

Quo vadis Education in Photogrammetry? The Contribution of E-Learning

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ABSTRACT

Several structural changes, in particular the introduction of Bachelor and Master programmes at Universities in several European countries, have an important impact on higher education and indirectly on post education, also in the field of GIS, Photogrammetry and Remote Sensing. Some of the underlying concepts of these changes favor the complementary use of E-Learning materials, especially in form of single courses or smaller tutorials. Goal of this contribution is to oppose the potential advantages that E-Learning can offer to the actual present status. Here the factors modularization, exchangeability, addressing multiple levels of detail and avoiding multiple generation will be considered. From the identified drawbacks we derive wishes and demands for future developments and usage of E-Learning materials in higher education for GIS, Photogrammetry and Remote Sensing.

1. INTRODUCTION

The tremendous technical and methodological developments in the Geoinformatics Science in general, and of Photogrammetry and Remote Sensing in particular, demand for an adoption and modernization of education and post education offers. Hence this paper picks up the overall motto of the 50th Photogrammetric Week “Quo vadis Photogrammetry?” with its subtopic “Photogrammetry in the Year 2025” and deals with the challenges related to education in Photogrammetry, Remote Sensing and neighboring disciplines within the next one or two decades.

Besides the mentioned technical and methodological developments the most important challenges for teachers and students are presently caused by a couple of structural changes. In particular, in several European countries the transition from the traditional University Diploma towards the two level educational model (i.e., Bachelor and Master degrees) leads to a rethinking of all issues related to education and post education, i.e. not only organizational but also thematic, didactical and economical aspects. Section 2 will briefly summarize these issues for the special case of education in GIS, Photogrammetry and Remote Sensing, with a certain emphasis on developments in Germany.

In this overall context the complementary or substituted use of electronic media for educational purposes (“E-Learning”) is seen as an efficient and flexible form of modern teaching. In the last years a couple of national and international funding programs have supported this idea which has evolved from a “hype” towards a realistically discussed trend within the last five years. The respective arguments for using E-Learning will be summarized in section 3, while in section 4 an overview of the actual use in the field of GIS with an emphasis on Photogrammetry and Remote Sensing will be given. From an evaluation of this present status we will derive wishes and demands for the future use of E-Learning (section 5).

2. STRUCTURAL CHANGES IN PHOTOGRAMMETRY EDUCATION

In order to put the following description and discussion of E-Learning in its broader context we will first briefly summarize some of the structural changes that are of importance for the higher level education today. It should be mentioned that we concentrate only on issues relevant for this contribution, while other aspects like competition between Universities or introduction of study fees which will also have an impact on the future setting will not be treated.

Presently the most important impact for higher level education comes from the “Bologna Declaration” that in its core aims for a harmonization of higher education certificates in the European area. In Germany as well as in a couple of other European countries the transition from the traditional University Diploma towards the two level educational model (i.e., Bachelor and Master degrees) leads to profound changes. First developments in Germany can be summarized as follows (see also Bill, 2005; Schiewe, 2005):

1. In German speaking countries there is a high increase in the **number of the new Bachelor and Master programs** incorporating a significant amount of GIS topics: In April 2005 41 Bachelor (most of them 3 over years) and 48 Master programs (most of them over 2 years) have been counted. Although the traditional Diploma programs are still in the majority (ca. 206) we expect a further significant increase of the two-level study programs with the beginning of the winter terms in 2005 and 2006.
2. In the meantime education in GIS and related disciplines such as Photogrammetry and Remote Sensing has become a fixed integral part of **several study programs**. While in the past there was a dominant attachment of these disciplines to Geodesy, we can now observe several programs (with a certain emphasis on Geography) that integrate relevant topics at different levels of detail.
3. A **comparison** within this variety of programs is nearly impossible. One reason for that is that in the planning phase a co-ordination between the several Universities has not taken place. For example no core curricula have been defined for the respective disciplines on a national basis. Instead of that we can observe a strong diversification of the thematic foci as well as of their names. Even within the former Geodesy programs no unique convention could be found, programs are named “Geodesy and Geoinformatics”, “Geomatics”, “Surveying Engineering”, “Surveying and Geoinformation”, “Civil Engineering and Geodesy”, “Geomatics Engineering”, or “Cartography and Geomatics” – just to list the presently available Bachelor programs. Furthermore, the classical separation of “Universities” and “Universities of Applied Sciences” in Germany becomes rather blurry. All these trends can be seen as a consequence of the politically imposed competition between higher education institutions.
4. Not only the desired comparability as intended by the “Bologna Declaration” but also the desired, improved **employability** of students is not guaranteed from the today’s viewpoint. While on one hand there is great agreement on the fact that the new Master replaces the old Diploma (and as such serves as entry for the higher public service), on the other hand it is quite unclear what kind of jobs are suitable for Bachelor graduates who will have only a three years education which is even less compared with the classical four years programs at German Universities of Applied Sciences.

