E-LEARNING – BEST PRACTICE IN PHOTOGRAMMETRY, REMOTE SENSING AND GIS – STATUS AND CHALLENGES

Gerhard König [a], Peter T.Y. Shih [b], Christiane Katterfeld [c]

[a] Geodesy and Geoinformation Science, Technische Universität Berlin, Berlin, Germany
[b] Department of Civil Engineering, National Chiao-Tung University, Hsinchu, Taiwan
[c] Helmholtz-Centre for Environmental Research (UFZ), Germany
gerhard.koenig@tu-berlin.de, tyshih@mail.nctu.edu.tw, christiane.katterfeld@ufz.de

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ABSTRACT

In addition to professional training, computer aided teaching has long tradition. The difficult economic situation, however, forced many customers to take drastic austerity measures in the field of learning. Cost pressure encouraged a new openness to innovative and tailored learning concepts. As a result e-learning gained more interest and importance promising great benefit to the user. Around the world a variety of well-designed e-learning products exist. The web pages of Commission VI/2 (http://www.igg.tu-berlin.de/ISPRS/) provide a decision aid to locate relevant material. Links to websites known to the authors are listed; a search function allows selective access, taking account of quality criteria. This article describes best practice e-learning applications in photogrammetry, remote sensing and GIS. The rating is based on results of the Computer Assisted Teaching CONtest (CATCON) initiated by ISPRS, and on observation of recent developments.

1. INTRODUCTION

In the period 1988 to 1992 ISPRS first placed emphasis on computer-assisted teaching, recognising that the rapid progress in computer technology will greatly contribute to the modernisation of teaching methods. Consequently Commission VI working group VI/2 'Computer Assisted Teaching' was established, based on the guidelines by the 1992 Washington Congress resolution. Collection, analysis and dissemination of materials, software and data suitable for teaching and training were main tasks in order to distribute knowledge of the existence of subject-specific courses.

Under the guidance of WG chair Kohei Cho the first software contest on computer assisted teaching was held at the ISPRS Congress in Vienna in 1996. The award comes with prize money that is given to the first to third placed. This incentive has motivated contest participants and has successfully contributed to the progress in the development of learning material. Since then, a variety of software for computer-assisted teaching was demonstrated and honoured at the subsequent symposia.

But not only the high speed development of computer hardware and software techniques, but also the progress with regard to new learning methods which are associated with the terms e-learning, blended learning, game based learning etc. had a major impact on course quality and acceptance. Learning management systems and rich authoring tools now support designers in rapidly creating and maintaining e-learning content. The high speed Internet, powerful processors and graphic cards allow for visualisation of sophisticated educational material enriched with built-in animations or embedded streaming video leading to a better understanding of difficult learning content. Active collaboration through interactive intervention raises learners' attention and motivation. The new mobile devices bring us closer to achieving our goal for lifelong learning at any time and in any place.

So far the theory – but in practice another aspect is often obvious which mainly effects the universities. In many cases, the first funding was combined not only by the hope of motivating the learners by introducing new (digital) methods, but it was also influenced by the expectation of reducing costs in the education sector. At the beginning of the Internet hype, a number of initiatives with considerable financial effort was launched. However, forgetting that the material must be subject to continuous maintenance and updating many successful and promising approaches came to nothing. After the funding ran out, it was difficult to continue further development. Often it has been maintained only by individual commitment, running business on a low flame. The issue of sustainability is still not solved. On numerous occasions outdated material was removed from the network and broken links are very common.

Nevertheless, in addition to universities, companies have recognized the value of online tutorials and webcasts which pushed the development of learning material. It is used for customer training, the demonstration of software use and showing new product features. With this method a wide range of users can be reached – with only minor costs for all involved.

On the website of WG VI/2 a list of to the authors known and free available material covering our fields is published (http://www.igg.tu-berlin.de/ISPRS/). A search function facilitates access to relevant information. Furthermore, based on quality criteria, an evaluation of the learning material with the participation of interested user was made (Katterfeld, 2008). To reduce uncertainty about which modules are worth studying you can check the rating at the WG VI/2 website.

This contribution gives practical support for quick reference to first choice e-learning material.

