penetrating and interacting modules, which are tightly connected to the core geography program of the Faculty of Geology and Geography:

i. GIS fundamentals module: This module gives the necessary theoretical knowledge about the geographical concepts behind GIS technology, Geographical (Spatial) modelling, traditional and computer based mapping, Principles of GIS, etc.

ii. GIS attributive module: Here students need to receive the necessary computer literacy, as well as knowledge and skills in Remote Sensing, Geodesy, Photogrammetry, Statistics, and all other related disciplines.

iii. GIS applications module: Stress is placed within this model on so-called problem-based learning. A case study approach is foreseen so that students will get to know how real-world problems are solved through GIS.

iv. GIS practicum: including field work thanks to the so-called “mobile GIS” applications.
The time line organisation of the programme needs to be slightly different from the standard ‘two stage’ approach: introduction and an advanced level, including applications. This two-step approach is likely to produce GIS technicians, instead of GIS specialists with competences to design more reliable and representative computer-based geographical representations. Therefore the fundamentals are formed of geographical concepts and courses, developing spatial thinking among students. The applications module stretches throughout the entire duration of the programme. It gives students the necessary link to the real world GIS implementation in business and the public sector. Students in GIS must be fully aware of the ‘requirements of the day’. Plenty of examples of good and bad practices should also be given through case studies. This is essential, since that is how the needed level of geographical based GIS professional culture is built. All necessary GIS and computer skills should be built shortly after the beginning of the programme, in order to protect from the excessive ‘technologisation’ of the students. This is doubtlessly a very important segment of GIS education, letting the future specialist become a real practitioner.

Fieldwork is also considered to be a crucial component of GIS education. Modern technological appliances supply geographers, in their traditional role as field researchers, with a very powerful set of tools, especially for data collection and analysis. This module will allow students to keep connected to real geographical space.

**Conclusions**

In conclusion, the new “Digital Geography” MSc programme is expected to start from the 2006/2007 academic year within the Department of “GIS and Cartography” at Sofia University “St. Kliment Ohridski”. The main objective of the programme is to respond to the constantly increasing labour market demand. The programme focuses on the geographical fundamentals of GIS and the spatial information. The course will be structured to provide professional education in the areas of geographic information systems, spatial analyses, spatial modelling, mapping science and remote sensing. Graduates will receive broad knowledge on geographical concepts that stand behind geographic information technology as well as the necessary geoinformation literacy, enabling them to become more educated, skilled and employable.
References:
Kotsev A and Dimitrov S (2004), Problems and potential solutions for the implementation of GIS within the Bulgarian Statistical System, 24th Biennial Conference on Regional and Urban Statistics: Understanding Change, 151-158, Minneapolis, USA
Vandenbroucke D P. Beusen P (2003), 'Spatial Data Infrastructures in Bulgaria - State of Play'; INSPIRE country report
Chapter 4

Application of GIS in teacher training at the University of Education Karlsruhe and the University of Education Freiburg, Germany

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Introduction

Particularly within a didactical context, the importance of geographical information systems (GIS) has increased greatly during the last few years. Subsequently, the curricula and the curriculum drafts of the different German States already consider GIS to be a requirement at nearly every level of the educational system. Thus the use of GIS was, in a compulsory way, taken up in several subjects and, depending upon the State, GIS is already firmly integrated to different school types and grade levels. As a result, higher education institutions and particularly teacher education has addressed this development (Falk, 2001; Hoppe, 2002; Falk and Hoppe, 2004).

One strong argument for the use of GIS is its high future relevance for the pupils and students who will leave education and enter the workplace, in which handling PC applications has become an integral and essential element of functioning within the culture. Additionally, knowledge of GIS will create opportunities for graduates to engage in many different and varied vocational fields. GIS also enables the students to obtain basic knowledge with which they can orient themselves and continually be abreast of the international job market.

Working with GIS enhances instructional content and methodology, and clearly increases motivation. For geography didactics in Germany, GIS also entails the positive representation of geography as a ‘guidance
subject’ for the acquisition of modern knowledge in which various social and cultural aspects can be combined. In Germany, the study of geography will benefit tremendously from such heightened awareness (Schleicher, 2004).

