Blending in GI e-learning environments: The role of standardized web services

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Abstract

This article will discuss the different view of learning and teaching within the subject of Geoinformatics. On the basis of the e-learning environment *geoinformation.net*, the different views of problem oriented teaching will be described and illustrated with their realisation in this specific platform. The article will end with some remarks which research areas should be addressed in future while trying to improve complex online and blended learning environments.

Different views of learning and teaching

Essentially, we differentiate two central views of learning and teaching: the traditional and the constructivist approach.

The traditional approach is mainly based on class teaching. Based on the opinion that teaching has to focus on the content that has to be transferred, this approach tries to teach systematic knowledge with very few tangible references to real world issues. The teacher processes and edits the content in a way that the student will be able to digest the knowledge and will be enabled to put it in use essentially. At the end of this knowledge transport, the student is supposed to have the same knowledge available like the teacher. The centre of the traditional teaching philosophy is taken by the instruction: The teacher takes the active part and gives the instructions and directions, whereas the student remains rather passive and consumes the presented material exclusively. There are further indicators and characteristic features that form his approach: Systematic teaching and learning, clear definition of the specific subjects (or avoidance of any interdisciplinary approach in reverse), and strict tests.

Traditional teaching is quite suitable to communicate information about a specific issue from the teacher to the student if reproduction is all the student is intended to do finally. The problems arise in the moment the student has to make use of the newly achieved knowledge within a distinct complex of problems. The transfer from the learning situation to the example of use is if anyhow hardly possible. All the student has achieved is sluggish knowledge: Knowledge that he is able to reproduce but not to make use of. Knowledge that is not transferable from one situation to another. The problem of the sluggish knowledge forms the starting point for the constructive approaches of learning and teaching. Those approaches give special emphasis to the active construction process performed by the student to avoid the development of sluggish knowledge. Following the constructive idea, instruction and direction will lose its central position. The student will be put into a self-active position, whereas the teacher has the duty to provide problem situations and suitable tools that will help to solve the problem. If required, he has to react on specific demands by the student until he finally holds the position of a coach or consultant rather than a teacher. Following the constructive idea, knowledge will be interpreted as the result of a construction process, based on and influenced by individual and social parameters. In consequence, learning is understood as a self-active constructive process within a dedicated plot and context. As a result, e-learning environments have to provide situations that allow the aforementioned construction work and enable the student to perform those in connected problem scenarios.

Based on this constructive perspective, we are able to define five fundamental process features (Reinmann-Rothmeier & Mandl, 2001):

- Learning is an active process. Effective learning is only possible if the student is involved actively. Necessary prerequisites are motivation and interest by the student.

- Learning is a self-directed process. The attempt to come to terms with a content area makes it necessary to control the own learning process by the student.
- Learning is a constructive process. Knowledge can only be achieved and made usable if it – in the first step – can be integrated in already existent knowledge structures successfully and – in the second step – can be interpreted on the basis of individual experiences.
- Learning is a process provoked by special situations and context. Knowledge has always references to situations and context. Therefore the acquisition of new knowledge is always tied to a specific context.
- Learning is a social process. The acquisition of knowledge frequently occurs in interaction with other people. If this is the case learning takes place in a definite learning culture. Knowledge content as well as values and attitudes will be negotiated interactively.

If the five features of constructive learning will be applied, in most of the cases it will result in very complex learning units. These units may expect too much of the students. To avoid a possible excessive demand, the knowledge acquisition process has to be facilitated by a certain level of instruction and supported. The balance between explicit instruction/support by the teacher and the constructive self-activity by the student is the challenge of problem oriented teaching. Figure 1 illustrates this challenge.

