A next step: W-learning

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Why Wireless
Making professional education material and students support available in the most flexible manner, increasing the ability of students to follow personalized and individual learning paths and to access education at the best convenience, is an everlasting challenge. The nowadays developments on wireless technology, which extends Internet accessibility to a range of devices, such as portable computers, personal digital assistants and Ebooks independent of the location where the user is located, push to take up this challenge. In the medium term these devices will be commonplace and it becomes relevant to make use of this possibility to increase flexibility and accessibility of education. This wireless extension, in its simplest form, could be seen as an extension of web-based learning to a variety of devices that have web access. This would require little research or experimentation. However, the location independence makes it possible to access education in a variety of situations (for instance while travelling, or during work breaks, or while away from home or school) that are different from the controlled environments in which education is mostly carried out.

This implies a reconsideration of the format in which education is organized and delivered. Making education always accessible, for instance, implies that it will also be accessed in non-optimal learning situations (e.g. noisy or dirty environments), or in short time breaks. Some new issues of didactical relevance should include:

1. The packaging of courses in modules that can be effectively followed in short intervals (e.g. 15 minutes);
2. The emphasis on interactive learning (exercises, questions, tests, etc.) rather than on passive learning and long reading which is more appropriate in traditional settings;
3. The emphasis on learning making use of an outdoor setting (for example by fieldwork).

In addition to this, a distinctive feature of wireless Internet is the possibility of pushing information real-time to a user without the user requesting it (email is another form of un-requested push, for instance). This offers the possibility of a more extensive interaction between students and between students and their educators. This can be used for administration and logistics purposes in traditional education environments (e.g. to communicate a change in the program, or in the room, or in the lecture time) but also to stimulate and initiate interaction toward students.

**W-learning**

Areas of education that can benefit mostly from this evolution are those that also include information needs and outdoor activities. This is common in areas such as environmental sciences, earth sciences, biology and the natural sciences in general. In these areas, a combination of traditional education, multidisciplinary workshops and fieldwork are the norm rather than the exception. In practical fieldwork, however, coordination and continuous support to students is crucial for the success of the initiative. A limitation to the effectiveness of fieldwork is the ability to access information (such as maps, data about a natural area, recent measurements, etc.) while in the field and based on the needs that emerge during fieldwork.

Recent developments in wireless GIS make it possible to fill the gap and support fieldwork with relevant information to students. Also, central to the interaction spirit of the field work, students collect information (data, text, pictures, sketches etc.) during their work, and the exchange of this information to other students is part of the overall data and information exchange experience inherent in field work. Therefore, the possibility of updating a central repository with the ongoing inputs of many students in real time will provide the fieldwork team with a more informed and effective way of carrying out their work and educational experience. Wireless technology is a natural candidate for these types of uses, especially taking into account the evolution of spatial information technology in combination with wireless, in the so-called location based services. An obvious evolutionary next step will be Wireless learning or W-learning.

**GIPSY-project**

A consortium of three Dutch universities started in 2002 with the GIPSY-project founded by the Dutch National Organization SURF. The GIPSY acronym refers to Geo-Information for Integrating personal learning environments by web and mobile ICT systems and tries to express a more flexible and on movement based way of learning. The development of a wireless supported learning environment is the main objective of the GIPSY project. By the end of 2003 this environment should exist of two courses which can be followed by students using wireless devices. To support students as well as educators in the main time a helpdesk will be developed.

Figure 1 shows the three main stages (I, II, III) within the project. The choice to create two courses is made on purpose. The “geo-information basics” course is mainly directed to wireless learning forms to support individual learning activities. The other course “integration for environmental policy” focuses more on group-learning processes and the role of wireless facilities in this type of education. Besides the
“integration” course tries to integrate desktop work and practical fieldwork in a cyclic procedure: students make, based on a project planning, several fieldtrips to collect geo-referenced data and materials. Directed by the outcome of team-discussions the data are processed, the materials analyzed and results will be checked again in the field.

