Practical Aspects of Project Based Interdisciplinary Teaching with GIS

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During the year of celebration of the 111th year of Academic Geography at Sofia University - 2009 the state of teaching and research is in a condition that can hardly be considered to be optimistic. It can be characterised with the constantly decreasing number of students, lack of qualified experts in many fields, old and frequently irrelevant methodologies in research, poor or no public image of geography in the country. On the other hand there are an increasing number of research and development projects in the country. The project based approach has been, as elsewhere a fact during the past decades, however a particularly important specific of the country is the increase of funding for research with budgets and priority areas, where projects exist have increased in times since 2007. This creates excellent opportunities for inclusion of students as participants in the research projects where they can get involved with practical applications of the knowledge that they gain during their studies in geography. This is also achieved thanks to the use of GIS in fields where geographic research is underrepresented like biology, archaeology, marketing and management, regional and urban development, etc. The paper addresses the issues of PBL with GIS through the inclusion of students in project activities with the benefits as well as the problems that occurred during this process. The problem of integration of the abovementioned PBL approach within the curriculum is also addressed in the paper.

State of the art of Academic Geography in Bulgaria

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

- **Awareness of GIS:** Geographic information systems can, as we mentioned above, be considered to be relatively new to countries like Bulgaria. Potential users are not fully aware of the functionality of GIS that they can benefit from.
- **Irrelevant Legislation:** Probably, one of the biggest problems for implementing GIS in the country is the absence of 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:** 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 education 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 geographic data production to jeopardizing multi-million euro projects.

Related to all that is mentioned here, there is an increased interest within the country for well educated specialists in the field of GIS, and the leader in the education field is the Sofia University.

The first GIS course, taught within the institution 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 could be found in most Universities and relevant academic institutions.
In 2001 in the Faculty of Geology and Geography started the first and still the only one Master degree program in GIS. The University is the first in the country to offer independent degree programs in GIS, remote sensing and spatial modelling. The number of students attending a GIS course during their studies has tripled for the past five years, which is unique for a geographic course in the country. The academic stuff as well as the laboratories and other facilities have during the same time remained constant due to budgetary and other objective limitations.

A dramatic change in the nature of the degree programmes has also occurred for the past few years – from strictly profiled and conservative to interdisciplinary, integrating knowledge and methods from various sciences. This has lead to a shift in the number of students from classical traditional programmes with over a century of traditions within the university (geography, geology, history, etc.) and an increase of the number of students within new interdisciplinary programmes. In order to satisfy the increased demand new courses have been developed including in the field of geographic information science – GIS in: archaeology, regional development, electoral studies, regional human resources management, geology, environmental protection, social and economic studies, tourism, etc. The abovementioned GIS courses are highly recognized by geographers and non-geography students and faculty. They are successfully being taught within the following both undergraduate and postgraduate interdisciplinary degree programs:

- Regional development and policy (undergraduate)
- Biology and Geography (undergraduate)
- History and Geography (undergraduate)
- Biomanagement (undergraduate)
- Geology (undergraduate)
- Applied demography (postgraduate)
- Tourism (postgraduate)
- Archaeometry (postgraduate)

Structurally all the interdisciplinary courses mentioned above are separated into two interrelated parts spreading into two semesters – (a) introduction to GIS and (b) thematic content based on the audience. The first part is similar regardless of the frequently completely different audience of the course. This is difficult to avoid, particularly because we require that a GIS course must cover at least some fundamental theoretic geographic concepts. Our strongest belief is that GIS is not an IT phenomenon born after the quantitative revolution and the computerization of the world we live in, but rather an inseparable part of geographic information science with its own methodology (see. NCGIA Core Curriculum in GIScience).

The highest employability rate of geographers is doubtlessly in the field of GIS, where even without good data it is more than likely that more than 70 percent of the graduates work in the field.

**Project implementation and the learning process:**

The project based approach is relatively new to the country, not only in the field of research and education. The main coordinator of the projects in Bulgaria...
is the National Science Fund, which is a supportive and consultative body of Ministry of Education and Science. For the past decade there have been an increasing number of projects and budget available for both research and education. The most significant increase of budget is observed during the past two years, with volumes of the available funding which have increased over four times for only two years (Figure 1). Another characteristic of the situation is related to the fact that over 50 % of the funding of 30 million euro goes directly to universities (2008).