Based on these observations we can derive some important **consequences** for setting up future education programs like in GIS, Photogrammetry or Remote Sensing:

- Due to the underlying concepts of the “Bologna Declaration” and the Bachelor and Master programs concerning mobility and comparability a strong **modularization** of content is demanded. A module is defined as a thematically and temporal closely fixed part which consists of one or more single courses over one or two terms and which is finalized with an exam directly after it has been taught.
- With the concept of modularization it is also intended to avoid multiple generation of content and with that a higher degree of **exchange** of materials between Universities.
- With the extension of GIS, Photogrammetry and Remote Sensing topics to a variety of study programs beyond Geodesy the necessity to teach these disciplines for various **target groups** and at various **levels of detail** has to be taken into account.
- We have to consider not only a modernization of content, but also a new ratio between conceptual topics and practical (“hands on”) units. For example, due to the limited study duration it seems unrealistic that Bachelor students will be able to intensively work with a GIS product or even with a Digital Photogrammetric Workstation. These qualifications have to be transferred to a eventually taken Master program or to the **post education phase**.

3. ARGUMENTS FOR E-LEARNING IN MODERN PHOTOGRAMMETRY EDUCATION

Based on the broad context of the present situation in GIS, Photogrammetry and Remote Sensing education in general, and the consequences of the introduction of the Bachelor and Master model (section 2) in particular, this section summarizes the potential of the complementary or substituted use of electronic media for educational purposes (“E-Learning”) which has already been introduced on basis of a couple of national and international funding programs.

Under the **term “E-Learning”** we subsume a large bandwidth of computer-based teaching forms, reaching from self studies with internet-based or CD-ROM units (*telelearning*) towards the transfer of lectures to other places or the implementation of distributed learning groups (*teleteaching*). It has to be stated that there is no generally accepted terminology for the super term “E-Learning”, and a variety of further terms (like Computer-, Web-, or Multimedia-Based-Training) exist which may have an identical meaning or build up a subset only. Concerning the volume of the material, respectively the institutional setting, we distinguish between full programs, (short) courses and tutorials.

In the meantime the general **additional value** of E-Learning is well accepted (e.g., Glowalla, 2005). The key advantages can be summarized as follows:

- E-Learning enables a much more flexible and individual usage compared to other teaching forms, this is not only important for the casual student but even more for people in the field of post education.
- In contrast to other teaching materials like text books E-Learning modules can be up-dated very quickly.
- While pictorial, very often also multidimensional or dynamical geo data are in the focus of modern Photogrammetry and Remote Sensing, we can conclude that vice versa multimedia and interactive tools of E-Learning are very well suited to demonstrate respective concepts and examples for these disciplines.

Following the consequences of the introduction of the Bachelor and Master study model (section 2) we can derive further arguments for using E-Learning:

- E-Learning units as such follow the concept of **modularization** and are hence suited for replacing complete courses, but also for substituting only parts of them.
- Because E-Learning materials are easy to access by remote users and, if demanded, to be controlled by supervisors from remote places, they also foster the ideas of **exchangeability** and **avoiding multiple generation**.
- In contrast to face-to-face teaching or text books, E-Learning can use technical means to offer content at various **levels of detail** – and with that for various **target groups** – much more easier.
- Due to the flexible and individual use over the Internet E-Learning is also well suited for **post education** purposes, for instance for teaching new developments or specific system knowledge.