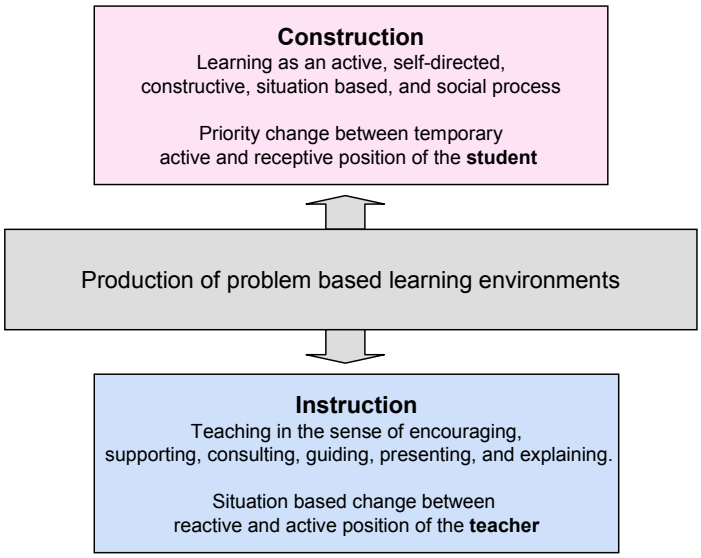

Figure 1: Learning philosophy (after Reinmann, Rothmeyer and Mandl, 2001, changed)

Blended Learning

Blended learning is the latest buzzword in didactic reflections upon the best ways of teaching. It describes a combination of e-learning methods such as the Internet, voice mail or conference calls combined with traditional education or training. Blending involves a planned combination of approaches, such as coaching by a supervisor; participation in an online class, exchange of ideas with fellow students, participation in workshops, seminars and chat rooms (online communities). In other words it's a special way of learning that combines online and face-to-face approaches. As an integrated way of learning it acquires new skills.

Blended learning comes – as a natural evolution of e-learning – along with the development of the new media. It was the arrival of computers and monitors in the classrooms, the intensive use of virtual slides for presentations and the nearly ubiquitous accessibility of the Internet that pushed e-learning a long way forward. Currently, it is said that best results will be achieved if a mixture of different media types is used

to teach in class or at home. If possible, a more complex media, like an online course, should be followed by a simpler medium, like a hands-on face to face session.

Problem oriented and blended learning within Geoinformatics

Based upon the concept of problem-oriented learning, it is possible to deduce a range of design principles for the e-learning environment that foster the active and situation based learning by the student. Simultaneously, the student is called to participate rather actively (Reinmann-Rothmeier & Mandl, 2001).

The design principles will be discussed in regard to an e-learning environment that is called *geoinformation.net*, a project funded by the German ministry for research and education.

E-learning environment

The aim of the research project „geoinformation - new media for the introduction of a new interdisciplinary subject", short title "*geoinformation.net*" was the opening of the potential of the new media to introduce an interdisciplinary subject within the traditional subjects geography, informatics, geodesy, geology, engineering and environmental science as well as land use planning. The realisation addressed three core components:

- Generic learning and teaching modules
- Interactive learning environment
- Project portal to a spatial data infrastructure, set up using standardized GI (**G**eographic **I**nformation) web services.

Based upon existing multi medial teaching material, the modules should cover a broad range of the GI curriculum. The modules should focus on an active interplay with the learning environment and the project portal to meet the demands of current learning-teaching-philosophy. The interactive learning environment provides an internet based communication platform to foster the cooperative knowledge acquisition process. The project portal supports the learning "close to reality and practice" by providing a large set of exercise data, accessible via standardized web service interfaces. This data could be used in problem oriented scenarios. The web services are accessible from the learning modules and the learning environment as well as from any other client that is enabled to send valid requests to standardized OpenGIS web services. The project portal contains three different types of web services: Web Map Services, Web Feature Services, and Web Catalog Services. Figure 2 illustrates the overall architecture. The geographic data is accessible to the web service world using Web Map and Web Feature Servers. To simplify data preview and access, two different types of clients had been developed: a desktop and a mobile (optimized for PDA) client. To integrate the rich processing capabilities of the ESRI software group, the main components are integrated additionally. The geographic data is accessible using the ArcGIS programs via an ArcSDE middleware. A detailed description of the portal could be found here (Simonis & Merten, 2003). The acronyms of the figure are defined as follows: WMS – Web Map Service, WFS – Web Feature Service, WMC – Web Mapping Client, mobileWMC – Web Mapping Clients for mobile devices like PDA or smartphones, ArcSDE – Arc Spatial Data Engine from ESRI, ArcCatalog, ArcIMS, ArcGIS, and ArcPAD are products from the current products range by ESRI (for futher information see http://www.esri.com).

