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Practicing GIS for secondary school pupils – dynamization of current methods or new innovative approaches?

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Abstract

Secondary schools are often missing practical approaches to teaching GIS topics. Nowadays, teachers teach about GIS rather than with GIS. We show an educational pilot project „Prakticky s GISy“ as an example of possible „good practice“ of teaching with GIS at several South Moravian grammar schools. The aim of our paper is to discuss if this approach is dynamized method of current teaching standards belongs to the geography in the 21st century or if it is new and innovative approach to deeply rooted curricular documents. Through our project we try to make GIS more active at geographical lessons at secondary schools with peer-to-peer students and teachers participation. The base of our methods lies in using open source technologies directly in educational process.

Keywords: GIS, South Moravia, geographical education, open source
Klíčová slova: GIS, Jihomoravský kraj, geografické vzdělávání, open source

1. Introduction

Current geographical education in secondary schools often lacks the elements of working with GIS. In spite of this, Gewin (2004) ranked GIS technology along with bio and nano technologies, as the most dynamic areas of contemporary science. According to Lloyd (2001), supporting the use of GIS in education to identify specific relationships through the acquisition of searching, sorting and analyzing information is an important educational process. Dynamic development of GIS technology, however, is complicated by their teachers to manage and implement the lessons (Composite authors 2009), not only in the Czech Republic but also abroad (Kerski 2003). Complications are often connected to general problems with ICT introduction into education environment (Madziková and Kancír 2008). The paper reflects GIS potential (especially the potential of open source alternatives) in opposite of current problems with use of GIS. The goal of the article is to show practical and useful methods of dynamization (in the meaning of making more active and productive) or new innovative approaches of using open source GIS during educational process.

2. Geographical education and GIS

GIS at standard geographical education at secondary school level are being taught quite often. GIS at education solves several authors (e.g. Novotná 2001, Kopp 2008), application at secondary schools describe Favier and van der Schee (2007) or Vondráková (2008). Inspirating are activities in the University of West Bohemia (Novotná 2001), Technical university Liberec (Šmída 2007, Vávra 2007) or activities of non-government organization “Buď Geo... o.s.” from Palacký University Olomouc. Nevertheless, diffusion of GIS all through educational contexts is generally slow and more selective (van der Schee 2006) and no effective (see Kerski 2003). Most pupils are already familiar with computers (students as digital natives, see Prensky 2001), so GIS can be an ideal tool for teaching geographic principals. But more difficult is to train the teachers (Davis 2002). Large amount of teachers have not yet come into contact with GIS. And if they know it, they rather teach *about* GIS than *with* GIS (see Sui 1995). GIS implementation into educational process is complicated. We can identify three general factors (Lloyd 2001, Bednarz 2001), which are:

- *technological*: bad availability of hardware, software and data (see Hassell 2002),
- *personal: lac*k of computer/technological skills in teaching staff (European Commissi*on 2006)*,
- *institutional/financial*: deficient in degree on top-down support and motivation.

There are also positive tendencies. For example, GIS position in the current reform of Czech education has benefited greatly from new curricular documents. Framework Education Programme for Secondary General Education (Grammar Schools) (cit. 2007, p. 36) speaks directly about the use of geographic data sources and information "in electronic form and to address geographic problems”. Specification of geoinformatic literacy is discussed in detail by Voženílek (2003).

2.1 Open source as possible alternative to commercial solutions?

As seen before, GIS are not fully implemented in common geographical lessons. If teachers use GIS in their education practically, they often use only simple GIS viewers or examples of commercial software (in demo or trial versions). The right question is the aim of meeting secondary school needs with low cost and still effective solutions. Suitable solutions for meeting the secondary schools aim could be reached by open source alternative providing highly developed technologies and recent innovations (Pucher 2003, Song et al. 2005). Open source as type of license (and even philosophy) has many disadvantages (implementation, services, user interface, support). However, open source solutions give the possibility to use things (data sets in our case) more interoperable, students could bring their data from school directly into their home computer and it does not matter if they use open source GIS applications at school computer (e.g. running on Microsoft Windows) or at their own workstation (e.g. running on any Linux distribution). Most open source GIS software nowadays perfectly works under several operating systems (Neteler, Mitášová 2007 or search for examples of QGIS, OpenJump and other applications), which shows the way how to create, use, share and distribute data and applications worldwide with low-cost effects.

3. Pilot project "Prakticky s GISy"

To dynamize current state and content of geographical education at secondary schools we developed project called "Prakticky s GISy" (*GIS practically*). The concept draws on the work by Malone et al. (2005), but without the use of subsidized or commercial GIS products. Implementation of open source solutions into the project is based on internationally reputable Czech open source GIS community around development of GIS GRASS (Neteler, Mitášová 2007, Landa 2006) and Open Jump (Růžička, Fuks 2005). Bringing open source GIS tools to the Linux operating system offers Klímek and Růžička (2006) through GISák Live CD. We decided to use Quantum GIS as GIT platform for the lecture and practical examples.

