

## Chapter 3



# Computer technologies in geography education at the Faculty of Pedagogy of Masaryk University in Brno

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### **Abstract**

The most common ways of PC application in geography education at the Pedagogical Faculty of Masaryk University in Brno are statistical data processing, digital presentation completing, text file writing, data acquisition on internet, GIS and GPS utilising. E-learning faces some problems here.

### **Introduction**

The Faculty of Pedagogy at Masaryk University in Brno was established in 1956. Since its beginning, it was focused on the preparation of future primary and secondary education teachers. There were also teachers for high school education educated in some years here. The modern computer technology has been introduced into the faculty in 1970s. Personal computers have been used by the broader way since middle 1980s. Since beginning of 1990s, the personal computer became a standard part of the education used both by teachers and students (Michal, 1992). The computer room is a shared facility for most departments. There is also a specialised general computer education centre at the faculty. Most students in the faculty have to pass courses from this centre regardless of their future specialisation.

## **Computers in geography education**

The education of future geography teachers is the main task of the Department of Geography at the Pedagogical Faculty, Masaryk University in Brno, Czech Republic.

Following changes as a result of the Bologna process, student study is divided into two phases: bachelor studies and master studies. During the three-year bachelor studies, students have to pass the education carried out in introductory and analytic geographic sciences, for example, introduction to geography, planetary geography, landform geography, climatology, hydrology, soil geography, biogeography, geostatistics, principles of GIS, basic economic geography, geography of population and settlements, basic environmental geography etc. The subsequent two-year long Masters-level study lies in the education in more complex or synthetic geography sciences: landscape ecology, political geography, regional geography of Czech Republic, Europe and the World – both in physical and human terms. The geographical sciences are taught in both of the phases with regard to the future pedagogical orientation of the students. Because future teacher preparation is a combination of two subjects, students need to be enrolled in the study of another chosen subject, such as history, citizenship education, sports, biology, chemistry, physics, special pedagogy, etc. Additionally they have to pass courses in specialised pedagogic subjects.

Less than half of their study time is allocated to Geography. That is why the geography education courses are highly concentrated, as in-depth details are not being taught. Lectures and practical work in any geography science have only one class hour each per week per semester. The individual work and study of students is so very important. This situation relates to the high number of students in the course (now about 80 students in a course).

### *Using PCs for preparation of digital presentations*

The preparation of digital presentations using the MS Office PowerPoint package represents the most common PC application used by teachers in Geography education. The Geography department is

equipped with data projectors and all the staff with own desktop PC enabling internet access. Most department teachers have laptop computers. Other applications used include digital images, as well as tabular and text data sets for presentations. The application of digital image presentations improves the attraction of lectures, their quality and makes them more synoptic and understandable for the students. PowerPoint presentations are being used in planetary geography, landform geography, palaeo-geography, principles of GIS, didactics of geography and landscape ecology. Some other subjects are in the preparation. There are also used in research.

Bachelor and Masters level students use MS PowerPoint software. They use this program package for presenting their seminary and yearly works, to document the results of their bachelor and diploma thesis necessary for public defence, to present experience from research journeys, foreign studies, field practices in home and foreign countries. The traveller presentations especially enjoy wide vogue both among the composers and auditory. Presentations usually represent examples of a collaborative work. At the present, the growing number of presentations is typical for the preparatory stages of foreign field practices. In this way, students inform the other participants about data collected about the territory to be visited.

#### *Statistical data processing by PC*

The statistical processing of smaller or larger geo-datasets is not possible without the application of specific computer technologies. Statistical methods in geography are a subject taught in the course of geography education. Various survey and analysis methods applicable in for example climatic, hydrologic, demographic, geomorphologic studies are discussed. Most studies are conducted using small sample data sets, which can be processed using cellular calculators, such methods are unavoidable during the completing the seminars and/or other research works when the PCs are necessary because of larger amounts of data.