2. BEST PRACTICE

We can distinguish between different types of e-learning materials: textbooks, interactive textbooks, course repitition, podcasts, youtube videos, webinars. A few specific outstanding examples are described in the next few sections. Of course there is much more valuable e-learning material available which could not be mentioned here. This contribution can be seen as an update to previous papers (König, 2009) in which further e-learning modules for remote sensing, photogrammetry and GIS are described.

2.1 Textbooks

2.1.1 CRISP

One of the first Internet based textbooks was produced by the Centre for Remote Imaging, Sensing and Processing (CRISP) at the National University of Singapore. It covers remote sensing basics, principles, and applications and includes chapters describing human vision, the Earth, Earth's atmosphere, electromagnetic radiation, atmospheric effects, airborne and space-borne remote sensing, analogue and digital images, optical (see figure 1), infrared and microwave remote sensing, and image processing and analysis. Space-borne remote sensing platforms and sensors are described in an appendix.

Figure 1: CRISP – Interpreting Optical Remote Sensing
http://www.crisp.nus.edu.sg/~research/tutorial/intro.htm

The tutorial has been implemented using a series of straightforward HTML pages. The content is clearly illustrated by a variety of figures and images. Although the content has not been updated since 2001 and several new sensor systems and platforms are missing the tutorial is well suited for getting an introduction to remote sensing.

2.1.2 University of Vienna – Aerial Image Archive

At the Department for Prehistoric and Early Historic Archaeology (Ur- und Frühgeschichte) of the University of Vienna techniques are developed to acquire, use, interpret and map remotely sensed data in archaeology and cultural heritage applications. The department can refer to a long time experience with respect to aerial archaeology, photogrammetry, as well as terrestrial and airborne laser scanning.

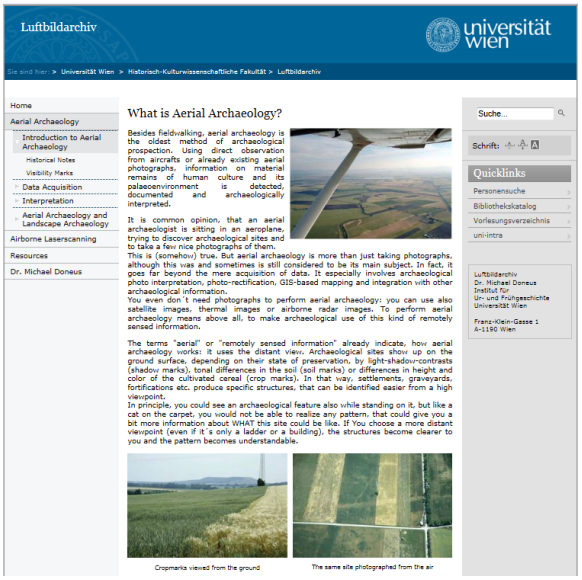

Figure 2: Introduction to aerial archaeology
http://luftbildarchiv.univie.ac.at/aerial-archaeology/introduction-to-aerial-archaeology/

The website gives an introduction in aerial archaeology (see figure 2) and includes information on the basics of data acquisition and image interpretation using aerial photographs. The second chapter introduces airborne laser scanning technology, data acquisition and post-processing.

2.2 Interactive textbooks

2.2.1 AT2 - Remote Sensing of the Troposphere from Space

The Atmospheric Composition Change: the European Network (ACCENT Plus) is an initiative bringing together the atmospheric science community focussing on projects that deal with issues of air pollution and global change (http://www.accent-network.org/). Within this framework, the project partner contributed to the outreach activities by developing e-learning modules on several topics (the terrestrial nitrogen cycle, changing paradigms in air pollution, atmospheric chemistry-climate links) and especially remote sensing of the troposphere from space, developed by the University of Bremen (ACCENT, 2006).