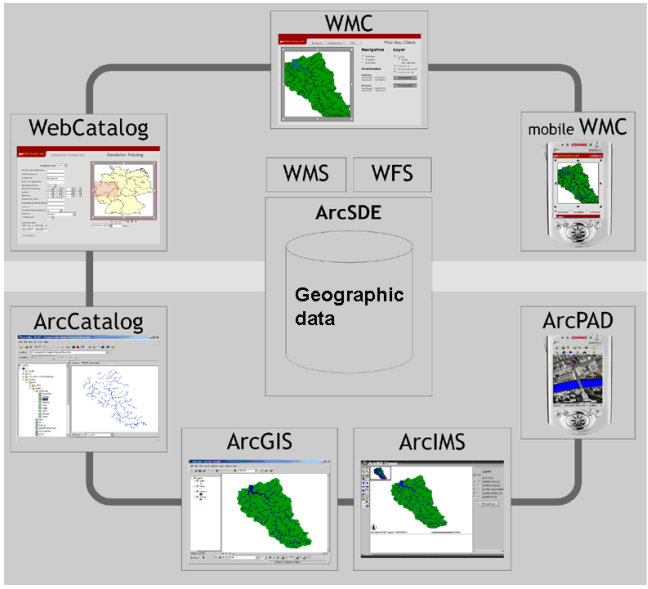

Figure 2: Architecture of the e-learning portal (Merten, Simonis & Streit, 2003, changed)

Design Principles and its implementation within the e-learning environment

(1) *Authenticity* and *example of use*. Any virtual learning modules should be shaped in a way that allows dealing with real world problem scenarios. The student shall be confronted with authentic exercises, making use of different types of the new media to depict a certain level of complexity. This will improve the feasibility that studying will not lead to sluggish but to active knowledge that is applicable to new problem areas and issues.

One of the major tasks trying to provide as much as possible authenticity and real world use case driven teaching and learning is the provision of adequate data material. Data from the local area usually improves the motivation by the student in all earth science subjects. Web services will allow building up a huge distributed data store with large data sets from a broad range of areas. It is interesting that quite often, universities and other academic institutes have data sets at their disposal that cover rather remote locations but lack data around their own hometown.

One of the big challenges is the expansibility of the virtual data store. The big advantage of a service based architecture lies in the distributed responsibility: Every institute take care for their own locally stored data sets only. E-learning environments or web service integrating portals should be optimized to allow the registration of new services and new data sets. Ideally, data providing services exist that accept and provide a large range of different data formats. This will allow an upload of the data even in case that no new service should or could be integrated into the infrastructure.

(2) *Multiple contexts and perspectives*. The virtual e-learning modules should be shaped in a way that allows viewing specific content and situations from multiple points of view. Multiple contexts and perspectives allow acquiring new knowledge that could be applied on other situations or problems more easily. Keeping in mind that it is one of the central theories in cognitive science that new knowledge is always integrated in relation to already existing knowledge, multiple contexts and situations further improve the integration on new knowledge because of the broader basis of the old one.

The complementary composition of project portal and e-learning modules provides the flexibility to illustrate specific content from multiple perspectives. After a theoretical introduction (e-learning module), it is possible to address the problem rather practically using the processing capabilities of the project portal in multiple contexts.

(3) *Social learning arrangements*. The virtual e-learning modules shall provide a high level of social learning arrangements to foster cooperative learning and problem solving. The development of learning- and practical training communities should be pushed. The focus lies on the coordination, the communication and the cooperation which are necessary to solve a complex task commonly.

This aspect will be mainly supported by the learning environment called “GeoCafe”. Internet based applications are used as a mechanism to allow distributed people to work on the same issue at the same time. Use of complex media types sometimes overextends the students. Therefore a central teacher has

control- and direction mechanisms to guide the students throughout their task. It has proved that the use of complex web service based infrastructures usually demands the availability of a teacher. No face-to-face communication is necessary, but a teacher should be contactable by email or chat/forum. It should be discussed if the implementation of new chat/forum systems might makes sense in this case. In my opinion, new implementations should be only started if they are integrated very tightly into the umbrella of the corresponding web portal. Otherwise, existing implementations should be used.

