Vermessung & Geoinformation 1/2009, p. 174 – 178

Teaching GIS in Central Asia




Rainer Prüller, Johannes Scholz, Clemens Strauß, Graz; Teresa Achleitner, Salzburg

1. Introduction

In the year 2008 the Institute of Geoinformation, Graz University of Technology, Austria participated in two geo-information science related activities in Central Asia. The first activity was the international conference on "GIS for the future of Central Asia" in Bishkek, Kyrgyzstan and the second activity was a train the trainer workshop titled "Geo-Informatics for Mountain Environment Management" in Katmandu, Nepal.

These two events brought the authors to the local geo-information scientist community for a first reality check of teaching geo-information topics on-site. Furthermore the novices among the Austrian participants socialized with the experts and existing contacts got reacquainted. Based on these fruitful networking and on the various impressions of these events, new ideas according to teaching Geographic Information Systems (GIS) related to local needs in Central Asia are arising for future activities.

The main challenges for teaching activities are finding the right Geographic Information (GI) tools that are available for the local institutions and having access to regional geo-data so that the participants will develop a better relation to the lectures.

2. Teaching experiences in Central Asia

The contact to teaching activities in the Central Asian region of the Institute of Geoinformation at Graz University of Technology began in spring 2008 with the invitation of the Eurasia-Pacific Uninet to a symposium in Bishkek, Kyrgyzstan. The goal of the Eurasia-Pacific Uninet is to support contacts between universities, universities of applied sciences and other research facilities in Austria and member institutions in the Pacific, in East, Central and South Asia. At present there are approximately 100 member institutions in Bhutan, India, Kazakhstan, Kyrgyzstan, Mongolia, Nepal, Austria, Republic of Korea, Russian Federation, Tajikistan, Taiwan, Uzbekistan and the People's Republic of China. Financial support is given from the Ministry of education, science and culture and from the Austrian Exchange Service (ÖAD) (Eurasia-Pacific Uninet, 2008 [5]).

The first participation of the Institute within Eurasia-Pacific Uninet was a Geoinformation symposium in Bishkek under the topic "GIS for the Future of Central Asia" (GISCA'08, 2008 [6]). The main intention for holding this conference was the encouragement of international cooperation and exchange of knowledge in GIS education in Central Asia. In the course of the conference the Austria-Central Asian Centre for GIScience was inaugurated which is the point of contact for Austrian initiatives for supporting the development of advanced competence in GIScience. Further objectives of the centre are the support of education through teacher education and summer schools and the support of joint initiatives towards externally funded projects in research and education (Austrian-Central Asia Centre for GIScience, 2008). Based on contacts of this symposium the Institute was invited to a "Train-the-Trainer"-Workshop in Kathmandu, Nepal under the topic "Geoinformatics for Mountain Environment Management (mountainGIS)" organized by the International Centre for Integrated Mountain Development (ICIMOD). ICIMOD is an international independent mountain learning and knowledge centre committed to improving the sustainable livelihoods of mountain peoples in the extended Himalayan region (ICIMOD, 2008 [7]). The content presented by the Institute of Geoinformation covered the topics forest growth modelling and forest inventory with GIS in general.

Future activities will expand to Mongolia: During a visit of Khovd University in Western Mongolia, several ideas for organizing workshops and realizing ideas in the field of agriculture or landscape development were developed.

3. Teaching GIS

The idea of teaching GIS in Central Asia is an emerging topic in GI education. The driving factors for teaching Geoinformation in these

countries are explained in the following paragraph. First of all we want the Central Asian countries to benefit from the skills the students acquire. Thus the economy may develop further and through the application of GIS techniques a sustainable and ecologically worthwhile growth can be maintained. By supporting international or national Organisations within the scope of multilateral research projects as well as projects carried out by local GIS experts and institutions an ecological and economical balance may be found. Furthermore we can facilitate social networking (student exchange, etc.) to enhance the cultural exchange.

