

Introduction of project-based learning into traditional geoinformation/geography learning programme



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Abstract: Having proved itself in a geography, traditional learning approach based upon fixed set of lectures and lab exercises appear to be less successful in the field of GI especially when compared to project-based learning (PjBL). Here it is proposed the possibility of merging modified PjBL into existing programme without the need of altering the latter. This is achieved by devising the means of collaboration and data-transfer between various courses. During the whole project different software, data formats and operating systems are introduced and the idea of interoperability and top-down learning is emphasized strongly as the way of avoiding the trap of teaching and learning proficiency in using software rather than in resolving problems. The „test run” was performed during a single semester in which students were given both artificial and real data from previous exercises. The results are suggesting that it is possible to introduce PjBL to the traditional lecture-based learning in this simple form to improve the learning process.

Key words: project-based learning, gis, geoinformation, geography

1 Introduction

While discussion on the form and the purpose of teaching GIS remains open for at least twenty years (Kemp, Goodchild & Dodson 1992; Unwin & Others 1990) still in many countries this is a relatively new challenge. In Poland for example, first courses were introduced in 1995-1996 (Kistowski 2000; Kistowski 2001) and GIS education is still in its adolescent phase. The lack of the appropriate technical infrastructure and experienced cadre is the reason why GIS courses in this stage of development rarely if ever form an independent curriculum. They are most commonly introduced as a part of a larger geography or earth sciences learning programmes.

This situation has its advantages - students gain GI skills as well as a solid and complete base-knowledge of geography and GI courses fits well in the geography curriculum.

Yet, the traditional methods of teaching are often inadequate and inefficient when applied to methods of geoinformation science. They fail in delivering necessary amount of practical skills and are lacking flexibility needed to cope with constant change in the field. It seems therefore, that GIS courses are an ideal place for more innovative teaching strategies like Problem and Project-Based Learning (Bednarz 2004; Höhle 2005). But it must be noted that extensive modifications or even a complete rewrite of existing learning programme are a common requirements for a successful employment of this techniques and this can be perceived as a strong barrier. Here it is argued that it is possible to devise a “soft” solution to this dilemma in by introducing PBjL within the curriculum framework.

2 The example of traditional curriculum

Faculty of Geographical and Geological Sciences of the Adam Mickiewicz University in Poznan (WNGiG UAM) is a standard example of teaching GIS in Poland and what it will be called hereinafter a “traditional learning programme”. Basic courses are taught on almost every speciality and there is also a separate one, dedicated exclusively to GIS, entitled “Geoinformation”. The latter, having evolved from the set of courses is currently in the phase of forming it's own learning programme in an effort to establish geoinformation as a master degree on national level and example presented here is based on it's structure.

The Geoinformation is a five-year speciality constructed around the set of courses that can be divided into four didactic blocks (Zwoliński 2007) (Tab. 1). Those are mainly lectures with accompanying laboratories as well as somewhat limited, and declining due to financial problems, amount of fieldwork training.

Table 1: Didactic blocks of the Geoinformation curriculum (Zwoliński 2007)

Didactic block	Length (hours)	Percentage share
General courses	420	12%
Geographical courses		
– general	866	25%
– specialistic	386	11%
Mathematics & Computer Science courses	630	18%
Geoinformation Science courses	1180	34%

much more exercises in computer labs, the whole curriculum is based on the concept of teaching theory and methods of geographical information science rather than specific practical skills. During the last two years students are required to write a master thesis. This standardized approach is administratively convenient since it neither require changes in the grading system nor additional facilities. It pose however some problems both from the faculty and students point of view, mainly:

- Students often feel that they gain insufficient amount of practical skills in the respect of GIS software
- Since geoinformation is a relatively new discipline the learning programme is limited to subjects familiar to the teachers and the resulting curriculum may be unbalanced
- Teachers are required to show examples of using GI methods in science and practical applications, yet they are often more accustomed to traditional methods i.e. hand drawn maps.
- Geographical courses are separate from GI courses. This can lead to a frustration and lack of common frame of reference between students and teachers
- In the common Geography/Geology faculty environment technical infrastructure (computers, net availability, up-to-date software) is largely insufficient

3 Benefits of alternative approach

Some steps can be taken within the traditional learning programme to mitigate the deficiencies mentioned above like encouraging students to practice in a GIS oriented institutions or companies. Even more effective would be to introduce alternative teaching method particularly Project-Based Learning, that can benefit GIS education in many ways:

