digital:earth:at – Implementing the Digital Earth Vision for Education at a National Level

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Abstract

Founded in 2008, digital:earth:at – the Salzburg Centre for Learning and Teaching Geography and Geoinformatics (www.digitalearth.at) represents the first and only research and education centre for geoinformation in school education in Austria. This paper intends to present the goals and activities of the centre. In order to show the structural framework of digital:earth:at, the first part is dedicated to the Austrian school system and its peculiarities.

Within the context of a rapidly changing education environment, not only in a technological perspective but even more from a pedagogical point of view, teachers face a multitude of challenges. Our students are increasingly connected (Internet, Web 2.0), the teachers’ role is changing into that of a moderator of learning processes, and information is more and more geo-coded. Learning must change from traditional patterns into a process adapted to the 21st century’s societies, taking into account the vast possibilities – as well as risks – offered by new media, including spatial information services, networks and communities.

digital:earth:at addresses this changing educational context. The initiative is a cooperation between Salzburg University’s Centre for Geoinformatics, the Salzburg University of Education and the GiScience Institute of the Austrian Academy of Science. The centre of excellence for learning and teaching geography and geoinformation aims at implementing pedagogical research using digital earth tools and enhancing teacher education and training. The second part of this paper highlights the centre’s goals in terms of research, educational and public awareness. Being integral part and coordinator of the European centre digital-earth.eu, digital:earth:at provides a model for national centres of excellence in the field of geoinformation in education.

1 Introduction

“The mediocre teacher tells. The good teacher explains. The superior teacher demonstrates. The great teacher inspires.”

(William Ward)

Teachers’ competences and enthusiasm are products of their individual talent, their education, training and – not to forget – the appreciation of their work within a knowledge society. However, teaching in schools is strongly depending on structural and financial conditions of an educational system. Besides innovative pedagogical conceptions within teacher education and training, structural aspects of an educational system have to consider professional development and career opportunities for teachers as well as a structure that allows collaboration of educational institutions and organisational flexibility for schools. digital:earth:at is embedded into the Austrian educational system, which shows a variety of
special administrational and pedagogical particularities. The following will describe the current situation and developments relevant for digital:earth:at.

1.1 The Austrian school system

Austrian school legislation is provided at a federal level, amendments can be effected by a two-thirds majority of the National Council. Curricula are in general established at this level. Individual schools have some influence in the distribution of credits/semester hours allocated to certain subjects, which allows some specialisation. At the same time, most organisational matters are dealt with at a provincial level, which causes a complex system of responsibilities (JEKEL et al., in print).

Secondary education is compulsory and free up to the age of 15 and optional and free after that. Secondary education is divided in ‘secondary education I’ (age 10-14) and 'secondary education II' (age 14-18). The final exam “Matura” allows access to postsecondary education. ‘Secondary education I’ is divided into two different types which adhere to the same curriculum but employ teachers educated at different institutions (universities and universities of education). The current (political) question is whether or not to merge “secondary school I” into one type of school for all, in order to prevent from the very early selection of students at the age of 10.

‘Secondary education II’ includes a variety of technical and vocational schools (age 14-19). Even within the same type of school, quality of education varies widely – mainly across an urban-rural divide, as well as according to various family and/or migration backgrounds. (see SCHWANTNER & SCHREINER 2011)

Currently, geography teachers are trained at five universities and 14 universities of education – depending on the type of school they want to teach in, students chose to attend either university or university of education.

Table1: School types and teacher educating/training institutions in Austria

<table>
<thead>
<tr>
<th>Level of education</th>
<th>School type</th>
<th>Teacher Education Institution</th>
<th>Teacher Training institution</th>
</tr>
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<tbody>
<tr>
<td>Primary school (6-10)</td>
<td>Primary School (Volksschule)</td>
<td>University of education</td>
<td>University of education</td>
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<tr>
<td>Secondary school I (10-14)</td>
<td>Secondary School I (Hauptschule)</td>
<td>University of education</td>
<td>University of education</td>
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<tr>
<td>Secondary (Grammar) School I (AHS)</td>
<td>University</td>
<td>University of education</td>
<td></td>
</tr>
<tr>
<td>Secondary school II (14-19)</td>
<td>Secondary (Grammar) School II (AHS)</td>
<td>University</td>
<td>University of education</td>
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<tr>
<td>Vocational Secondary School (BMS/BHS)</td>
<td>University</td>
<td>University of education</td>
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</table>
Whereas teacher education is split into two completely different institutional and conceptual tracks – at the same time meaning different levels of salary – teachers of all school types attend in-service training courses at universities of education. While teacher education at universities is more focused on scientific backgrounds in the subject, universities of education concentrate on pedagogical and practical competences. Universities lose touch with their alumni in the moment they enter school. There is actually no exchange between the majority of in-service teachers and their universities, preventing feedback cycles into university teacher training.