Prakticky s GISy was introduced at 20 grammar schools in South Moravian Region. It was structured as lecture for pupils during their geographical lesson. The lecture is logically structured into five divisions. After the topic introduction and student motivation the lecture continues by theoretical part followed up by practical examples. This procedure is quite simple and rooted in the educational system processes but we dynamize it by using open source alternatives, peer-to-peer approach and practical examples.

Information and visual demonstrations contained in the presentation, without tangible tools for listeners, lost their value. Therefore every teacher of geography (or any class participating in the project) received the DVD medium with the presentation (in PowerPoint, OpenDocument and PDF/A format for maximum interoperablity), a brief presentation of the project (DOC format) and in particular the component data and software. Pupils and teachers can then return back to the individual topics and have the opportunity to work with GIS on their own.

3.1 DVD as practical handout for every student and teacher

Receiving electronic media as practical handout from lectures was standard part of the project. There were two independent projects in format *.QGS in the DVD (map composition project which could be opened directly in QGIS) – *JmK_zaklad.qgs* (project used during lemure) and *JmK.qgs* (advanced project with sophisticated map composition). Files with *.QGS extensit are working projects (like commonly known formats *.MXD or *.APR in ESRI projects – typically ArcGIS 8.x/9.x/10.x, or ArcView 3.x).

Important parts of DVD are two folders - *SW* and *Data*. *Data* folder is internally structured according to the origin of data. Individual data were obtained from publicly available sources and are freely distributed. Basic four sources are:

- sample data set ArcČR 500 (provided by ARCDATA Prague for free for the South Moravian Region - this data was also used for model demonstration program for working with QGIS),
- FreeGeoData CZ developed by Czech community around open source GRASS,
- pasport data on road sections (in the Czechia) administered by the Directorate of Road and Motorway,
- basic settlement units (including urban districts), distributed by the Czech Statistical Office as part of territorial and analytical work.

Another key component is the *Software*. This is the folder of installation files of geographic information systems in the most updated versions. Installation files, if possible, are in the Czech version and with user guides. In addition to traditional viewers (ArcExplorer educational version, Christine GIS viewer) we packed also popular interactive programs for viewing satellite images (Google Earth, NASA World Wind). The core of *SW* folder are full-fledged GIS applications - represented by Quantum GIS (QGIS), gvSIG, MapWindow, OpenJump and SAGA GIS and GRASS.

4. Discussion: open source and peer-to-peer approach as dynamization or innovation?

Making more active and productive (definition of dynamization using e.g.

http://dictionary.reference.com/browse/dynamize) is crucial step for improving current geographical education in the field of using GIS. The question is if the key stones presented by our paper are innovative approaches or just dynamized standard methods. Using open source instruments and practicing peer-to-peer educational process are rare. Peer-to-peer methods, when students of geography and cartography are teaching pupils with GIS, were selected for several reasons:

- GIS topics are often classified as hard to learn and teachers usually do not like to teach it,
- pupils get wider information from other students rather than from teachers,
- the motivation are raising when pupils could communicate with lecturer without hesitation,
- this model develops pupils' knowledge and motivation as well as students' soft skills.

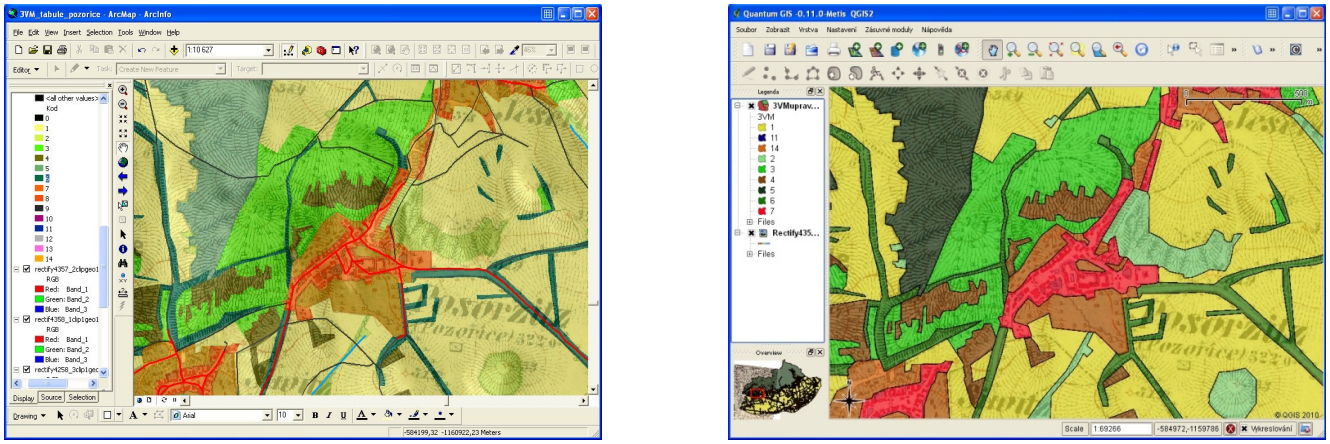

Fig. 1: Comparison of commercial software (ArcGIS 9.2) with open source alternative (Quantum GIS 0.11.0), see analogous interface as well as content visualization
Source: J. Trávníček 2010