In order to have sustainable teaching "results" the Problem Based Learning approach (Kopp and Mandl 2002 [8], Car 2004 [4]) seems to be appropriate. In traditional instruction methods, the so-called instructional view, students are often trapped in a passive role (Mader and Stöckl, 1999 [9]), and we observe the phenomenon of inert knowledge (Artelt et. al., 2001 [1]; Arzberger and Brehm, 1994 [2]). This form of isolated knowledge can be reproduced by the student, but cannot be applied to any practical problem. This problem arises when theoretical information is presented based on the following assumptions (Kopp and Mandl, 2002 [8]):

- Knowledge is a consequence of learning both facts and routines.
- Knowledge can be transmitted from one person to another like products.
- Learners can bridge the gap between theory and practice themselves.

Mader and Stöckl (1999) [9] and Kopp and Mandl (2002) [8] proposed, that a certain learning approach, the constructivist approach in learning and teaching may overcome the creation of inert knowledge. According to this the learner has to be set in an active position, and the process of learning should be a social process. Thus the teaching itself does not have a prominent part, it has act in the sense of encouraging, supporting, as well as consulting.

To create a Problem-based learning environment, both the instructional and the constructivist view have to be combined in an appropriate and balanced manner. Thus, Reinmann-Rothmeier and Mandl (2001) [11] proposed four principles that have to be considered:

Authenticity and reference to application: Knowledge is presented using "real-world" examples and showcases that may originate from the professional field. With this "practical"-oriented presentation students are motivated to focus more on specific topics.

Multiple contexts and perspectives: Each topic should be presented from different contexts in order to avoid becoming trapped in one certain context. This results in a broader and flexible knowledge, which helps applying the latter in varying situations.

Social learning arrangements: Due to the fact that cooperation and communication is essential in every professional environment, learning has to pick up and facilitate that concept. Working in groups on certain tasks deepens the understanding of the gained knowledge and fosters the students' communication abilities.

Instructions, information and construction supply: Instructions are a way of supporting the students while they are working on tasks. The teacher has to maintain that the tasks are not too complex and thus avoid a cognitive overload. In addition the students should look for more detailed information for completing the task on their own, based on the instructions from the teacher.

Based on these assumptions, we want to work spatial problems and incorporate problems from the local countries/education institutions. Project/Problem input from students and local professors is very welcome, which intensifies the learning and teaching experience for both sides. A major part of the teaching material may be disseminated via the TUG TeachCenter – similar to the interactive learning portal geoinformation.net (Plümer and Quadt, 2009 [10]). Moreover this approach helps to have a sustainable impact on the students, due to the fact that they can go through the teaching material more often – even if the course is over.

Based on our experience open source software is appropriate for sustainable teaching, due to the following facts: minimum costs for licensing (mostly available for free), great community based support. For most GIS-related tasks there is an open source tool available that can be applied in the course of Problem Based Learning. Basically we provide "the way of thinking" during the short theoretical lectures which will be the basis for understanding GIS tools.

What our institution can provide are: highly skilled and motivated teaching personnel, a great number of students for exchange programs, a

pool of various geo-data, as well as several infrastructure facilities.

4. Workshop Participants Mentoring

Beside the primary content of a workshop that is focused on the knowledge transfer of technologies and methods in the area of GI in the connection with local needs, the basic infrastructure to support this intention should be kept clearly in mind. Furthermore this infrastructure should lead to a sustainable learning success.

For this purpose the mentoring phases of a workshop have to be identified considering the participant's needs, and link the necessities to the supporting teaching infrastructure.

4.1 Mentoring Phases

The phases where participants of a workshop need support or additional information can be divided into three temporally separated parts:

- Pre-workshop

In this phase the potential participant should receive general information about the structure of the workshop, links to useful documents and software tools to exercise a preparation independently and get fit for the workshop. Additionally a portal for participant – participant and participant – lecturer communication in the pre-workshop phase should be provided for shorter communication channels and better information flow.

- Workshop

During the workshop itself the presentation slides or e-books, concerning the theoretical part, and instructions for practical work during the lab sequences and their sample solutions should be available by the supporting teaching infrastructure.

- Post-workshop

Following the on-site workshop phase further mentoring of the participants might be necessitated. For example coaching a long time lab project, a knowledge evaluation for a workshop certificate, or just the facility to archive lecture documents and results arising from lab or project work.

4.2 Mentoring Infrastructure

The required functionality figured out afore can be found on several e-learning platforms. These platforms include a data exchange area and a forum for communication purposes as their basic modules. One exponent of e-learning platforms in the free and open-source software community is represented by moodle (http://moodle.org). As they propagate on their web site, moodle can be seen as a course management system, learning management system or as a virtual learning environment.