The system and its complicated structures in terms of school types AND teacher training/educating institutions do not foster a dynamic development of pedagogical innovation. The last decades drew the picture of a petrified giant that was not able to move on with all those new ideas brought in by enthusiastic teachers and policy makers. Currently, at least some movement towards a co-operation in teacher education and training can be sensed – one good practice example is digital:earth:at. As a collaboration between a university (University of Salzburg, Centre for Geoinformatics), a university of education (Salzburg University of Education) and a research institution (GIScience Institute, Austrian Academy of Sciences) and also linking to local small and medium enterprises (SME’s), the centre comprises three key types of institutions for sustainable teacher education.

The implementation of innovations such as GI-based learning is typically a slow process and therefore probably is best achieved through teacher education and training. Teacher students and teachers are encouraged to make use of various training offers. However, these support systems for professional development are not compulsory across all types of schools. Moreover, they do not adhere to a common curriculum for professional development. This makes seminars supporting GI-use in school highly selective and leads to the introduction of GIS through a handful of innovators at teacher level.

1.2 Teaching with geoinformation in Austria – a history

Computer-based learning in geography education in Austria has a quite long tradition, going back to the mid-eighties of the last century. Early publications on this topic include a distinct emphasis on the Web as means to access geoinformation for geography education, and argued for an approach centred on geo-media competencies. Geo-media includes both classical geo-referenced data as well as text, images, films which are linked to a location. The Austrian journal for geography education – GW-Unterricht – devotes an own commented section to GI-software and openly available geographic media suitable for school use. Since 2006, this approach been reflected in a series of conferences named ‘Learning with GI’. In 2008/2009, digital:earth:at was founded in order to give a framework to research and education activities. In 2010/11, the term “digital earth tool” was introduced for all types of geographical software, services (including data) and community.

Research activities in the field of GI in secondary education have concentrated on the development of competence models for GI-based education, namely the concept of spatial thinking and more recently, the concept of spatial citizenship (JEKEL & GRYL 2010). Here, competences are focused on everyday orientation, communication and participation tasks in a wide variety of contexts rather than specialized scientific problem solving or software proficiency (STROBL 2008, 2010). Education should be oriented at basic principles and
competencies to be acquired. This approach is also reflected in Austrian curricula. The Austrian ministry of Education and Culture has edited curricula containing GIS and geoinformation indirectly (BM:UKK, 2009). They are mentioned in open phrasing in the geography curriculum and as general principles. Within the geography curriculum, most themes can be directly related to a spatial approach. Teachers are also urged to use new media and modern technology. Media education, citizenship and environmental education are applicable to all subjects. The use of online mapping, virtual globes, images, and movies on the Web is justified across a broad range of subjects.

Although there are compulsory courses on basic concepts of geography for teacher students, education in the field of geoinformation is not compulsory in teacher training. There are numerous seminars available for in-service teachers willing to use geoinformation. Topics of these seminars include geocaching, collaborative gaming and planning, use of remote sensing imagery in school or hypothesis development using spatial information. (see Jekel et al. 2011)

2 digital:earth:at

After a period of technology-centeredness, learning with geoinformation is being integrated into a wider pedagogical debate (Jekel et al, 2008). Practical experiences with new learning environments are being gathered and scientifically evaluated. In many cases, theory lags behind practice.

According to the “Benchmark Statement on GIS in Secondary School Education” (Donert 2008), geography education prepares school leavers who

- can actively participate in public decision making,
- understand the basic purpose of GIS to real world problems, and
- can use GI interfaces in order to investigate, reflect and communicate spatial phenomena.

This is a great educational mandate. Universities, teacher educators and teacher training institutions are asked to provide teachers with adequate skills, materials and working conditions.

2.1 National centre for learning and teaching geography and geoinformation

Curriculum requirements in Austria and the benchmark statement for GIS in secondary school education provide the basis for digital:earth:at. Initially supported by the Austrian Federal Ministry for Education, Arts and Culture (BM:UKK), digital:earth:at provides an information and communication platform for geography teachers. Literal affinity to Al Gore’s “Digital Earth” vision (ISDE5 2007) is intentional. digital:earth:at aims at contributing to the vision of digital earth citizens, linked through the Internet, being able to freely access digital (spatial) information and knowledge resources on our planet.

digital:earth:at has been established in late 2008, the key partners are the University of Salzburg, Centre for Geoinformatics, the GIScience Institute of the Austrian Academy of Sciences and the University of Education Salzburg. They are collaborating with number of institutions and companies dealing with geographic information at different scales and
levels, including the Salzburg provincial government’s Institute for Spatial Planning and Housing (SIR), research unit (salzburgresearch) and GIS department (SAGIS), the Austrian Federal Office for Calibration and Mapping (BEV), the Austrian research centres’ studio ISPACE, and several local SMEs like eovision.at and bgis.at.