Figure 1: Stages (horizontal rows) and products (vertical columns) of the Gipsy-project

Byte chunks
Browsing the Web brings forward a lot of basic GIS course material. Most of the educational web sites of universities offer their educational content for free. On the other hand there are a number of commercial sites, which offer their educational content by a pricing system. Both practices proof that a lot of Web based learning content is already created and available. However, and that’s a serious problem for individual learning activities, most of the content is fixed in a certain course-program and not available in smaller parts (reusable content objects or RCO’s). The IMS initiative to define reusable content objects by a standardized meta-data system, via the so called Learning Object Managing description (LOM), could initiate a more open and flexible environment to share and to re-use pieces of educational content. This pieces of learning content are called byte chunks in ICT-slang In the Gipsy project the educational content of three different educational courses in geo-information basics are subject of selecting such byte chunks and to describe these chunks via a meta-data system.

The development of a meta-data system demands a clear definition of byte chunks. A byte chunk must be a piece of learning material that takes not too much work load (maximally 15 min.), exists of limited reading material and, preferable, interactive material. Two types of byte chunk can be classified: information object and pedagogical object. The first one exists of content, which has to be mastered like theories, concepts, methodologies, examples, cases and assessments. The second type
refers to the way of learning, instructions and advises to guide the students in their personal learning process to master the learning content.

Figure 2 gives a first attempt of a wireless “geo-information basics” course setup. Each cell of the matrix represents one or more byte chunks that can be selected and followed by a student using a wireless device. One horizontal line in the figure represents a module and its contents. Students will start with an intake assessment. Based on the result of the assessment an advice will be given to the student to start with certain module or learning activity belonging to the module (e.g. theoretical or application byte chunks). In fact a student is free to pick out the learning activity and related byte chunk to study, but after a certain number of activities (belonging to one line – module- in the scheme) the student will be assessed. The student could be forced to do by using a push medium and by remarks filled in the personal course portfolio.

<table>
<thead>
<tr>
<th>Module</th>
<th>Theory terms, concepts</th>
<th>Examples</th>
<th>Application skills</th>
<th>Case</th>
<th>Assessment</th>
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<td>data sources</td>
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Figure 2: “Geo-Information basics” course design. Light gray show the intake and assessment activities; gray show the theoretical and application activities and dark gray the final case.

Location based
The previously described basic course based on the ideas of a personal learning mode is just one opportunity of going wireless. It is just a first try into the direction of time and place independent learning. Another interesting challenge is based on group-learning process in which desktop and fieldwork have to be combined. In such a course GIS is not merely the learning content itself but in the meanwhile the tool to learn by.

As for the fieldwork in traditional learning processes the accent is mostly on gathering data. The interpretation of relations between different types of data is done afterwards by desktop or laboratory work. But with PDA, GPS and a wireless connection, data can be accessed that is somewhere on a server, for example a soil map while looking at vegetation. Comparing the map with what is experienced in the field gives more
insight in the relations between them. It can stimulate students to think about these relations and accordingly adjust their way of gathering data if necessary.

Data can be stored together with a GPS derived location on the PDA or sent wireless to a server. When on a server the data is also accessible by other fieldworkers or at an office. The wireless connection provides means of contact between field and office. In this way a question (accompanied by a digital picture) from the field can be sent by e-mail to the office and a reply with instructions on how to proceed will be returned. This interaction between students in the field and in the office or between different fieldworkers also contributes to the integration of the different backgrounds and views students bring in. This part of the fieldwork is important because students interact real-time. When coming, like the Gipsy-project, from three different universities and more field study areas are involved, it is important that means for efficient communication are available.

Wireless in this sense means the support of location based services. From the previous sketch of activities the following opportunities for support pops up (figure 3):

- navigation to fieldwork location: each person in the figure will be guided to a predefined fieldwork location of interest (for example a certain restaurant). The system will track the position of the student in relation to the predefined fieldwork location. A cellular phone network will most of the time not offer the right positional accuracy;
- in-field check of location based historical data: a student wishes to know which measured data is already available on a dedicated server database. A location based query will be sent to this server;
- in-field investigation by other location based data sets. The same procedure as the previous opportunity only the server and the database will differ;
- in-field validation of locally gathered or processed data. Analytical procedures on a dedicated server are initiated by sending a data set. Results will be send to the location based client;

**Figure 3: Location-based service basics**
- in-field update of location based data in a central database. Collected data with a location reference will be send to the dedicated database on a server to update the database;
- field-team control and check up: the students in the field could track each other and their supervisor. Field explanations or instructions of the supervisor can be transmitted and received synchronously by the students.