Excel is commonly used for statistical geodata processing. The application of specialised statistical software, such as STATGRAPH,

has become a standard. Students are taught to use procedures to get statistically processed results and to create synoptic graphical outputs necessary for successful dissemination of their results. Such methods are commonly used in the population geography and climatology education.

### *Completing Text files*

Text processing represents the most common application of computer technology among Geography students. Text processing knowledge is mainly acquired in secondary education. All the computers operating at the Department of Geography, Faculty of Pedagogy are equipped with the MS Word text editor. Some other PCs have SW AmiPro, or T602 text editors. Other text editors are quite rare.

The computer rooms at the departments of the Faculty of Pedagogy are predominately used for word processing related to seminars, bachelor or other studies, if students do not have own computer at home or in the college. Teachers use text editors for completing materials for publishing or internet transmission predominately in the MS Word format. Html format is being used for the dissemination of study materials or news on the Department of Geography internet site (<http://www.ped.muni.cz/wgeo>).

### *Searching the Internet*

Internet searching using various searching engines is another common application of PCs. Student are taught about optimal searching methods and about the interesting web sites through lectures. A catalogue listing the web sites presenting geographic and relevant data/information is available to them. This way, important climatic data ([www.chmi.cz](http://www.chmi.cz)), hydrological data ([www.vuv.cz](http://www.vuv.cz)), geological data ([www.cgs.cz](http://www.cgs.cz)), topographic data ([www.cuzk.cz](http://www.cuzk.cz)), soil data ([www.vumop.cz](http://www.vumop.cz)), population census data ([www.csu.cz](http://www.csu.cz)) and many others can be accessed from Government department web sites. There are also many international and national geoinformation companies operating on the Czech market here, provideing customers with important imformation (e.g. [www.arcdata.cz](http://www.arcdata.cz), [www.geodis.cz](http://www.geodis.cz), and dozens of others). Students are being encouraged to use various Internet

information sources to get verbal, numerical and graphical data useful for their studies. Teachers gain important teaching materials in the same way.

### *e-Learning*

The e-learning question is being frequently discussed by the geography education not only at the Department of Geography, Faculty of Pedagogy at the MU. The first development and implementation of e-learning projects were proposed about six years ago. Until now the realisation is not the reality. The main reasons for that are as follows:

1. Not all the students have any internet access.
2. The traditional way of teaching still dominates (the system of lectures, practices, seminars and individual study using published – printed learning materials: textbooks, scientific books and papers).
3. The governmental and university education programmes announce a growing interest in such kinds of study, but many universities are not capable in resource terms to carry out it while they are overloaded by an enormous rise in the number of students taught by traditional methods.
4. The predominant individual study way using the Internet is not possible for overloaded teachers who continue to use traditional teaching methods. The number of geography students rose four-times in the last five years (at present: 80 students/course in the standard study, additional 20 students in distant study), while the number of teachers has remained constant (7 persons).
5. E-learning agenda, and especially the electronic communication with large number of students, would be possible but under the present conditions it would probably not lead to a rise in the quality of education and improved knowledge levels.

There is considerable experience being acquired by the teachers of the Department of Geography in the preparation of electronic teaching and examination materials. So it is only a question of time before e-learning will be implemented. A change in teaching policy (more students need more teachers) and a certain change in the relationship between teachers and students will be needed. However with the wider

availability of computer technology we should anticipate the implementation of e-learning.

### *GIS*

The principles of GIS are being taught in a compulsory course for all students. Their GIS knowledge can be substantially extended in consequent courses. The Department of Geography provides an introduction to GIS technology in high school studies and in secondary education. Through this important experience has been gained in past years. As a result, ArcExplorer technology from ESRI is being used for geography education in many secondary and even primary schools in the City of Brno and in other towns in the Czech Republic.

The ability to work with a PC is an obligatory condition for GIS study. Students get the principal theoretical knowledge about GIS, GIS techniques - starting from the data acquisition through data storage, evaluation, analysis, processing and presentation in computer maps. Computer cartography still dominates in the GIS application of students who are completing their diploma theses. Students create various thematic atlases of selected regions on the Earth surface. Analytic work using GIS is mostly related with land use studies in different regions of the Czech Republic, with regard to the run-off conditions, ecological stability, recreational utilising (e.g. by MTBs) and the nature protection.