(4) *Information- and construction supply*. The virtual learning modules should contain concrete instructions and strategies how a specific task might be addressed and a specific problem could be solved. It is important that these instructions to not seduce into simple "absorb and reproduce", but suggest to active self-directed knowledge construction. Single information should be provided like individual pieces of a puzzle that have to be collected and put together by the students to get to the final conclusion or result.

The project portal is built on multiple column architecture. This architecture allows the use of newly acquired knowledge actively and independently. The portal offers a broad range of geo data that has to be acquired using different search and access mechanisms. Standardized web services like a catalog service and different web feature services interact for this task. The portal provides a broad range of data processing capacities; the ESRI product range is fully integrated in the project portal and offers multiple construction approaches.

(5) *Instructional guidance and support*. Learning in virtual environments always requires instructional guidance and support. The self-directed and social contact with complex exercises and manifold offer of information as well as the consideration of different perspectives describe both the way and the aim of learning. Supporting elements are exercise instructions, continual accompaniment of group based processes, allegation of group- and moderation rules, or detailed and frequent feedback.

The project portal is intended to be used as a basis and a tool collection to solve problems that are designed specifically for dedicated remits. The integration or upload of fully elaborated exercises is not yet part of the portal but is one of the big desirables. Consequently the project portal does not provide any default solutions.

Figure 3 illustrates the different aspects of problem based learning and the interplay and dependencies between the individual components.

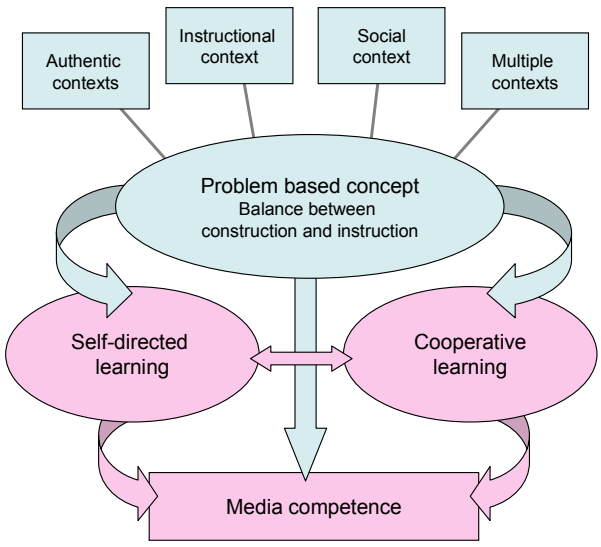

Figure 3: Problem based learning and new media

Conclusions

The intensive use of a web service based infrastructure like *geoinformation.net* in face-to-face teaching environments has shown that the blended learning aspect fosters the transfer of active knowledge from the teacher to the student. On the other hand, the three years project turned out to be a too short to produce a real convenient portal. One of the most important issues is that the level of instruction and guidance by

the teacher necessary to allow the students to work cooperative and self-directed should not be underestimated. Three points should be addressed in further research projects:

First it is extremely important that the entire system could be maintained easily. The semi capsulated approach *geoinformation.net* followed is a dead end. A web based content system has to be accessible from the outside to allow the necessary maintenance and updating. This is true for the web service based portal but not for the learning modules. Further projects should investigate existent content management systems that provide the necessary features like user management and administration rather than spend a lot of time implementing an optical nice but rather inconvenient system.

Second the communication aspect should not be overestimated. A simple and stable out of the box solution should be preferred over a fully integrated solution that is complex, different to maintain and nearly impossible to replace. The communication aspect of blended learning environments is usually restricted to face-to-face communication, email, chat rooms and internet forums. These functionalities are provided by every out-of-the-box communication suite. A solution that allows further capabilities like "reverse playing" of a conversation might make sense in theory but should be thank over more than once. The benefit might not compensate for the immense workload during the implementation phase and the later maintenance problems.

Third a web service based infrastructure is suitable to solve a bunch of problems teachers usually have in class, especially during the data acquisition phase. Integrated into a web portal, web services prepare a good basis for blended learning exercises. In future, the usability aspect has to be investigated. The current spatial data infrastructure is an exemplar of "being technologically possible", rather than being a user friendly tool. More research is necessary to improve this issue.

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