4. PRESENT USE OF E-LEARNING

Like in other disciplines also in the area of GIS, Photogrammetry and Remote Sensing the above outlined potential of E-Learning has been widely recognized and has led to the generation of a variety of materials. Those are strongly distributed over the World (Wide Web), so that comprehensive overviews become necessary. Respective examples for materials available on the international market are initiated by the former Working Group VI/1 of the International Society for Photogrammetry and Remote Sensing (ISPRS, http://www.photogrammetry.ethz.ch/general/persons/jana/isprs/ed_material.html) or the GeoCommunity (<http://spatialnews.geocomm.com/education/links/>). A portal with mostly German speaking modules has been established by the Geoinformatics Centre for Excellence (GiN, <http://www.gin-online.de/elearning>). However, a generally well known and accepted as well as preferably up-to-date and complete overview does not exist yet.

Furthermore it can be observed that concerning the volume of material all types of E-Learning materials are offered:

- We can find a limited number of **full programmes** in the area of GIS – like the
 - UNIGIS Master of Science (Geographical Information Science & Systems) at the University of Salzburg (www.unigis.at),
 - Master of Technology Management at Aalborg University (<http://www.aau.dk/evu/udd/msgeoinf.htm>), or
 - Master of Geographic Information Science at Birkbeck College/University of London (<http://www.bbk.ac.uk/gisconline/>).
- Also the number of (**short**) **courses** that are finished with a certificate is quite limited – one example are the courses given by the European Organization for Spatial Data Research (EuroSDR; for details see Höhle, 2004, or Heipke, 2004).
- The majority of available E-Learning materials are smaller **tutorials** – which are either developments of
 - companies offering up-to-date system knowledge (e.g., for GIS products developed by ESRI, <http://campus.esri.com/>, or Intergraph, <http://imgs.intergraph.de/training/default.asp>), or
 - of single institutions like an introductory tutorial on Remote Sensing (Technical University of Berlin; <http://www.fpk.tu-berlin.de/cbt/fernerkundung/>) or a tool for digital monoplotting (ETH Zurich; Flüher et al., 2005), or
 - larger joined projects covering a variety of topics, like

- GITTA (www.gitta.org),
- FerGI (www.fergi-online.de),
- geoinformation.net (www.geoinformation.net),
- gimolus (<http://www.ilpoe.uni-stuttgart.de/projekte/gimolus/www/>), or
- WEBGEO (www.webgeo.de)

While the project GITTA already comprises all higher education institutions in Switzerland, the latter four German projects are currently merged into one conglomerate named *geo-kiosk* (<http://www.geo-kiosk.net>). The idea of this joined effort is to integrate existing materials, to offer additional services (like translations or migrations to other learning platforms), and to develop marketing strategies and business models.

Besides the just described variety with respect to volume, content, target groups and language the **diversity** of E-Learning units for Photogrammetry and Remote Sensing can also be fastened on other aspects like underlying pedagogy, integration of tests or exams, integration of multimedia elements (like animations, videos, audios), possibility for certification, integration into learning platforms (Learning Management Systems, LMS), other technical dependencies, costs or terms of usage.

5. EVALUATION OF PRESENT AND DEMANDS FOR FUTURE USE OF E-LEARNING

Goal of this section is to give a general evaluation of the actual potential but also of the existing problems of existing E-Learning materials (section 4) in comparison to the outlined advantages (section 3). From that wishes and demands for a future use will be derived. Because E-Learning must not only be seen as a simple transfer of learning materials into digital form we will in the following address the whole bandwidth of thematic, technical, didactical, organizational and economical elements (see figure 1).