At the Graz, University of Technology the prime infrastructure for supporting educational needs for online and online-supported teaching is called TeachCenter (http://tugtc.tugraz.at). A second system, LearnLand, completes the infrastructure and focuses on the documentation and presentation of individual work (http://tugll.tugraz.at).

- TeachCenter

The function range of this infrastructure is adaptable to the needs of a course. The key tools include an administration area for general course information, time schedules or a grouping tool, a download area for lecture documents, a forum for communication and the possibility to take an examination (e.g. a multiple choice test). Moreover the course participants have the facility to upload their own documents arising from labs or project work for evaluation and exchange.

- LearnLand

Contrary to the TeachCenter, LearnLand provides an internet blogging framework including social networking facilities for participants and lecturers. Within a blog lab or project work can be recorded for the participants themselves, for a participant – lecturer communication or even for the whole LearnLand community to share ideas and collect new approaches.

5. Workshop concept "Solar energy potential in Central Asia 2009"

This workshop is planned for summer 2009 in Bishkek, Kyrgyzstan for students and lecturers of GIScience in Central Asia and will be founded by the Eurasia-Pacific Uninet. The workshop will create skills for the application of tools which can contribute a main part for the security in regional energy supply. The calculation of the theoretical, technical and economical potential of solar energy can be handled by GIS. This is the subject-specific aim of the workshop. To create practical qualifications for the implementation of solar energy in Central Asia is the strategic objective. Therefore the structure of the workshop is built in that way that 75 % will be focused on theoretical background for modelling solar (in addition wind and hydro) potentials in the region. Austrian experts from these scientific fields are

invited to communicate the participant ideas and concepts of solar, wind and hydro models which are implemented in the second part of the workshop with appropriate open-source GIS tools. This part will be about 25 % of the planned five days duration. We will offer several modules to meet requirements of the participants.

Practical applications will be the collection and spatial analysis of energy characteristics to document the actual state, the calculation of solar potential and the calculation of potential for micro hydro plants in Central Asia. For these tasks only for the participants available data will be used to ensure that they can implement the methods in their own workflows. The calculation of solar potential will be done by the free available r.sun model which is implemented in the GRASS GIS open source environment. The model is able to serve raster maps of selected components (beam, diffuse and reflected) of solar irradiance [W.m*], solar incident angle [°], the daily sum of solar irradiation [Wh.m-2] and duration of the beam irradiation [minutes] as output. The daily sum of solar irradiation and the duration of the beam irradiation computed as integration of irradiance values that are calculated in a selected time step from sunrise to sunset. Another open source geographic information system is SAGA GIS which is also able to calculate solar radiation coefficients within a very powerful terrain analysis. The decision which specific GIS tool will be chosen depends on the foreknowledge of the participants. Due to the fact that the workshop is modular built, we can teach these modules which fit best. Further worked out modules besides GRASS GIS or SAGA GIS are the UMN Mapserver for delivering calculation results, PostgreSQL/ PostGIS database, PHP &phpMapscript and the treatment of further open source GIS like QuantumGIS or gvSIG.

The workshop should not only be seen as knowledge transfer from Austrian universities to the counterparts in the Central Asia region, it should also be a starting point for further cooperation with Central Asian partners.

6. Eurasia-Pacific Uninet

Eurasia-Pacific Uninet is a network which aims at establishing contacts and scientific partnerships between Austrian universities, universities of applied sciences, other research institutions and member institutions in East Asia, Central Asia, South Asia and the Pacific region. The network was founded in the year 2000 by Prof. Dr. Brigitte Winklehner and is strongly supported by the Austrian Federal Ministry for Science and Research and the Austrian Exchange Service (ÖAD).

At present with a total of 115 member institutions in Austria, China, Mongolia, the Russian Federation, Korea, Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, Bhutan, Nepal and India, the network promotes multilateral scientific cooperation, joint research projects, conferences as well as faculty and student exchange.

Eurasia-Pacific Uninet is the largest sovereign university network of its kind within Europe.