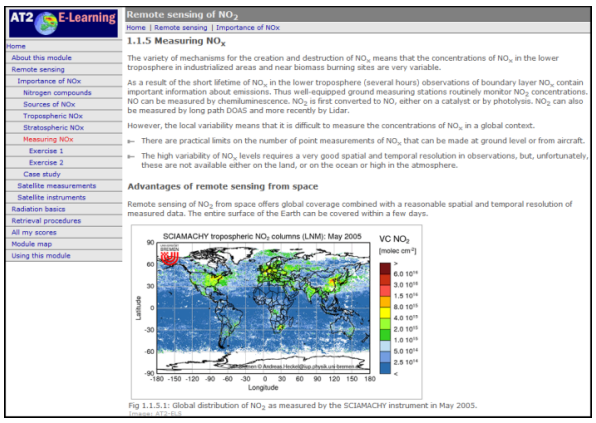

Figure 3: ACCENT – Measuring nitrogen oxides
http://www.iup.uni-bremen.de/E-Learning/at2-els_NO2/index.htm

The AT2 e-learning module presents the subject material in the field of satellite remote sensing of the troposphere as textbook. By means of about 70 interactive exercises it allows the students to get familiar with satellite instruments capable for

measuring nitrogen oxides NO and NO_2, (see figure 3) to check and to improve the understanding of remote sensing basics, and to use these techniques to analyse the changes under the impact of man's activities. The module has been tested successfully throughout Europe and is accessible by everybody.

2.2.2 NRC Geodesy

Natural Resources Canada and the Canadian Centre on Remote Sensing have developed several comprehensive sets of training materials.

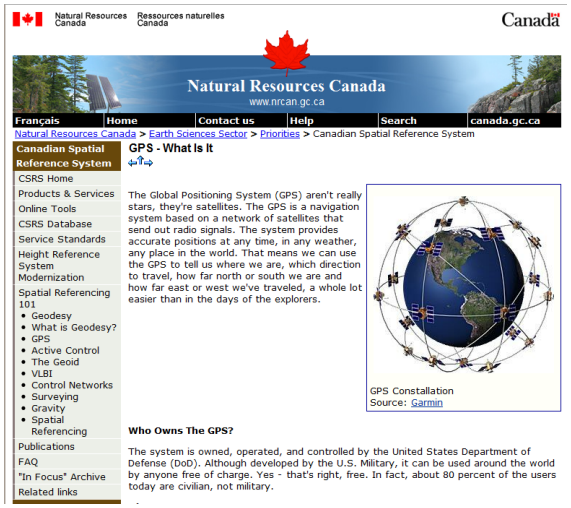

Figure 4: NRC – Tutorial on Spatial Referencing
http://www.geod.nrcan.gc.ca/edu/geod/gps/gps0204_e.php

Tutorials are available on a variety of topics including the fundamentals of remote sensing, image interpretation and analysis, microwave remote sensing, radar polarimetry, satellite data reception, and spatial referencing (see figure 4). Users can find an extensive and nicely illustrated glossary of remote sensing terms containing more than 1000 records. A quiz for testing students' image interpretation skills completes the website. These materials are available in English and French and in some cases, also in Spanish and Portuguese. The material is free for non-commercial use.

2.2.3 EARSeL – SEOS Project

One of the most recent and well-maintained websites was developed in the *Science Education through Earth Observation for High Schools* (SEOS) Project. Funded by the European Commission (EC) and coordinated by the European Association of Remote Sensing Laboratories (EARSeL), eleven partners from different European countries setup 15 Internet-based e-learning tutorials on selected topics in earth observation. These cover the basics of remote sensing but also give a broad overview on applications in various fields, such as geography, biology, physics, environmental sciences, engineering, and mathematics (see figure 5). Chapters are supported by references, links, educational games, and worksheets that teachers can use and/or adapt for their own lessons. The website uses a standardised layout and is enriched by a large amount of animations and interactive figures. Moreover, forums are open for teachers, students and other users to exchange information.

The Learning Management System and tutorials are available with open access in English, German, French, Greek, Dutch and Arabic language, and shall be translated in Spanish and Czech in the near future (Reuter, 2011).