**Issues affecting the University of Education in Karlsruhe**

Currently GIS courses have only a very low importance at the University of Education in Karlsruhe. The main reason for this has been the insufficient training of university teaching staff, even if the equipment available in the university fulfilled all the necessary specifications for the execution of appropriate courses for students, as well as for currently employed teachers.

The geography department of the University of Education Karlsruhe has worked for several years with the Ministry for Environment and nature protection, agriculture and consumer protection Nordrhein-Westfalen and other partners on a project aimed at “Visualising land use and land consumption in Nordrhein-Westfalen by means of satellite and aerial photography” (http://www.flaechennutzung.nrw.de). Apart from providing an Internet-based information platform with GI data, one aim of the cooperation has been to produce suitable training aids as well as documentation materials for teachers.

To be able to meet the expectations of the curricula and testing standards in Germany, Universities have to offer corresponding courses for GIS. In Baden-Württemberg, the new curricula for the teacher training in Geography include GIS as a compulsory subject during the main phase of studies. So the University is required to offer a continuous range of courses on GIS.

At this time, the planned goals for the implementation of GIS at the University of Education in Karlsruhe are as follows:

* Courses for geography student teachers to apply GIS in schools
  * Background knowledge and understanding of the technology
  * Introduction into the main aspects of GIS
  * Conversion of units into instruction-suitable topics
  * Production of age-based materials
b) Workshops for geography teachers of different school types and grades with the aim to initiate independent GIS use by teachers and students in the future

- Introduction to the topic
- Overcome inhibitions
- Assistance and support for providing suitable teaching aids and teaching units
- Accompaniment of first instruction attempts with the employment of GIS in the school

c) Interdisciplinary courses for the use of GIS in the school context

- Introduction into the topic
- Development of multidisciplinary teaching units
- Development of multidisciplinary and suitable teaching aids

d) Student research projects in the context of university degrees (Staatsexamen)

- Studies of the meaningful use of GIS in the different school types and at different grade levels
- Development and testing of training aids and teaching units
- Testing of different subject-related and interdisciplinary topics
- Evaluating the impact of GIS in the tested units by using both statistical and qualitative methods, and by establishing a baseline prior to implementation of GIS for comparative purposes

e) Development and testing of training aids and teaching units for teacher and students

- Development of assistance for the school use of geographical information systems, in which on the one hand instruction-practical and methodical references are given, on the other hand possible content issues and methodical weak points, software problems and limitations are described
- Planning of realisable teaching units with the adequate consideration of curricular, institutional and instrumental defaults
- Development of suitable materials and assistance for teachers, students and pupils

Most of the actual GIS software packages available on the market unfortunately show weaknesses and limitations, which are mainly to be attributed primarily to the complexity of applications under the institutional basic conditions of the school. Alternative solutions reside in a reduction of the software functions, with the resultant loss of GIS-
specific characteristics. Another option might be the delimitation of the GIS employment for certain groups of students; primarily, those who are enrolled in ‘achievement courses’ from Germany’s Gymnasium Schools who might elect to participate in this subject. Since GIS is an essential geographical tool in the 21st century, appropriate methodologies need to be identified which can be used with all types of pupils.

**Issues affecting the University of Education in Freiburg**

The University in Freiburg is required to offer a complete range of courses in GIS if it is to meet the standards set in terms of curriculum and assessment in Germany. In Baden-Württemberg, the new teacher training curricula in Geography includes GIS as a compulsory subject during the main phase of studies.

The Council of the University of Education in Freiburg has defined Europe as a main focus of the University and thus it aims to widen course content into a European context. Therefore, a working group has been created, which is researching the opportunities that could be afforded by the introduction of GIS into the bilingual geographical curriculum.

The Geography department at the University of Education in Freiburg is beginning to develop teaching content in Geography teacher training. In this context, the University is also seeking to pioneer new teaching methods. However, currently GIS courses have only a very low importance at the University of Education in Freiburg. The main reasons for this is insufficient training of the university teachers and the need for suitable equipment at the university meeting the hardware specifications to deliver appropriate courses for students.