The Department of Geography at the Faculty of Pedagogy, Masaryk University in Brno is equipped with the GIS SW ArcView v.X, multi-licence ArcGIS 9, GIS Autodesk Map 2000i, Leica Geosystems SW for the image analysis, etc. Students can work with GIS software in the departmental computer room where it is installed on all PCs (Svatoňová, 2005).

### *GPS*

The use of mobile computerised technology applications has been growing very rapidly. The Department of Geography at the Faculty of Pedagogy, Masaryk University in Brno operates the integrated terrain education centre near-by the Jedovnice community in the Moravian

Karst Protected Landscape Area about 35 km to the north from the City of Brno. A one-week fieldwork course in Geography is run here every year for different groups between May and September. This includes pupils coming here from secondary schools in the Czech and Slovak Republic. The pupils learn here how to carry out geographical work in the field, commonly in integration with other sciences, such as geology, chemistry, physics and biology (Hofmann, 2002). The Geography students from the university practice here to get experience in working with children in the field.

GPS technology is being used as a standard tool for the safe orientation in the field here. Tourist navigation instruments such as Magellan are being applied. Geography students, school geography teachers and children as well learn to work effectively with this equipment. They study the principles of satellite navigation, and the advantages and disadvantages of its using GPS technology. Independent work with the GPS is based on various games when groups using maps pass a defined route with the set of control points (orienteering), or they have to find out individual objects described with detail geographic coordinates (geocaching).

The navigation of pedestrian student groups during excursions into the unknown terrain represents another way of using the GPS application in the geography education. This kind of GPS application plays a very important role in the course of overseas field practices carried out in countries with poor tourist maps, for example in the Romanian mountains or in forested regions of Russia. This way, students can also get a feeling of responsibility for the group and confidence of modern computer navigation technology as well.

## **Conclusions**

The growing intensity of the application of PCs in Geography education at the Faculty of Pedagogy is in tune with the main aim of the faculty in improving the skills components of the geography teacher training curriculum. These computer technologies allow rapid searching for facts, processing of data and presenting results. More geographical computer technologies, like GIS, geostatistics and computer cartography, make the putouts of bachelor and diploma theses much more successful. Geographical work using ICT presents an obvious “added value“, which has been appreciated in various competitions outside the Faculty, such as the Student GIS project prize by ESRI, the Student Scientific Activity competition, MU Rector’s prize, Minister of Environment prize, etc. Using GPS plays an important role in everyday geography. This way, geography students (and graduates) and their neighbourhood perceive the practical aspects of geography education to be useful, relevant and good.

It is necessary to remark in an objective evaluation, that on one hand the geography teachers push the students to acquire standard knowledge and skills without their own positive acceptance of the technology. On the other hand, there are among students many individuals with higher specialised computer knowledge and skills than their teachers have. The enthusiasm of these students can be used to motivate the teacher to acquire new knowledge in the application of advanced computer technologies. Through the integration of technologies Geography can play an important role in the future information society.

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## Chapter 4



# Geo-Informatics and Geographical Education in the Czech Republic

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### Introduction

Geoinformatics has been developing quickly, affecting a number of other scientific disciplines in the process. Its position has been strengthening in many areas of education. Geo-informatics has been used by a number of disciplines of geological science using spatial information. The main contributors to the dynamic progress of geoinformatics include private businesses, universities and institutes of the Academy of Sciences of the Czech Republic. In the Czech Republic the demand for specialists in informatics and geo-informatics has significantly increased recently. The interest in geo-information courses at universities has been tremendous.