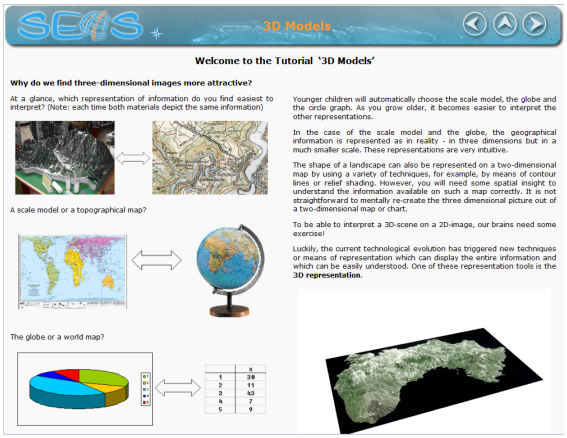

Figure 5: SEOS – Tutorial on 3D models
http://lms.seos-project.eu/learning_modules#2

2.2.4 W3schools

The basic technologies for creating websites are lucidly explained on the webpages of W3Schools. It's a commercial site created by Refsnes Data, a Norwegian software development and consulting company. Since the project is financed by advertising, the use is free of charge. 19 million hits per month prove the acceptance of the pages. The topics are related to HTML, HTML5, CSS, CSS3, browser scripting (including AJAX), server scripting (including PHP and SQL), and ASP.NET (a development framework for building web pages and sites). Of special interest for our fields are the introductions to XML (see figure 6), and Web Services.

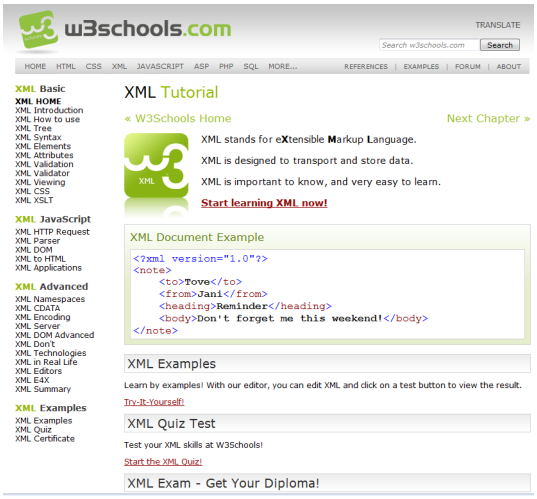

Figure 6: w3schools – XML tutorial
http://www.w3schools.com/xml/default.asp

Students learn the topics step by step and can check 'Try it Yourself' examples. Through direct editing in a split code-page / result view it is possible to immediately control how changes affect the layout of a web page. A comprehensive forum supports users.

2.2.5 Centre for Agricultural and Rural Cooperation – PGIS

The advantages of the use of Geographical Information Systems during the land planning process are indisputable but too often the involvement of all parties is neglected. In order to reduce conflicts and to reach a consensus considering everyone's interest participatory approaches to planning, geo-spatial and communication management tools, grouped under the term "Participatory GIS (PGIS)", have been developed. To

fill the gap of missing reference materials for training potential stakeholders interested in participatory mapping, the Technical Centre for Agricultural and Rural Cooperation EU-ACP (CTA) conceived a Training Kit in partnership with the International Fund for Agricultural Development (IFAD). The project was launched during the first quarter of 2008 and finished in 2010.

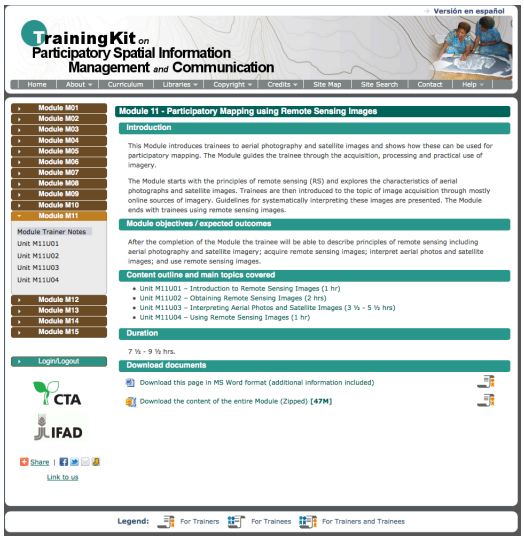

Figure 7: Lecture on Airborne Data Acquisition including annotations
http://pgis-tk-en.cta.int/

An English and a Spanish version consist of 15 modules, each subdivided into several units (see figure 7). Module and unit trainer notes give valuable hints and recommendations on how to make use of the material. Microsoft PowerPoint presentations as well as exercises, video material, and some case studies for the trainer and handouts for the trainees form the wide range of the Training Kit (CTA, 2010). The content is licensed under an Attribution-Non-commercial-Share Alike 3.0 Unported License (by-nc-sa).