The goal of Eurasia-Pacific Uninet is to support interdisciplinary scientific exchange between its member institutions through

- scholarships for Post Docs and Ph.D. students coming to Austria
- projects
- summer schools

Further Eurasia-Pacific Uninet supports scientific, economic and cultural relations between Austria and the target countries, R&D activities of multinational companies, visiting professorship and reciprocal acknowledgement of study degrees and programs. Eurasia-Pacific Uninet supplies contacts between government agencies, educational institutions and companies, intercultural expertise through intense programs and courses and initiates joint research centers, joint schools for teaching, research and training, the development of joint curricula and double-degree program and research activities by means of workshops, seminars and conferences and through the exchange of scientists among member institutions.

7. Outlook

Based on the impressive experiences in Kyrgyzstan and Nepal in 2008, the authors are highly motivated to intensify the existing contacts to Central Asian GI institutions and ideas for new GI workshops are arising. Additionally different Austrian GI institutions in close connection and sciences, which are not situated in the core area of GIS, have the chance to reactivate existing social networks or built up new links covering such teaching projects.

Furthermore, by creating lessons dealing with local circumstances the sensitivity rises for problems and challenges in Central Asia that are hardly known in the western world. This will

start at the technical infrastructure of communication networks, like internet, concern the configuration of teaching class rooms, like computers and software, and end up at the accessible geo-data.

Last but not least the importance of the Eurasia-Pacific Uninet as an institution for academic exchange should not remain unmentioned. This institution acts as base for scientific activities in Central Asia and provides the social infrastructure on-site which allows the participants to focus on contents but not on organizational work.

References

[1] *Artelt, C., Baumert, J., Klieme, E., Neubrand, M., Prenzel, M., Schiefele U., Schneider, W., Stanat, P., Tillmann, K.-J. and Weiß, M. (Hrsg.) (2001):* Pisa 2000: Zusammenfassung zentraler Befunde. URL: http://www.mpib-berlin.mpg.de/pisa/ergebnisse.pdf [accessed on: 12.1.2009].

[2] *Arzberger, H. and Brehm, K.-H. (1994):* Computerunterstützte Lernumgebungen. Planung, Gestaltung und Bewertung. Erlangen: Publicis.

[3] *Austrian-Central Asia Centre for GIScience (2008):* Objectives. http://www.aca-giscience.org/ .

[4] *Car, A. (2004):* The Problem-Based Learning Approach in Geoinformation: An Example. In: Proceedings of The Fourth European GIS Education Seminar (EUGISES 2004), Villach, Austria.

[5] *Eurasia-Pacific Uninet (2008):* Activities. http://www.eurasiapacific.net .

[6] *GISCA'08 (2008):* Second Central Asia GIS Conference – GISCA'08 "GIS for the Future of Central Asia". http://gis.org.kg/confer/gisca08/ .

[7] *ICIMOD (2008):* About ICIMOD. http://www.icimod.org/?page=abt.

[8] *Kopp, B. and H. Mandl (2002):* Problem-Based Learning in virtual GIS learning-environments. In: Proceedings of The Third European GIS Education Seminar (EUGISES 2002), Girona, Spain.

[9] *Mader, G. and W. Stöckl (1999):* Virtuelles Lernen. Begriffsbestimmung und aktuelle empirische Befunde. Innsbruck, Studien Verlag.

[10] *Plümer, L. and U. Quadt (2009):* Interactive GIS Learning Portal geoinformation.net. URL: www.geoinformation.net [accessed on: 12.1.2009].

[11] *Reinmann-Rothmeier, G. & Mandl, H. (2001):* Unterrichten und Lernumgebungen gestalten. In: A. Krapp & B. Weidenmann (Hrsg.), Pädagogische Psychologie. Ein Lehrbuch (S. 601-646). Weinheim: PsychologieVerlagsUnion.

Contact

Rainer Prüller, Johannes Scholz, Clemens Strauß, Graz University of Technology, Institute of Geoinformation, 8010 Graz, Steyrergasse 30, Austria
E-mail: rainer.prueller@tugraz.at,
johannes.scholz@tugraz.at,
clemens.strauss@tugraz.at

Teresa Achleitner, Eurasia-Pacific Uninet, 5020 Salzburg, Kaigasse 28, Austria
E-mail: teresa.achleitner@sbg.ac.at