Planned goals for the implementation of GIS at the University of Education in Freiburg are the following:

*a) Creation of “normal” GIS-courses*

In these courses the students will be familiarized with GIS in general:

- Background knowledge and understanding of the technology
- Introduction into the main aspects of GIS
- Basic information about the work with GIS
- Field work practice

*b) Creation of didactical GIS-courses*
In these courses the students will have the opportunity to reflect about the implementation of GIS at school:

- Importance of GIS for today’s youth
- What are the opportunities and what are the challenges of GIS at school
- Conversion of units into instruction-suitable topics
- Production of age-based material

c) Interdisciplinary courses for the application of GIS in the school context

- Introduction to the topic
- Development of multidisciplinary teaching units
- Development of multidisciplinary and suitable teaching aids
- Implementation of GIS in bilingual teaching

d) Accomplishment of student research projects in bilingual teaching of GIS in the context of university degrees (Staatsexamen)

- Studies of the meaningful use of GIS in the different school types and grade levels
- Development and testing of training aids and teaching units
- Testing of different subject-related and interdisciplinary topics
- Evaluating the impact of GIS in the test units by using both statistical and qualitative methods, and by establishing a baseline prior to implementation of GIS for comparative purposes

e) Implementation of research project that incorporate GIS into the geography department

Conclusions

Despite the positive effects of GIS in German schools (Falk, 2002, http://www.flaechnutzung.nrw.de), there are also some critical comments rejecting the use of GIS (see the summaries of this at for example http://www.lehrer-online.de/url/gis). In most cases this rejections appears to result from a fear of the introduction of an allegedly difficult-to-understand technology. This inhibition towards the new media needs to be overcome.

Against the demands of the curriculum even today, very few schools in Germany work with GIS. In most cases GIS is used exclusively in the framework of specialised projects. So the systematic introduction of GIS in the different school grades and types is not yet evident. So teacher-training institutions are preparing teachers to work in schools where GIS
has not yet been integrated. However, it can be supposed that these teachers will have the opportunity to implement GIS in their schools and to widen the horizon of knowledge of tomorrow’s pupils. Creating with today’s students GIS courses and research projects at the Universities of Education in Karlsruhe and Freiburg is part of a future-oriented teacher training program and it has to be enforced.

References

Some Useful Web sites
Diercke Geographisches Informations System, the web site of one of the German school book editors specialised in maps http://www.diercke.de/gis/gis.html
Lehrer online, a multifunctional web site for different school subjects which integrates a lot of innovative aspects http://www.lehrer-online.de/dyn/315885.htm
Research project about land use of the University of Education Karlsruhe in cooperation with the German State Nordrhein-Westfalen http://www.flaechnutzung.nrw.de:
SchulGIS – Internetbasiertes Geographisches Informationssystem, a web site created by the Geography department of the University of Erlangen-Nürnberg especially for the work with GIS at school http://www.schulgis.de
WebGIS-Schule – der Einstieg für Schulen in Geographische Informationssysteme (GIS), an introductory web site into the work with GIS at school http://www.webgis-schule.de/

http://www.ph-karlsruhe.de
http://www.ph-freiburg.de
http://www.leu.bw.schule.de
Chapter 5

The use of GIS at the University of Tartu, Estonia: application into cultural landscape studies

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The present use of GIS
The Institute of Geography at Tartu University includes three Faculty Chairs, one of which is in Geoinformatics and Cartography (http://www.geo.ut.ee/kartool/index.html). The courses taught by the Chair include basic and advanced courses of geomatics and map-making, including practical training in different GIS environments (MapInfo, Idrisi, ArcGIS, Microstation/MGE/Geographics). Essentially, basic courses are offered to all students. These primarily include simple exercises, whereas courses for graduate students in geoinformatics include more sophisticated spatial analysis and modelling. The Chair is trying to offer something to different levels although the number of lecturers and researchers available in the institution is limited. A full list of courses can be found at the University of Tartu study information system (http://www.is.ut.ee/pls/ois/tere.tulemast).

The University of Tartu started switching from the 4 year BSc + 2 year MSc program (with MSc being a science degree) to the new 3+2 system fitting the Bologna declaration in 2002. The new curriculum for the first three years includes two basic modules, too general direction modules and two specialization modules. Obligatory for all students of a particular curriculum are the basic modules (the same for all students of the faculty of biology and geography), one direction and one specialization module. Another direction and specialization module can be elected by the students.