The underlying idea behind the project was to support the work with geographic data on the level of secondary education, and clearly show the possibilities of geographic information systems. We are thoroughly consider advantages and disadvantages of using free software. Unlike the commercial applications, open source software lacks technical support (help desk) and there is no guarantee. But it offers advanced features, large users communities (often saturating help desk) and frequent updates. In the case of geographic data compatibility it is excellently supported - the files are being displayed and editable within the most commonly used formats (shapefiles for vector and TIFF for raster) and also some of the XML-based formats (e.g. Geographical Markup Language - GML).

Finally, we did not use commercially available geographical data viewers (such as ArcExplorer type), because these data can only view and browse map sets and do not have advanced features. The program should stimulate user for further learning and it should also provide more than just looking at the data. Commercial license terms are usually restricting the use of extra programs (not only) for personal use. For these reasons, alternatives to full-fledged geographic information systems among free software were chosen. These also allow more sophisticated operations on geographical data. Like most common (in alphabetical order) were selected gvSIG, MapWindow, OpenJump and QGIS. MapWindow needs .NET Framework to run, OpenJump and gvSIG are dependent on Java environment. One of the conditions of the selection was possible implementations on operating systems other than Windows, while minimizing other components to run the program. Important was also the subjective aspect of work such as the intuitiveness of the program and graphical user interface (GUI). From these reasons we have chosen Quantum GIS (QGIS) version 0.11.0 codenamed Metis (since August 2010 the version of 1.5.0 Tethys is downloadable). QGIS environment gives multiplatformity and offers the possibility of reading and writing multiple formats of raster and vector data, enhanced operations and also allows direct integration with GRASS.

Every "good practice" project must be critically evaluated. Pilot project *Prakticky s GISy* was broadly discussed in international forums (e.g. Trávníček, Trojan 2010). The feedback was collected after the lectures from teachers and pupils as well. Some selected outputs are:

- well accepted were two-hours lasting lectures,
- positively was classified the structure, dynamic form, practical impact and flexibility
- appreciated were methods used in lecture (peer-to-peer approach),
- better should be solved the connection between crucial curricular documents and the presentation,

- teachers would like to repeat lectures and extent the lectures by seminars (working on PC as more interactive solution).

Intersection of international discussion, feedback from target groups and pillars in foreign sources and researches could answer the question of legitimacy. If the educational process based on peer-to-peer teaching and open-source approach in geographical lessons is dynamization of current methods or innovative tendencies in Czech educational system (or if the both possibilities are legitimate) is the question for further evaluation, comparison of impacts to pupils and methodological proofs in other educational levels.

5. Conclusion

Our project reflects current situation at secondary schools in Czechia. Tendencies to teaching GIS are rooted in the Czech educational system but teachers are teaching often about GIS and do not use them in practical lessons. That was the reason why pilot project *Prakticky s GISy* was developed. According to modern trends the project aim was to present dynamically raising field of geoinformatics. Authors' conception was innovatively based on open source solutions suitable for every student and teachers. Methods used in the project came from peer-to-peer approach, which allowed interactive pupils participation during lecture. Combination of dynamic practical lecture and innovative using of open source tools with peer-to-peer approach is accomplished by practical handout for every course participant.

We realized this program in twenty secondary schools in South Moravia, and we evaluated feedback and identified strong and weak points of our approach. Findings were very important for establishing the right way of integration of practical GIS use at secondary schools. Continuance could be seen in three independent ways:

- Activities around peer-to-peer teaching and using open source GIS were implemented into project financed by European Union (Operational Program Education for Competitiveness), in which the cooperation with pupils from vernacular primary school is being held. Pupils from local community around this school are being authors of local map book using user-friendly open source GIS and terrain mobile mapping. This activity uses bottom-up principle at primary school level, where pupils are working with open source GIS together with their teachers.
- The second continuance could be seen in project of further education of teachers at secondary school level (also financed by EU grant schemes). In this project we try to "teach teachers" how to easily work with open source GIS. Teachers then uses open source GIS from their top-down hierarchy during the geographical lessons.
- The last way is in the university level when one of the author became a tutor of GIS in the non-geographical college and introduces GIS topics to university students who have never met GIS before. Feedback from the tertiary students would have key impact to course calibration and further optimization.

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