2.2.6 Geographic Information Technology Training Alliance

Funded by the Swiss Confederation, the Swiss Virtual Campus (SVC) initiative started in 2001. Within this framework the Geographic Information Technology Training Alliance project (GITTA) has been setup.

Figure 8: GITTA Introduction to GIS
http://www.gitta.info/

Ten partners from universities, federal institutes of technology, and universities of applied sciences created over 40 e-learning lessons covering the following thematic areas: GI Systems, Data Capture, Data Management, Spatial Modelling, Spatial Analysis, and Cartographic Presentation (see figure 8). Content makes heavy use of different media and is mostly multi-lingual, with English, German, and French materials. You need only to subscribe to the GITTA newsletter to receive a full access link.

After SVGs funding ended in 2006, the GITTA Association was founded. Active members and sponsors now support the association thus preserving sustainability. E-learning modules are available as open content under the creative commons license, implying that they can be used, copied, distributed, adapted, updated etc. free of charge for non-commercial use. Moreover, GITTAs lessons follow e-learning standards, which means that IMS Content Package or SCORM compatible Learning Management Systems can easily import them.

2.2.7 ESRI Virtual Campus

ESRI has been one of the first companies that recognized the significance of online training at an early stage. Since 1998, ESRI Virtual Campus offers a variety of training over the Internet.

At present, 274 web courses are available, self-paced as well as instructor-led. 100 so-called Training Seminars – one-hour recorded presentations that include software demonstrations and question and answer sessions – are available for free (see figure 9). Web courses including conceptual material and presentations, hands-on software exercises, and an exam are available for a fee (some free, but most cost between 32 US$ to 224 US$) and need 3 to 24 hours to complete.

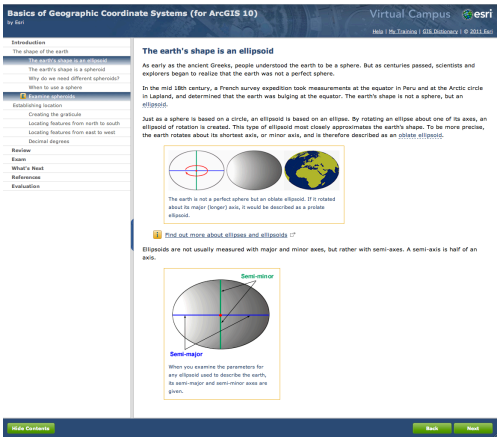

Figure 9: ESRI – Free Web Course: Basics of Coordinate Systems
http://training.esri.com/Courses/CoordBasics10_0/player.cfm

Universities or institutions participating in the ESRI Site License Program get unlimited seat access for using these modules. Depending on the license agreement with ESRI, users are entitled to have free access for most of them. Moreover, ESRI offers traditional classroom and online instructor-led training for 505 US$ per day. The web courses cover a wide range of topics related to ESRI software, the application of GIS, and the theory behind GIS technology.

In the course forum participants can get help from mentors and discuss the course with other students. Registration is obligatory.

2.3 Video podcasts

With the introduction of Apple's iPod, iPhone, iPad or mobile devices from other vendors, learning content can be offered anytime at anyplace. The still increasing bandwidth allows easier handling of video material and distribution for learning purposes. Today, some Higher Education institutions offer video podcasts for their students.

2.3.1 Podcasts Uni Stuttgart

The Institute for Photogrammetry (ifp), Universität Stuttgart, started to record teaching courses on several topics in October 2006 and took a leading position in Germany. Lectures are based on Microsoft PowerPoint slides which are synchronised with the explanations of the course instructor and focus on Signal Processing, Geographical Information Systems, Statistical Inference, Airborne Data Acquisition etc. In order to add annotations (see figure 10) given during the lectures, such as deriving formulas or adding sketches, a Tablet PC with special recording software is used (Fritsch, 2007). The videos are offered in two different resolutions (480x320 and 640x480) that can be accessed by everybody who is interested in the topic.