### Geoinformatics and Literacy

For centuries literacy, in the sense of reading and writing, used to be the benchmark for community education a sign of usability of an individual for the community. The privilege of a narrow group of people developed over centuries to become one of the basic human values. The State invests money into active knowledge of reading and writing acquired in the course of the first years of elementary school education of its citizens. Literacy opens ways to further education. With the changing world the society requirements change too; the original meaning of literacy has been considerably extended. The latest

extensions to the notion of literacy include computer literacy information literacy and geo-information literacy, all of which are a fundamental for the workplace today.

Stanfield (2002) maintains that geo-information literacy consists of geographic, cartographic and information literacy. The distinction between geographic and cartographic literacy follows from the distinction between the two branches of science themselves, even though the two overlap to a certain extent. Generally speaking, what is geographic (i.e. spatial), may be expressed cartographically, and vice versa, i.e. what can be expressed cartographically is spatial and can be subject to geographic research. To solve the individual types of tasks with geo-information methods requires today all aspects of geo-information literacy, even though to different extents. Voženílek (2002) says that geo-information literacy is not a sole privilege of individual experts in geo-informatics. As a consequence of compulsory school attendance, especially secondary and university education, a number of elements of geo-information literacy can become part of everyday life of every expert (natural scientist, cartographer, expert in informatics, economist, manager etc.) Geo-information literacy is not only an ability to comprehend a special set of issues, procedures and activities using geo-information technologies, but also a tool of generation of new knowledge, approaches and decision-making materials.

### **Geoinformatics and World**

Geo-informatics has become an important part of many branches of science and economic functions of the society in the practical terms. The idea of Digital Planet Earth (refer to the conference Digital Earth – DE, China, 1999) contemplates a new wave of technological innovation allowing us to collect, store, process and display unprecedented amounts of information about our planet Earth and its versatility of environments and cultures. The developing modern technology serves people only to a certain extent. People are clearly unable to use the technology at the right moment for selection or acquisition of the needed information. The Declaration on Digital Earth therefore states that while the global progress of 20<sup>th</sup> century was characterised by rapid improvement of science and technology, which significantly

contributed to economic growth and social welfare, the new century will be the era of information and spatial technologies supporting global knowledge economy.

### **Geoinformatics and EU**

The European Union is well aware of the disproportion between the grand entry of geo-information technology and the weak response to it in general education, making therefore use of geo-information, especially practical skills in work with various portals providing spatial information one of its principal education objectives.

### **Geoinformatics and Czech Republic**

The status of general knowledge of work with geo-information corresponds to the status in other EU countries. The newly accredited university subjects react to the needs of experts in this field through the creation of training courses and workshops.

However, what is still virtually neglected is education in information and geo-information technologies for teachers and for the general public. This issue has not been neglected on the theoretical side (Svatoňová, 2001a; 2001b; 2001c; 2001d; 2002; Voženílek 2002; Foltýnová, 2005; Novák and Barányová, 2005) but

Figure 4.1 Student of Geography and pupils working with a PC and thematic atlas – diploma work.

there have to this date been only a few practical projects developed on the Internet platform (Vranka and Kolečka, 2000). However, there are few visible results yet of geo-information education of teachers and the general public. The gap between the young and the old generations thus becomes ever wider. So, we often meet with a situation that can be

defined, with a little exaggeration, as a clash between digital student and analogue teacher (Figure 4.1).

### **How do Czech schools react?**

The Ministry of Education, Youth and Physical Exercise of the Czech Republic has prepared a new Framework Education Syllabus. The syllabus allocates two lessons a week in the first grade elementary education and four lessons a week in the second grade elementary education to “Information and Communications Technology“. The expected competences to be acquired by study of the subject are:

- The pupil will be able to use application, educational and multimedia programs
- The pupils will be able to use available application software for solutions of learning tasks and issues
- The pupil will know how to present the results of his/her activity
- The pupil will be able to orient himself/herself on a web site and acquire the offered information from the web site menu
- The pupil will master algorithms of learning tasks and practical case tasks
- The pupil will be able to use different types of software
- The pupil will acquire basic knowledge on methods of computerised solutions to simple practical problems

The introduction of GIS is in full harmony with the Framework Education Programme (see above). It is up to the teacher of Informatics and Geography whether he or she makes use of this material and have it supported its curriculum. The practice only demonstrates the well-known fact that “everything is possible if you want to make it possible“.