- Real-life problems that are solved during projects are always much more “up-to-date” comparing to traditional application examples that are given during the lectures
- Students gain both practical GI skills and social skills related to project management and team work
- By giving the students a large amount of freedom in the choice of project subject and tools that can be used to solve it it is possible to introduce a top-down approach of learning software (Holz & Merting 2005) with a much wider range of additional software and techniques.
- In long-term projects various techniques of data and resources management are almost “naturally” introduced - this is in contrast with most traditional courses where this aspects of GI can be easily omitted i.e. students are required to gather and evaluate their own data
- The opportunity to combine newly-gained skills together with experience and knowledge from wide range of lectures and exercises can greatly increase the overall gain from the course
- During the PBJL participants are learning not only content but what is even more important thinking strategies (methods of geoinformation) (Hmelo-Silver 2004)
- The nature of the student-teacher interaction in the PBJL can help teachers gain knowledge and keep in touch with new technologies(Höhle 2005). This is also a main reason why Project-base learning was chosen over a Problem-based learning

This features can be used to improve the value of newly developing GIS curriculum as well as an existing learning programme. However the latter pose a much greater challenge.

4 Project-based learning within the traditional curriculum

In the WNGiG the traditional teaching model based on lectures and lab exercises is well established and already functioning on every speciality. To change it entirely in the favour of project-based learning on the Geoinformation speciality is impossible from the formal and organizational reasons. Therefore every attempt to introduce alternative teaching method is under the following constraints:

- In the end of every single course every student must be given an appropriate mark representing its involvement and gained knowledge
- Students are required to participate in a given number of classes and the time and place are not flexible. This can be counter-productive since it is against the principle of student-centered teaching
- The content of each course can be modified only to limited extent and some topics are mandatory

It may be noted that these requirements are common for most of the traditional learning programmes.

However, looking closely to the curriculum one can often find didactic paths or sets of courses that are related in the respect of used software, methods or overall subject. For example, on the WNGiG there is a number of courses on the image processing and remote sensing (Figure 1) that are forming a clearly outlined path (Krolewicz & Ewertowski 2006). It can be imagined that such didactic structures, if present, can form a backbone of a project.

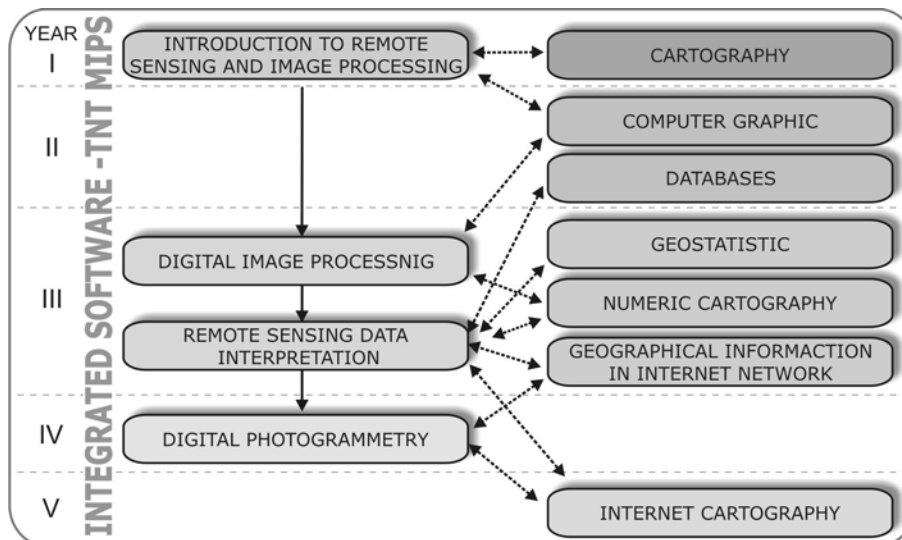


Figure 1: Relationship between main geoinformation courses in WNGiG (Krolewicz & Ewertowski 2006). The set of courses dedicated to remote sensing and image

processing is shown on the left side of the diagram.