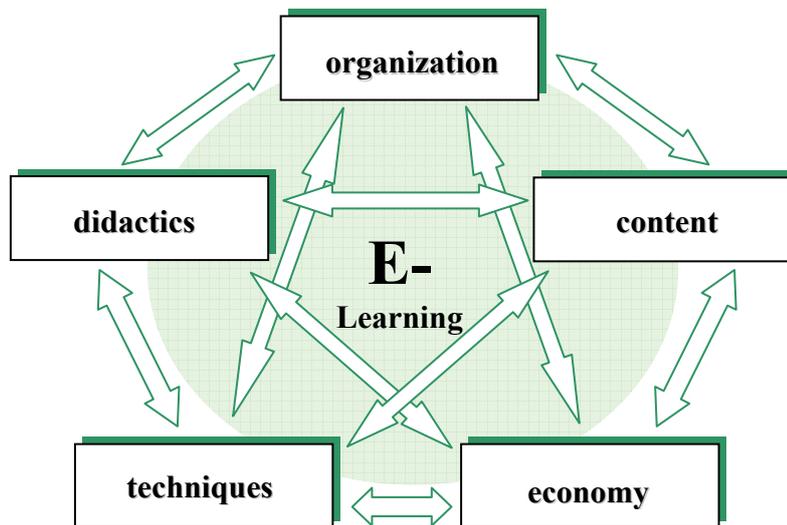


Figure 1: Network of factors influencing the development and usage of E-Learning materials

5.1 Thematic issues

Elementary advantages of the new media in contrast to text books lie in the abilities to update and distribute content faster. Vice versa we have observed that for a couple of basic topics (named “Introduction into...”) materials have been developed several times while some “hot topics” have not been covered so far.

In order to further increase the desired **exchangeability** of tutorials the trend should go to units as small or divisible as possible. This eases the integration into existing courses significantly.

5.2 Organizational issues

There is definitively a lack of suitable E-Learning courses (e.g., in the order of 1 to 3 ECTS credit points) that could replace conventional ones. Universities from which most developments are coming from do not have the respective necessary personal and marketing structures to create, update and supervise such courses. With that the exchangeability of full modules between education institutions is still very limited.

Not only for full courses but also for smaller tutorials this limited **exchangeability** is even strengthened by the following aspects:

- The **willingness of lecturers** to use external material is traditionally rather limited. In this context we can already observe some successful actions which have definitively to be extended in future: The concept of open content (like with the GITTA project) or the offer of free modules for a limited time (like with the FerGI project) are good measures in order to motivate lecturers to begin with E-Learning materials and get used to them.
- There is no generally accepted or nearly complete **overview** of E-Learning materials available which also hinders the usage. In the very near future, the generation of central overview portals (as mentioned in section 4) have to be fostered.
- There is no generally accepted **reviewing procedure** for E-Learning materials so that due to a missing quality estimation the formal and practical acceptance of units is nearly impossible. On the other hand, we expect that within the next five years appropriate quality and reviewing procedures will be established, either in respective journals (comparable to book reviews) or in centralized portals (as intended with the *geo-kiosk* project mentioned above). In this context it has to be stated that evaluating E-Learning materials is a rather complex task because not only thematic but also didactical, organisational and technical issues have to be addressed. A respective, extended criteria catalogue was suggested by Schiewe et al. (2005).
- Most **examination regulations** do not formally accept (external) E-Learning courses as comparable examination performances yet. One can hope that in the near future quality and cost arguments will lead to the integration of corresponding passages into the regulations.
- Another critical point is the **sustainability** of many modules that have been developed in the course of publicly funded and hence temporally limited projects. This leads to the fact that updating or user support can not be guaranteed over the end of the projects. Because public funding is short and will be run out within the next three or five years, other strategies have to be developed. From our point of view joined efforts between author teams from Universities and commercial institutions like publishing houses have to be established very soon. In fact, the proposed *geo-kiosk* project will support this direction.