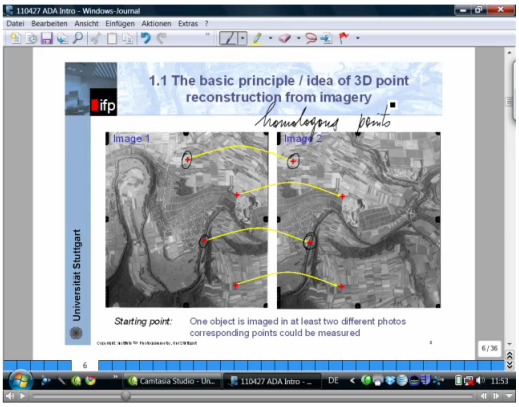

Figure 10: Lecture on Airborne Data Acquisition including annotations
http://www.ifp.uni-stuttgart.de/lehre/vorlesungen/geo-airborne/110427-ADA-Intro.mov

2.3.2 Podcasts TU Berlin

The Institute for Geodesy and Geoinformation Science at the Technische Universität Berlin has established a desktop training course on standards in the field of urban information modelling that introduces to XML, GML, and CityGML (Kaden, 2011). Explanations given by the lecturer are recorded and synchronised with his PowerPoint slides.

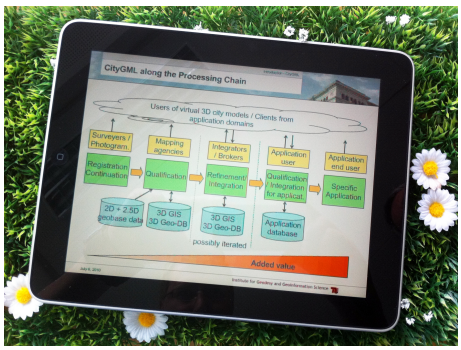

Figure 11: iPad with CityGML podcast
http://www.igg.tu-berlin.de/podcasts/rss.xml

These lectures-on-demand form the basis for video podcasts. Speech-to-Text software transforms audio to text and after possible revision and synchronisation the text is transformed back to speech. This approach has the advantage that errors can easily be corrected and there is no need to engage an instructor when slides are exchanged for future updates. Merely text editing is needed followed by Text-to-Speech conversion. The video podcasts are available for Apple's devices (see figure 11) as well as for the mobile devices from all other competitors.

2.3.3 ETH Zürich – GRAPE

In order to consolidate knowledge in geoinformation science more then 20 so called repetition units are offered by the Department of Environmental Sciences at ETH Zürich (Niederhuber, Brugger, 2011). Each of these units consists of three parts. At first, students see a video podcast that takes no longer than five minutes. Relevant topics are explained. During the following phase they have to work on one or two exercises, which are available as PDF files. In the final step students have access to the master the solution and can check if they succeeded. This work was awarded 2011 with the third prize in the web contest (WEBCON), organised by Asian Association on Remote Sensing (AARC). The repetition units are integrated in the Moodle LMS maintained by ETH Zürich. Further information can be found on the project website: http://www.lue.ethz.ch/GISTeam/Projekte/index_EN.

2.4 Webinars

Web-based Seminars – in short webinars – are web conferences that share information among an interested community distributed in remote locations. In this manner, a much wider audience could be reached in comparison to live demos on site. This technique was taken up by companies to provide user training, or to inform them about new features of their latest program releases. In most cases, webinars use VoIP technology to broadcast audio and video streams. Usually, they allow collaborative participation between the audience and the presenter including polling and question and answer sessions too.

2.4.1 Safe Software - FME

The Feature Manipulation Engine (FME) by Safe Software, Canada is a well-known product that cannot be ignored in our fields. It helps to convert data from one format to another, transform data between different data models, and integrate spatial data within various applications.