The first three years of study include the following GIS related courses. The first year course of basic physical geography includes two lectures –
introductions to cartography and GIS. In the second year of study the obligatory direction module of geography includes Geographic Information Systems I (3 ECTS credits, lecture course with introductory practical training in database management and GIS software), (Basic) Cartography (3 credits, lecture course with practical training in thematic mapping) and Data management in Geography (3 credits, lecture course with practical training in geographical data analysis). The obligatory specialization module includes courses Data Base Applications (3 credits, brief theoretical introduction with major attention to practical training in database management), Basic Remote Sensing (3 credits, lecture course with practical training in image analysis) and Land Surveying (3 credits lecture course). The elective geography direction module includes Field Training in Land Survey (3 credits).

The specialization mostly is left into the four modules of the two year MSc programme, one of the specializations in the curriculum of geography is that in Geoinformatics and Cartography including courses of Methods of Spatial Data Processing I and II (3 credits each, lectures combined with practical training), Modelling of Geosystems (4.5 credits), Practical Training in Geoinformatics (4.5 credits), Statistical Data Analysis (4.5 credits), Statistical analysis of spatial data in ecology (3 credits), Spatial Decision Support Systems (1.5 credits), Practical Exercises of Spatial Data Processing (1.5 credits), Remote Sensing II (3 credits), Thematic Map Design (3 credits), Cartography II (4.5 credits), Cartographic Drawing (3 credits), Applied Programming (3 credits), Geodesy (3 credits), Toponymics (3 credits), Photogrammetry (4.5 credits) and Geographic Information Systems II (4.5 credits). The MSc programme also includes some general courses in methodology of research and philosophy and is completed by the defence of the thesis (30 credits). Most of the courses include theoretical part and practical training with the proportions between the two varying. The PhD studies are fully research based.

Research undertaken at the Institute of Geography includes the use of geoinformatics in many different projects. There is dense cooperation between the different chairs of the institute. The research includes topics such as:
- modelling of spatio-temporal changes in nutrient fluxes in the landscape (Mander et al., 1999; Laas, Kull 2001),
- landscape diversity analysis (Mander, Koduvere, 2003; Remm, Luud, 2003; Palo et al., 2004),
- relating ecological indicators to landscape use (spread of plant and bird species depending on landscape diversity, landscape consumption by human activities) (Remm, Oja 2001; Oja et al., 2005)
- interpreting aerial and spatial imagery by different methods and relating the diversity indices to different biological, geographical and cultural phenomena (Remm, 2004)
- planning application of ecological engineering methods in wastewater treatment (Mander et al., 2001, Mauring et al., 2003),
- use of GIS methods in practical planning (Reintam et al. 2003, Ahas, Mark 2004),
- analysing systems supporting spatial decisions and terrain modelling (Roosaare 1995; 1997).

GIS is also used in landscape planning and other ecological engineering applications, research and development projects in environmental impact assessment, transport system analysis, nature conservation and ecological network planning, standardisation of spatial data and in preparing cartographic atlases for schools etc. Also, the Chair is involved in two European thematic networks (HERODOT and EEGECS) and thus in the development of curricula in geography and surveying/cartography (Liiber, Roosaare, 2000).

**Future use of GIS**

The main activity in the coming two years related to the curricula development is actuation of the new MSc curriculum – the first students to the new curriculum will be admitted in the fall of 2005. Approximately half of the courses in the curriculum come from the earlier 4 year BSc course of the old MSc course, another half needs to be fulfilled with the content as they have never been taught in the way planned. No major changes in the curricula are planned before the first students have fulfilled the two year MSc programme and there will be feedback from the programme.

Research using GIS methods will go on in most of the directions mentioned above. As one of the new developments hereby the authors would like to bring out the options to use GIS determined landscape metrics for describing (and predicting) the land use by natural phenomena
as well as human the landscape consumption. The latter is related to the analysis of cultural landscape diversity.

GIS in the analysis of cultural landscape diversity

There are several cases of applying GIS in cultural geography in Estonia much inspired by the research of Antrop (Antrop, 1988; 1998; Antrop and Eetvelde, 2000), there has recently been greater emphasis placed on these studies. One of the extensive projects during the last years was “Defining Valuable Landscapes for county planning”. Following a Government decree of June 1999, each Estonian county had to provide a planning theme as a layer in the county’s master plan defining and delimiting valuable landscapes, while also establishing management rules for these areas. The primary methodology was a map analysis to figure out the most historically valuable areas in different counties. This was developed at the Institute of Geography at the University of Tartu. This research is summarised in (Palang et al., 2004). Palang et al. (1998) explored using GIS to analyse landscape changes, bringing out time series changes of Estonian cultural landscapes.