5.3 Didactical issues

Concerning didactics a clear trend towards “blended learning”, i.e. the combination of E-Learning and face-to-face elements, can be observed for all scenarios. However, with respect to design it has to be mentioned that most materials do not exploit the full potential of the used media, like the integration of meaningful animations, tests with automatically generated recommendations for further learning paths or additional communication channels. Also a user friendly implementation of various **levels of detail** for different target groups is very often missing. As a consequence, the already successful co-operation with experts from pedagogy and psychology has to be extended even more in future.

5.4 Technical issues

From a technical point of view the use of standardized formats (like XML, HTML, Flash, PDF) has been established for the generation of E-Learning materials and hence facilitates an uncomplicated user access and increases the **exchangeability**. Due to the heterogeneous user demands concerning functionalities different grades of implementations, from the simple web-based version towards the integration into Learning Management Systems (LMS) have to be considered. Because a unique trend towards a default LMS is not visible from today’s point of view, the generation of E-Learning material should be done independently from any platform. This will also be a key factor for the exchangeability as demanded in sections 2 and 3.

5.5 Economical issues

The acceptance of E-Learning material is closely related to moderate and opposed to other media comparable costs. In this context the idea of “open content” can be of advantage and importance for the **exchangeability** issue. However, it has to be made clear that for adding value to basic material (for example, for migrations to certain Learning Management Systems or translations) or for support or supervising services the users have to pay for. The same is valid for the usage of E-Learning in post education which include exams and certificates.

As already mentioned before it seems to be unrealistic that Universities, which are presently the driving force in creating E-Learning content, are able to guarantee a sustainable offer, including updating materials, proper marketing, etc. Hence joined efforts between author teams from Universities and commercial institutions like publishing houses have to be established. Because the market for exchanging materials between Universities is rather limited and would not be sufficient for an entire business model, the post education market has to be addressed more intensively. First steps will include the generation of profound market surveys including the identification of potential customers and their needs. Again, these tasks shall be performed by the already mentioned *geo-kiosk* project.

6. CONCLUSIONS

Presently we experience profound structural changes in higher and post education in GIS, Photogrammetry and Remote Sensing, in particular due to the introduction of Bachelor and Master programs. Some of the underlying ideas favor an intensive and complimentary use of E-Learning materials. However, by opposing the arguments for E-Learning to the actual present status of developments and usages not only the high potential but also several problems can be identified. In fact,

most of them are of organizational nature, for example missing reviewing procedures, insufficient examination regulations or lacking sustainability of projects. It has to be concluded that at this time in particular the exchangeability, but to a certain degree also the factors modularization, addressing multiple levels of detail or avoiding multiple generation can not yet be satisfied by E-Learning materials as theoretically intended.

For future developments and usage of E-Learning in the field of GIS, Photogrammetry and Remote Sensing we heavily demand for the generation of a central institution which builds up a sustainable organizational structure for the import, quality assessment and marketing of high quality E-Learning materials as well as for additional technical, organizational, didactical or economical services. This concept is followed by the project *geo-kiosk* which is currently built up within a research program of the German Federal Ministry of Education and Research (BMBF). With that the interesting and successful, disciplinary as well as interdisciplinary co-operation between experts from GIS, economy, media didactics, psychology and others will be continued and hopefully lead to the use of E-Learning as a flexible and standard teaching format in the near future.

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Summary of WWW links mentioned in the paper (last access: July 1st, 2005):

ESRI Virtual Campus: <http://campus.esri.com/>

FerGI: <http://www.fergi-online.de>

GeoCommunity: <http://spatialnews.geocomm.com/education/links/>

geoinformation.net: www.geoinformation.net

geo-kiosk: <http://www.geo-kiosk.net>

gimolus: <http://www.ilpoe.uni-stuttgart.de/projekte/gimolus/www/>

GiN: <http://www.gin-online.de/elearning>

GITTA: www.gitta.org

Intergraph: <http://imgs.intergraph.de/training/default.asp>

ISPRS: http://www.photogrammetry.ethz.ch/general/persons/jana/isprs/ed_material.html

WEBGEO: www.webgeo.de