Each of these opportunities demands the use of a positioning system (e.g., local via a wireless total station, regional via a cellular network or global via the Global Positioning System). This positioning system has to be connected via a device to geodata processing software (client side). To transfer data wirelessly (see figure 4) to a server-side (the mobile platform in figure 3) for storage and data-handling one need to use a mobile network protocol. The Gipsy project tackles this location-based items via the “Integration for Environmental Policy” course.

**Wireless demands and supplies**

Both wireless courses demand a supporting learning environment by which:
- each student is uniquely personalized,
- can work location and time independent,
- the learning materials are modular and based on byte chunks,
- the devices have to be always on and online,
- and asynchronous and synchronous feedback by educators or colleagues via data or voice has been offered.

Conceptually all of these demands are expected sooner or later but the current project has to deal with a fixed and limited schedule. Supplying these demands means making use of the available technologies. Like each location-based service project this Gipsy project has to deal with the design and inter-structuring of five research components:
- wireless protocols and bandwidth;
- positional information;
- devices;
- system and database architecture;
- availability and diffusion.

![Wireless network diagram](image)

*Figure 4: Location accuracy and Network capacity (distance and transfer speed)*
Figure 4 shows the positional accuracy of different location based information as well as the network capacity (right column).

The fieldwork component needs the longer distance capacity that will be supported by GPRS data network. The wireless protocol is still under discussion. Originally two protocols are of interest: Imode and XML. Imode restricts the interactive demand, because it is a subset of HTML (see figure 5).

In sake of the Gipsy-project Java-extensions become available on the client side devices which offer an opportunity to mimic or to incorporate the full internet applications known from the traditional internet. For this reason the project is mainly focussing on the devices with screen resolutions 200*300 and higher, preferably in color mode. These are mainly PDA- (ao. Ipac, XDA), Ebook- (ao. Simpad) and laptop-like (ao. Vaio) devices. Most of these devices do already have facilities for wirelessly sending and receiving data.

The demand for positional information in the basic course is low. The contrary for the group learning course. The fieldwork component of this course needs a high positional accuracy that has to fit between 1 and 10 meters (see figure 4)

The system and database architecture will be based on traditional client-server architecture with a specific wireless portal (figure 6).

Figure 5: An example of the Imode interface

On the server side different databases will be related to each other. Considering the different devices the Wireless protocol Gateway (called Wap gateway in figure 6) take care for the conversion of the style sheet of each internet-based script.

The most difficult part of such a project will be the dissemination of all developed components of the wirelessly supported learning environment. The style and content of dissemination will lead to a certain level of diffusion and acceptance amongst students and educators as well as the political responsible. It means that different stakeholders of the participating institutes as well there direct participating surrounding must be involved in most of the project activities.
A next step?

There are a number of reasons to perform projects like Gipsy. The wireless technology is just in its infancy. The combination of education, wireless technology and location based is promising and challenging. On the other hand a lot of pitfalls in each of the five components have to be gone through before finding the real benefits of W-learning. Criteria like usability, availability and affordability will be continuously screened to verify the benefits for an educational course or curriculum.

However new technologies like UMTS, new polymer and TFT based interfaces (heading to a digital A-4), new standards for open system architecture (OpenGIS group has started a Open Location Service project), better availability and standardization of geo-information itself, will push society into a more wireless way of communicating. This increasing technology will push future education demands for full support of educators and students. Going wireless introduces a new link in the chain of E-learning technology. It means that professional W-learning will need, like E-learning, a technical and educational oriented check, advice, back-up and support service by a classified “W-learning Garage” and according “W-learning directives”.

The first results of the Gipsy W-learning courses will hopefully give a hint to a wise a worthwhile step in GIS-education; at the moment the outcome is rather time and place independent.

Figure 6: The wireless system architecture based on a WAP-protocol
Notes
1 See: Boeing provides wings to WSU wireless education project (http://www.wsutoday.wsu.edu/completetestory.asp?StoryID=131) or the OWLS-project (http://owls.sit.ecu.edu/project.htm)
2 These three universities are Wageningen University, Free University Amsterdam and Nijmegen University.
3 http://www.surf.nl/ (mainly Dutch)
4 http://www.geo-informatie.nl/gipsy (mainly Dutch)
5 http://www.imsglobal.org
6 http://www.ou.nl/open/psl/
8 http://www.mobileinfo.com/Glossary/ glossary of the wireless ICT terms
9 http://www.openls.org/

Credits
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