Fig. 1: digital:earth:at partners in school education

This collaboration helps not only to keep in touch with regional and national public and private players in GI, but also to bring “real life” into the teachers’, students’ and pupils’ learning. At the same time, companies and public services have an interest to showcase their activities in order to raise awareness for a spatial perspective and to involve future citizens in geographic information society. – Partners consider their activities as reasonable investment in terms of upcoming generations of geographers and geoinformation scientists!

digital:earth:at is Austria’s first and foremost competence centre for the application of geographic media in school. Established in Salzburg, an internationally reputed location for GIs-Science, as a member of the Salzburg GIScience research cluster, the centre understands its role also as a contact institution between GIScience and school education, bridging the gap between research and technological development on the one side and school education and pedagogical concepts on the other side.

2.2 Goals, activities and target groups

digital:earth:at aims at developing a comprehensive concept for effective teacher education and training. A multi-level approach has been selected in order to meet the demands of different groups involved in geography teaching and learning.
digital:earth:at provides activities for all target groups involved in secondary education. Teachers, teacher educators and teacher trainers, teacher students, scientists (geographers, GIScientists, educationalists), practitioners (GI-companies, GI-related public services, geodata providers), and pupils will benefit from the initiative’s activities. Each of these groups is actively participating in a joint process of learning geography and bringing in constructive contributions to the development of adequate geography teaching concepts.

### 2.2.1 Developing modern pedagogies for learning with geoinformation

In order to foster the use of geographical media including the web 2.0 in school education, digital:earth:at intends to research and communicate aspects of pedagogically reasonable concepts for school teaching. All pupils and students should be able to understand and make use of cartographically enhanced communication processes in order to participate in future decision making. This includes competences in map reading and production.

It is a pedagogical principle to connect school learning to the learners’ social and natural environment. As adolescents are highly connected to the internet and its services in their leisure time, it is up to teacher education and training to offer pedagogical concepts and technological trainings to put these competencies to use in education. It can be expected that the use of spatially enabled web-tools will significantly motivate and activate learners of all ages. Teachers will have to relinquish control and thus will have to provide scaffolding in order to receive reasonable learning outcomes.

Along the way the digital gap in society shall be mitigated by using internet technology in school education. The outstanding role of spatial information and communication within the web 2.0 is communicated through digital:earth:at. The importance of the spatial perspective for school education will thus be highlighted by digital:earth:at initiatives, spatially competent teachers are going to offer web 2.0 experiences to all pupils, including those who come from less digitalized backgrounds.

### 2.2.2 Research

Research in the field of geoinformation in school education is implemented in school-research collaborations. digital:earth:at scientists are cooperating with other research institutions and school teachers and classes. Recently, research activities have concentrated on participative cartographic communication processes within GEOKOM-PEP (see VOGLER et al. 2010), a project under the Austrian Ministry’s of Science and Research (BMIWF) “SparklingScience” programme (www.sparklingscience.at) which adopts an unconventional way in the promotion of students as young scientists that is unique in Europe. Researchers are working closely together with young people doing research following the students’ ideas and research plans prepared in cooperation with scientists. More basic research is directed at the links between society, the digital spatial world and education, leading to pedagogies for spatial citizenship (GRYL et al. 2010).

Research activities and results are shared with the scientific community. digital:earth:at hosts an international conference named “Learning with Geoinformation” taking place in Salzburg annually in July. The digital earth concept is in the focus of many research papers presented and published in the conference proceedings. Moreover, experiences and research results are disseminated and discussed in teacher education and training courses.
2.2.3 Networking
digital:earth:at is a highly connected national competence centre. It is networking with national and international organisations and networks like the HERODOT network, the COMENIUS network digital-earth.eu, the European Association for Geographers (EUROGEO) and the Austrian centres for learning and teaching geography based in Vienna, Graz, Klagenfurt and Innsbruck.

The COMENIUS network digital-earth.eu (www.digital-earth.eu) has started in November 2011 and is coordinated by the Centre for Geoinformatics Salzburg. Different working groups will research aspects of learning with GI, including
- Resources, data, technologies and geo-information
- Learning and teaching with GI
- Teacher education and training
- Curriculum aspects and geoinformation.

digital:earth:at will – as a coordinator of the network and sending members to the working groups – benefit from the network in terms of research and dissemination of the digital earth concept for education.

2.2.4 Provide high quality teacher education and training

The process of teaching geography is influenced by several factors, besides internal and external teaching conditions, technological development seriously affects learning processes. Technological progress offers a huge number of tools – increasingly including the spatial perspective – for teaching. Apparently teachers are often just overwhelmed by these rapid developments and find it difficult to put them to use. Due to a significant work overload, restricting school environments and a lack of suitable training possibilities, all those tools find little application in learning and teaching geography.