Geography teaching can then be well supported by cartographic teaching in the context of regional geography and local landscape studies. Geo-informatics may ideally be used as a synthetic subject forming a link between geological science and informatics. So the question “Is application of geo-informatics on the elementary and secondary school level realistic?” needs to be asked. This may in turn be answered by whether the equipment and teaching aids are available

in sufficient quantity and quality, whether there is interest on the part of the pupils and students and teachers as well as whether the teachers are qualified to teach this subject.

### **Geoinformatics and School Equipment**

Czech schools were beneficiaries of an extensive project called “Internet to Schools“, which was designed to allow pupils to use this medium. In the context of wide computer access, improvements based on significant computer price reduction and a simultaneous increase in their performance and output there is an opportunity for geoinformatics to also be developed. While geo-informatics is quite demanding in terms of hardware processing requirements, GIS software is relatively hardware-independent, incompatibility of the software means and the data themselves remaining an issue, though, significantly complicating use of data/formats. Software selection affects the curriculum. However, according to ArcData Prague, 22 out of the 27 universities in the Czech Republic are equipped with ESRI and ERDAS software.

The status of hardware equipment is continuously improving many elementary and secondary schools are currently even better equipped than university departments of Geography. The simplest version of the software, still sufficient for acquisition of basic orientation, can be uploaded free of charge from the Internet, e.g. via ArcExplorer or other data browsers. Software for data creation is more expensive. In our experience companies provide 50% discount to schools and lease of a 30-, 60- or 180-day licence can be agreed upon. Certain funds are needed for data purchasing, but there are also discounts for schools and the first applicants can count on other benefits in the case of active interest of the teacher. Large companies, such as ESRI, represented in the Czech Republic by Arcdata Prague, are interested in inclusion of the GIS issue into elementary education curricula, and are prepared for active involvement in this process. That would in future mean for these companies increased numbers of paying subscribers. Negotiations with these companies are in my opinion substantial for acquisition of their support for potential introduction of GIS into schools.

## **Geoinformatics and Pupils and Students**

What is the interest on the part of elementary school pupils and secondary school students? At the general level there appears to be no interest at all yet, mainly due to the fact that the notion of geoinformatics has not really entered the area of public awareness. Where we have introduced GIS already (e.g. at Integra Grammar School in Brno, elementary school in Blansko, elementary school at Křtiny) the pupils and students mastered work with the software without difficulties and both the pupils and students and the teachers found the work very interesting. The results of the experiment called "Terrain Mapping in the Orda River Basin and Transfer into Digital Format" were reported by Ing. Dalibor Mahel, PhD., at the Ministry of Education of the Czech Republic. Theoretical research is carried out by doctoral students (Mgr. Foltýnová, Mgr. Barányová, PhDr. Hübelová) of the Department of Geography of Pedagogical Faculty of Masaryk University in Brno (PF MU).

## **Geoinformatics and Teachers**

The shortage of qualified teachers of information and communication technologies is a major, lingering problem. Many lessons in informatics are often devoted to computer games or repeated work with a text editor. In our experience, teachers of Geography are usually inclined to learn these new things, especially when they see examples of the work and are convinced that geo-informatics can be mastered by a teacher. We

Figure 4.2 Teacher and student on individual studies

have also received teacher-training proposals to Centres of Pedagogical Education for GIS lecture series. The GIS laboratory of the Department of Geography, Pedagogical Faculty, Masaryk University in Brno, is ready (technological equipment and human resources are available) to

provide lectures in geo-informatics to geography teachers or teachers of related subjects (Figure 4.2). The syllabus is designed to provide sufficient theoretical knowledge of GIS and the relevant practical skills to the teachers fully covering the needs of elementary and secondary school education.