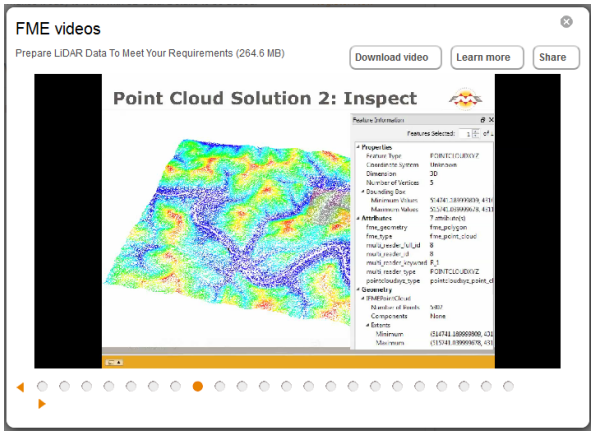

Figure 12: Lecture on Airborne Data Acquisition including annotations
http://www.safe.com/learning/webinars/

In addition to the fee-based instructor-led courses Safe Software also offers free download PDF tutorials combined with related sample data, on-demand courses, and videos. Moreover, user can register for free overview webinars (see figure 12), which are scheduled regularly on a weekly or monthly basis. Webinars on special topics are announced in advance, but are also recorded and may be downloaded for later use.

2.4.2 Erdas Imagine

Since 2008, Erdas – now taken over by Intergraph – offers, records, and achieves webinars. Erdas maintains more then 100 webinars mostly related to the usage of the Imagine software product. Some are also explaining basic technology used in photogrammetry and remote sensing. The languages used are English and Spanish. Registration is required. The videos are stored in Windows Media Video format and free for download (Zimmermann, 2009). The webinar seen in figure 13 demonstrates a photogrammetric project and explains the steps necessary for feature collection using stereo visualisation.

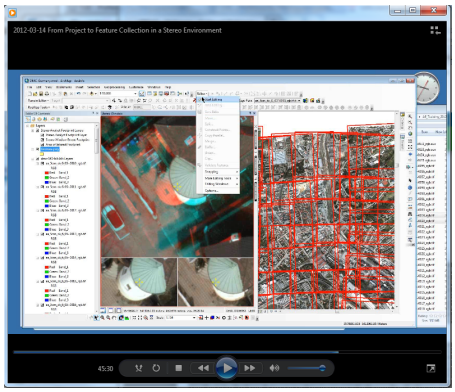

Figure 13: Webinar demonstrating use of Stereo Analyst for ArcGIS http://www.erdas.com/Resources/webinars/ArchivedWebinars.aspx

2.5 YouTube Videos

Most big companies share videos for advertising, provide the latest information about their products, or explain processing steps on the YouTube website. But not only companies use this medium as an information carrier, but also home users who often provide valuable tips and tricks in handling software.

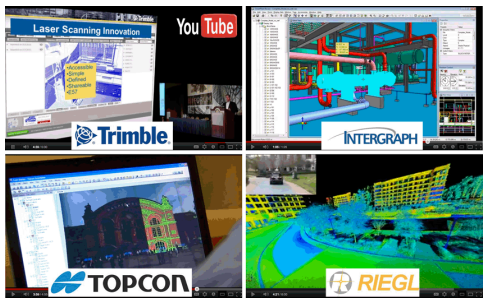

Figure 14: YouTube presence by different companies

A variety of videos were put on the Web by Erdas TV, ESRI TV, Google SketchUp, and as seen in figure 14, by Trimble, Intergraph, Topcon, and Riegl.

3. CONCLUSION AND OUTLOOK

E-learning has highly influenced education in our fields. It has been adopted by most companies that use the Internet as a tool for advertisement, information, and for employees or customer training. In this domain, it is not imaginable to work without Internet based training tools or webinars. Large companies spend lots of money for the development of high quality material.

In higher education e-learning material is mainly spread for supporting students in preparation or repetition of topics. But there is a trend towards blended learning, combining traditional face-to-face classroom education with online course content. In many cases material is developed for basic courses only with high student numbers. This can only be overcome if knowledge and energy of several partners of different (research) institutes and different disciplines are combined, as demonstrated for example by GITTA, SEOS, or PGIS projects. Maintenance and sustainability often cause problems, but learning management systems offering discussion forums, wikis and blogs, and software toolkits for rapid content developments and students' assessments are valuable instruments supporting administrators as well as instructors.

An unsolved aspect related to e-learning material in our fields especially affects the quality of resources available in the Internet. A number of different approaches can be used to determine quality indicators, such as the reputation of the site or organisation, the number of citations of the material or an objective evaluation by professional reviewers. Concerning this aspect, however, ISPRS should play a more important role, possibly by establishing a seal of quality for our discipline.

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All links cited in the paper are accessed on April 08, 2012.