Given that schools in most countries are currently facing critical social, structural and financial challenges, the question of using up to date technology seems to be secondary in many cases. However: it’s not a matter of technology, but of teaching concepts and motivation. Thus, using innovative pedagogical and didactical approaches involving learners as active and responsible personalities must not be underestimated in terms of sustainable learning. LINDNER-FALLY (2009) reports results of a survey carried out in late 2008, showing students’ preferences and information about ICT- and GI-use in Austrian schools. At the same time, teachers asked for continuous education in learning with geoinformation, mainly as support in school projects, but also as online-courses and face-to-face seminars. digital:earth:at could collaborate with teachers in a new school-research collaboration and has implemented several teacher training courses since then.

Austria’s first joint teacher education and training module for learning with geoinformation could be started at this opportunity. The course is outstanding from both the provider and the consumer perspective: for the first time in Austria, a university and a university of education offer a collaborative course which is accredited by both institutions. And for the first time, in-service teachers attend a course together with teacher students. The course started in November 2010 and will be certified with 24 ECTS at the end.
2.2.5 Create teaching materials and disseminate good practice

Technological development, especially the web 2.0 offers great services and platforms dealing with spatial relationships. Depending on a teacher’s technological abilities and pedagogical experience, these services can be directly used in school education.

While good practice just happens in daily school business, digital:earth:at focuses on collecting and disseminating these examples and encourages teachers to share their experiences and materials. These materials are developed by practitioners and meet the requirements of the curriculum.

Additionally, digital:earth:at develops teaching materials and media enhancing the use of geographic information in school education. For instance, a local geoservice platform has been set up in cooperation with the Salzburg provincial GIS and planning departments. Spatial planning data was made accessible for school use. Analyses and visualisation functionality are provided for educational purposes within a special framework. “raum:planen” (literally: space:planning”) is presented within this volume (ASAMER et al.).

The dissemination of news regarding the educational use of geoinformation is a main issue of digital:earth:at. The website www.digitalearth.at offers information on the centre’s goals and activities, learning concepts and materials. Beyond that, it serves as an exchange platform for learning materials and provides a news service on geoinformation in school education. Quarterly e-newsletters containing information on digital:earth:at activities and general information on GI for education are provided to the target audience with the aim of building a strong community of innovators. A professional logo including the earth as a symbol and a fancy lettering, information flyers and roll-ups have been produced in order to be able to transport the digital:earth:at brand to the public.

2.2.6 Actively involve pupils and students

The main focus of the digital:earth:at initiative is clearly teacher education and training. These efforts are highly multiplying and its effects spreading all over Austria. Nevertheless, the centre is also in direct contact with pupils. Scientific support is provided within the above mentioned school-research collaborations. Both scientists and pupils gain a great benefit from these projects, but given the limited budget for such projects, these experiences remain restricted in quantity.

Additionally, digital:earth:at invites schools to visit GIScience and business: as a GIS Day partner, the centre hosts the Austrian GIS Day platform (www.gisday.at), which provides general information on GIS, GIS Day and GIS Day events in the different parts of the country. GIS Day (www.gisday.com) provides an international forum for users of geographic information systems (GIS) technology to demonstrate real-world applications, scientific backgrounds and business models.

The Centre for Geoinformatics Salzburg (Z_GIS) has been hosting GIS Day events in Salzburg since 1999. From 2009 onwards, digital:earth:at has been taking charge of GIS Day organisation and implementation. In 2010, 13 workshops and presentations dealing with GI in research, business and administration were offered by in collaboration with the centre’s regional partners. Current projects and concepts were presented to and hands-on experienced by some 300 pupils, teachers and other interested persons. All over Austria, more than 2000 visitors were attracted by GIS Day activities (see www.gisday.at).
3 Outlook

The digital:earth:at initiative – while in no way the final product - may provide a model for national competence centres that aim at the inclusion of geoinformation in education. From our experience, we suggest a three by three formula that may be considered both during development of centers as well as for the ‘accrediation’ of centers once established. This formula roughly could read

- **Three types of institutions** – in the fields of education, research and private sector enterprises related to GI - provide services in
- **Three fields of activities** – research, teacher training and awareness activities – to
- **Three different target audiences**: Teachers and students in teacher training, teacher trainers and researchers in pedagogics, and students in primary and secondary education.

The Austrian competence centre does not consider its work done. It intends to investigate in detail the impacts of its activities in teaching practice, in terms of instructor engagement and of student learning. Lobbying for the promotion of spatially enabled school education is one of the further tasks that digital:earth:at will undertake continually.
References