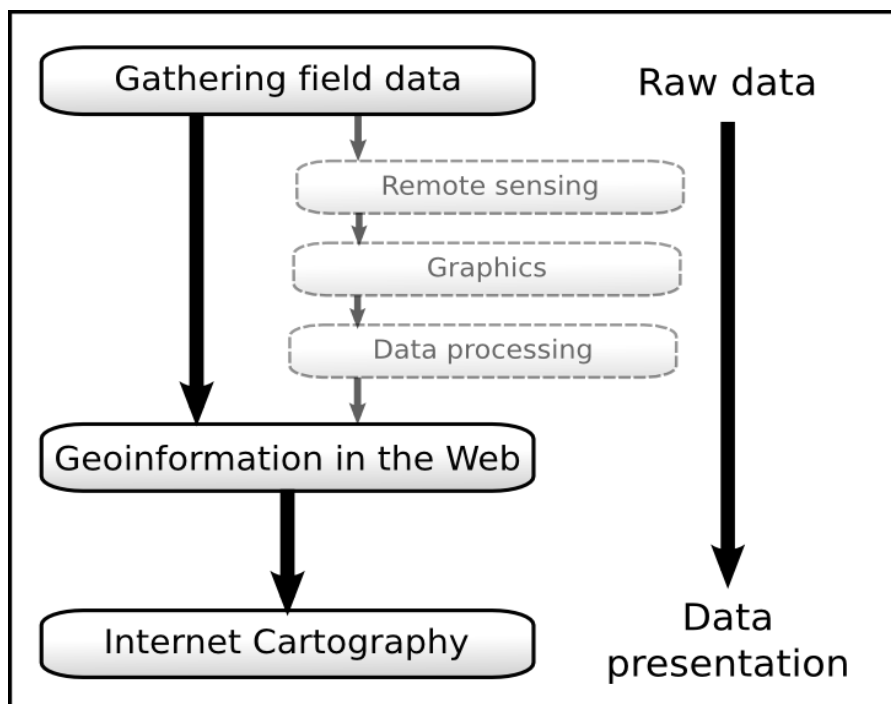


Figure 2: WebGIS project path. Courses outlined in dotted line were not included during the test run.

Courses from any given path can be used as a phases of the project. In the traditional curriculum they are separated in all respects with the exception of knowledge that should be accumulating with each step an to combine them into a project it is necessary to establish a connection between them. Here it is proposed that it can be done using data transferred between courses. Results from each exercise are used as a data source for the next course in the path (Figure 2). This approach requires that:

- The first course in the project path is somehow related to data gathering - to produce raw material
- The last course in the project path is concentrated on a data presentation and publication - this assures that the project will produce visible effects
- There is an appropriate technical infrastructure for data transfer and storage. This is crucial for a long-term project - time interval between courses can be as long as eight months
- Minimal requirements for the data from each course are clearly defined and respected

With the respect of this constraints the test run was devised basing on a courses existing within Geoinformation speciality. It consist of three stages (Figure 2) that are guiding students from gathering data to its presentation in the form of web-portal. The web-gis didactic path was chosen mainly because of its simplicity, the possibility of showing a three layer structure of GIS and openness for alternative approaches.

The test run was conducted during two semesters of Geoinformation speciality in the academic year 2007/2008. Since time span was to short to ascertain full data transfer and continuity between courses some sample data-sets were supplied to the students, although use of own data was strongly encouraged. It is obvious that a proper evaluation of presented approach cannot be obtained in such a short time. To have a fully completed project cycle would require at least four semesters. Nevertheless, even at this point it is possible to draw some conclusions, basing on experience of the teachers involved and non-anonymous feedback from the students:

- The main problem is that even with this fairly non-invasive approach the structure of the traditional curriculum is still not suited to host project-based learning. The marks gained for a participation in the project are not crucial for the completion of any given course (project phase) and so, they can be pretty much ignored by the students. But bearing this in mind it must be said that most of the students showed a very positive attitude when given an opportunity to create and develop their own project. They appreciate the authenticity of the task ahead (Car 2004). The most commonly expressed opinion was that they like to see “they data not being wasted”
- A well known problem with the PBJL is the risk of failure (Livingstone & Lynch 2000) and it also exist with presented approach. It is possible to prepare sample data for each phase of the project and to supply it to groups that failed previous stage or they data become corrupted etc. It was practised during the test run. Although this can ensure the continuity of the project it can be perceived by other groups as unfair
- It would seem that the necessity for regular, based on a fixed schedule meetings (in the place of classes) is not as counter-productive as predicted, as they are more familiar to students than a flexible ones
- The concept of team-work is also already familiar to WNGiG students and the problems commonly associated with introducing group activity (Livingstone &

- Lynch 2000)(i.e. choosing group members, their functions and responsibility, fairness of marks etc.) are marginal, if present
- The data storage mechanism should be made as accessible to students as possible - yet, the data itself must come with some sort of licensing (i.e. Creative Commons License)
 - Since during the whole project different software, data formats and operating systems are introduced, the idea of interoperability and importance of metadata are well understood by students. This also pose an opportunity to stimulate the use of opens-source software
 - During the test run it was apparent that there is a need for an efficient way of communication between groups, group members and teachers, and that it is vital that all course materials can be accessed online. This can be done by using one of the wiki engines but requires policy on users access (i.e. Projects open to public or only to group members?). It also introduces the concept of “working in the cloud”

Overall results of the test run were satisfactory. Almost all groups were able to deliver working web-based applications basing on previously gathered and prepared data. What's more, surprisingly large number of groups opted for using their own data they had from previous exercises and courses rather than sample data-sets. This shows that there is a potential in presented approach to improve the learning process by using materials that are commonly wasted. Authors are aware however that it is necessary complete at least one full project cycle with real data to asses the value of proposed approach.

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