### **Geoinformatics and Department of Geography, Pedagogical Faculty, Masaryk University in Brno**

In the Department of Geography of the Pedagogical Faculty of Masaryk University in Brno basic software was purchased in 1998, including ArcINFO7.2.1. and ArcView3.1., with extensions Spatial Analyst and 3D. This became the software building block of the GIS laboratory, which consisted of second-hand computers and their upgrades, some new computers were purchased along with a multi-licence for software.

#### *Hardware equipment*

Today the Department has its own in-house GIS laboratory equipped with ten computers and the necessary software. The computers are equipped with ArcExplorer, ArcView 3.1, ArcView 8 with extensions.

#### *Teaching of geo-informatics*

Students of geography teaching at the Pedagogical Faculty of Masaryk University take geo-informatics as a compulsory subject of 3<sup>rd</sup> semester. They are introduced to theory of geographic information systems, remote research on the Earth and the global coordinate system. The related practical seminar focuses on practical skills needed for use of GIS, DPZ and GPS:

- Use of Arc Explorer including spatial data visualisation,
- Inquiries to spatial data database,
- Use of air and satellite photos
- Assembly of photo-mosaic from original air photos
- Photo evaluation and description
- Comparisons of photos from different time scales
- Use of GPS apparatus
- Sources of photo acquisition for schools
- Didactic use of the photos in geography lessons

- Preparation of in-house CD with freeware ArcExplorer, exercise data, digital topographic map of the locality or region, air and satellite photos including detailed descriptions of photos of the surroundings of the students' residence or planned place of work

A number of students continue their geo-informatics studies after taking this rudimentary course in the following semesters, where they get a detailed knowledge of data creation, analysis and visualisation in advanced SW systems (Figure 4.3).

The Department of Geography has developed a number of thematic atlases of world regions for schools and the wider public processed with geo-information technologies (such as Atlas of Australia, Atlas of Near East, Atlas of Central Asia, Atlas of Russia, Atlas of Southern Europe etc.). A very valuable contribution is represented by diploma theses Rudiments of GIS and Advanced GIS containing theory and a set of

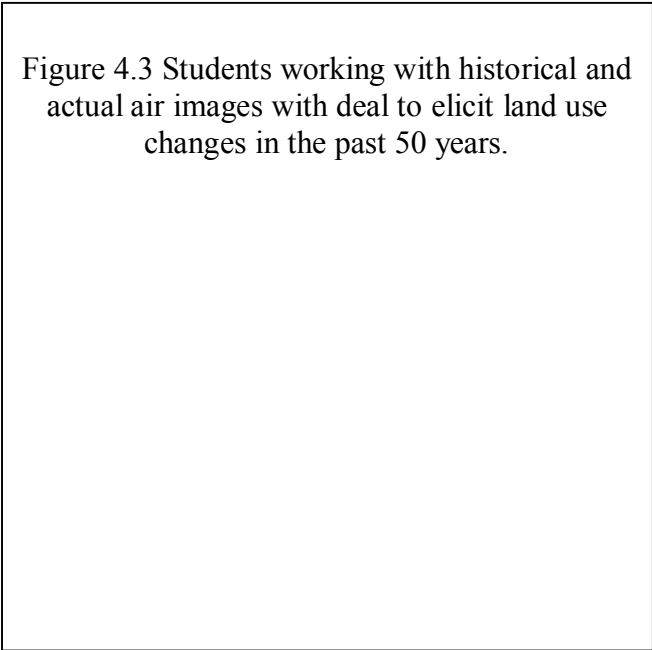


Figure 4.3 Students working with historical and actual air images with deal to elicit land use changes in the past 50 years.

exercises for teachers and pupils. Atlases of satellite photos are under preparation to cover selected regions of the Earth, again with emphasis on their future use at school.

Department of Geography, Pedagogical Faculty, Masaryk University in Brno is one of the leading sites of its type in the European region with its complex and modern student preparation in the area of geo-information technologies.

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