The above-mentioned, ongoing activities exploring the use of GIS in cultural landscape studies are being developed at the University of Tartu as part of the Target Funded (by the Estonian Ministry of Education and Research) Project’ 0181788s01 “Systems supporting spatial decisions in analysis of landscape values and regional development and in regional planning”. This project analyses the diversity of landscape as measured by a number of different parameters and indicators, and affecting landscape consumption (Oja, Prede, 2004; Oja et al., 2005)). These are also connected with the Estonian Science Foundation project 5261 “Spatial-dynamic modelling of the impact of landscape diversity to nutrient fluxes, plant cover and habitats by combined use of GIS and point models” (http://www.etf.ee/index.php?id=636&keel=ENG) and a new ESF project due to start in 2005 “Modelling landscape consumption based on landscape metrics”, to include an enlarged GIS application in cultural landscape studies.

Using GIS when studying cultural landscapes gives advantages in comparing large data sets, which is especially useful in historical geography and landscape archaeology. Like all cultural geography, the GIS studies originate from aspiring to produce objective descriptions that are environmentally deterministic (ED), that is to say they disregard all
social and cultural aspects of past societies. ED models were confronted with cognitive models that tried to create ideal space and society or at least uncertainty and irrational causes in settlement selection. Different aspects of GIS use in studying cultural landscapes have been preliminarily attempted in the research by students and will be explored in the further research. The first cognitive models are now called “more cognitive” models as they are based on measurable environment characteristics but take also in consideration social and cultural aspects. The most well known applications of the more cognitive models is known as “viewshed analysis”. Viewshed analysis can be applied to determine different visibility strategies of settlements in different landscape development phases (Printsmann 2002) and in exploring whether valuable landscapes determined in then county theme plan are more susceptible, in terms of visual impacts to physical changes, than the rest of the county. Scenic visual absorption, as a planning tool, has also been used to assess the viewsheds of newly built lookout towers in five South-Estonian counties (Printsmann et al., 2004).

One focus of the research is associated with using GIS to assist in analysing the cultural or human interpretations of landscape. The landscape forms a perceptible portion of environment that according to Antrop (2000) can be characterised as dynamic, subjective and holistic and that according to Keisteri (1990) consists of visible part, invisible part and the processes between the two. Widgren (2004) brings out four different approaches to make a study on landscapes – through form, function, context and processes, but he has left out the concept of meaning, which plays invisible but influential role for making the mentioned aspects. Those aspects can be studied through space and during the time. Concerning temporal aspects, we could also ask the questions Antrop (1998) did, connected with landscape change as: change of what; what is the frequency of change; what magnitude of change; what reference time-base is used?

Inside the landscape, there exist places, which according to Relph (1974) can be understood and experienced, on one hand, as a landscape where the visual qualities demonstrate the traces of human actions, or, on the other hand, more abstractly, as a landscape that reflects human values and ideas. At the same time, not all experiences (such as longing for home) connected to a place can be dealt with as landscape experience. So,
landscape forms a buffer zone around the places, which in turn form a network.

Places create areas in the landscape that are interconnected by a concentrated field of meaning and are produced by human action, experience, perception and evaluation. It is planned to research the places, as parts of landscape, with concentrated meanings given by people. As each person will get a feeling, an idea, or understanding from landscape experience, it means that some areas among landscapes have been paid more intention by people than to the others. And those areas one can call places. Stefanovic (1998) explains that a place is more than just a physical or spatial location that can be exactly delimited. A place can be recognized by different signs that are located on the ground, but have meaning in human conscience. The varying over the landscape density of meaning of places forms a field that can be described and analysed by GIS.

Over time, different social-economic events can influence the form, function and meaning of places. We can name formation change every modification of social-economic understanding, ideology and technology. Cosgrove (1984) has stated that every new social-economic formation creates it is own landscape with distinctive symbols, ideology and with history. Much of this symbology is can be mapped and has been mapped.