Research projects are of critical importance now. The economic crisis and funding for research and education in Bulgaria have a diametrically opposite influence on the situation of academic institutions. The slowing economy (forecast for an increase in GDP of 2.4 % in 2009\(^1\)) is already limiting the opportunities for employability of students in the field of GIS, particularly in the private sector in US owned companies from the IT branch. On the contrary long term projects create the opportunity for students to be employed and develop their competences in the field of GIS for periods from a few months to three years. Departments dealing with GIS are in a unique situation to be able to independently apply or partner other institutions in virtually every possible research area of the ones identified by the National Science Fund (Figure 2). Faculty of the department of GIS and Cartography at the Sofia University “St. Kliment Ohridski” are working in all the identified areas below, within projects ranging from suitability analysis for placement of solar panels and wind generators to underwater archaeology GIS databases elaboration.

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\(^1\) Source: The Economist country forecast, Economist Intelligence Unit
Examples of good practice

During the past years due to the process of shifting of funding from directly subsidised to project based there an increasing number of project based education examples have been observed. They can all be summarized into three types, based on the nature of the activities which are being accomplished:

1. *Postgraduate thesis preparation as part of research projects.* All PhD students during the past five years have participated in research projects most of which are directly related to their field of research. The majority of masters students have also prepared their thesis as part of a bigger projects: Some of the examples of our practice are:
   - Geological GIS Database for the Needs of Petroleum Geology;
   - GIS for Identification of Potential Habitat of the Black Bilberry (*Vaccinium myrtillus*);
   - GIS for Planning of the Regional Development in the Country.

2. *Spatial data collection and manipulation for the needs of project implementation* – All the projects that have been implemented include some sort of data collection. Most students in GIS and cartography have been involved into the creation of spatial data on a paid basis. By doing so they have acquainted industry standard software products like ESRI’s ArcGIS + extensions, as well as open source software products like GRASS GIS. Some examples of data collection include:
   - Hydrological data collection for GIS-based zebra mussels infestation risk assessment for basins in Northwest Bulgaria;
   - Creation of large scale digital geographic data for archaeological purposes in the Kabyle National Archaeological Reservation.
   - Data for spatial planning purposes.
   - Rila National park geographic database optimization and actualization.

3. *Extracurricular activities* – Most projects that have been implemented during the past years have included fieldwork for data collection and verification purposes. Both undergraduate and postgraduate students in the department of GIS and cartography have participated in fieldworks with GPS, DGPS, mobile GIS and total stations.

Conclusion

The inclusion of students in project activities is doubtlessly a “win-win” approach, where everyone benefits in one way or another. Not only do students get to know more about the contemporary GIS and the GIScience, which gives the fundamental methodological and theoretical foundations, but are also placed in an interdisciplinary environment. This is so because the majority of projects are implemented jointly with various institutions, and departments external to geography.

There are also certain problems arising from the learning during project implementation. The major ones we consider to be related to:

*Lack of Integration of the project content within the curriculum.* Curricula are certainly not in any way coherent with various projects. An option for solving those coordination issues is to include an obligatory module within the curriculum for an internship and/or work within research projects. This can however only be achieved after the inclusion of an obligatory one semester course in project cycle management, so that students will know theoretical and practical aspects of project implementation.
Limitation of theoretical concepts

Project activities implementation frequently ignores theoretical concepts. Therefore, the integration of theoretical topics, as close to the content of project activities as possible, needs to be done within the curriculum.

Use of a toolbox and not fundamental geographic principles. One of our strongest concerns is the worshiping of technology among a representative share of students, which is in no way stimulated by students working within projects but is rather a consequence of the information society we all live in. It must be noted that the abovementioned is in a way indirectly supported by the necessity to use industry standard software products to teach GIS.

References

Kotsev, A., S. Dimitrov (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 (pp151-158), Minneapolis, USA.