Previous studies undertaken at the University of Tartu addressed the “Places with Large Swings in Estonian landscapes”. (Pungas, 2004; Pungas et al., 2004). Places were analysed using ‘a swing’ as an example (Figure 4.1). The word swing is used to denote a large construction (traditionally made of wood) that is able to carry and swing at least two people (though usually 4-8 people). Swing places have existed in Estonia for hundreds of years but have been studied in limited cases based on mainly handwritten materials from archives. (Langinen, 1956, Vissel, 2003). Village swings (for public use) are usually located in the middle of a village and the site is commonly used by youth as a place to meet and have good time. Swinging takes place mostly in the summer and spring, forming one of many seasonal activities that make up the Estonian traditional calendar. The seasonal break in swinging activity contributes to the eagerness with which swinging is resumed when summer returns, so seasons create kind of frames, where the most valued time is the spring. With swinging the spring as a very valuable and long-waited season has been celebrated. Although the religious background for swinging is
forgotten, the place is still special as visited mostly on certain festive occasions (Tampere 1956; Hiiemäe 1995).

GIS has been used to investigate the reasons that maintain the phenomena of swing sites, a tiny element in landscape, alive. This may be because there is no comparable alternative to swing sites as a socialising place of the village, so they have persisted through centuries. The research concentrated on the processes taking place at traditional swing places, which were mainly determined by the impact of socio-economic issues. The expected natural pre-requisites for swing places were researched, and the seasonal use of the traditional places that are not protected officially, analysed. To get those solutions, 15 local districts were investigated (Figure 4.2) and 520 pupils from those districts were questioned.

GIS will be explored as a means to provide assistance in understanding the spatial field of varying meanings in landscape. The applied part of this research is related to nature education at the Emajõe-Suursoo (the Big Mire of Mother River, Figure 4.3) nature conservation area (http://turism.tartumaa.ee/j6eriik.php, http://www.loodus.ee/el/vanaweb/0008/emajogi.html). The research will address the cultural meaning and change in importance of the mire landscape. Mires are a relatively uncommon type of natural landscape in a central and southern European context, but they have a relatively high importance in Estonia. Almost 22% of total area of Estonia is covered by mires. There is relatively good natural scientific background knowledge about mires from telmatological research (Masing, 1984) which form one layer of the spatial field. The more extensive swamp areas are officially protected by different regulations, mostly emphasising the importance of preserving large reservoirs of pure water, maintaining water levels and the protecting the habitat for unique animal and plant species (forming another layer). There is also a layer of data on human activities in mires from archaeological and historical research. GIS is a tool that allows these spatial layers to be combined.

People have certain opinions of mires and attribute meaning to them. Living conditions found in mire areas are not the most appropriate for human settlement, but nevertheless people do live there. So by studying cultural indicators in the physical world, meaning can be given to temporal change in the forms, meanings and functions of mires as compared to relevant changes in other landscape types and Estonian cultural space.
Considering the above-mentioned, the likely GIS approach for this work would be to:

- investigate the dynamics of mires – is there any change, and where, how much and why have the borders of mires changed since the last glaciation;
- provide a map analysis combining different map layers and comparing spatial-temporal changes in mire areas;
- evaluate the diversity of landscape around the places with meaning (churches, villages, human settlements etc.
- compare and evaluate the effectiveness of quantitative (GIS-based) and qualitative (interviews for instance) methods.

It is expected that the results of this work will be used in future course developments as an example of using GIS in cultural geography for students at the Institute of Geography. The results of current activities will also be used to develop introductory lectures with illustrated materials for visitors (mainly pupils and tourists) to the Emajõe-Suursoo Nature Reserve, in order to help explain several changes taking place in the mire, in terms of physical and cultural aspects and to explain the necessity to protect and preserve mires in Estonian landscapes.

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Some useful Web sites
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http://www.is.ut.ee/pls/ois/tere.tulemast
http://turism.tartumaa.ee/j6eriik.php
http://www.loodus.ee/el/vanaweb/0008/emajogi.html

For Information about different aspects of Estonian research funding
Figure 4.1: Estonian village swing (Ida-Virumaa county, Iisaku local district). (Photo: Pungas, P. 2003).

Figure 4.2: Case study areas in Estonia.
Figure 4.3: The Emajõe Suursoo Mire and the Koosa Lake. (*Photo. Oja, T. 2004*)