AN INTEGRATED LEARNING MANAGEMENT SYSTEM FOR LOCATION-BASED MOBILE LEARNING

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ABSTRACT

This paper discusses the relevance and challenges of a location-based learning platform that supports mobile learning in education. We present the design of an integrated management system for location-based mobile learning. Independent of the taught subject, the objective of the system is an easy-to-understand user interface for both - teachers and students.

KEYWORDS

Location-based mobile learning, learning platform, Geographic Information System, GIS

1. INTRODUCTION

With the rapid development of mobile telecommunication technologies, learning content can be accessed virtually anywhere and anytime. Learning on mobile devices is typically referred to as *mobile learning* (Murphy, Castillo et al. 2014), or as wireless, ubiquitous, seamless, nomadic, or pervasive learning (Frohberg et al., 2009). *Location-based mobile learning* (LBML) can be seen as a sub class of mobile learning, which accounts for the learner's location in the learning concept, allowing her to interact with the environment during contextualized learning activities (Patten et al., 2006). This offers opportunities to support formal, nonformal, and informal learning (Tan, Liu et al. 2013) as experience (learning in the environment), or from the perspective of the natural environment and its affordances it offers to educate visitors (learning about the environment) (Brown, 2010). Even though the potential of LBML has been recognized in research, a large-scale adoption of LBML in education is still missing. One reason can be found in the high effort required for setting up and customizing LBML.

In this paper, we argue that LBML requires specialized learning management systems for geographically referenced content (Geo-LMS). We describe an architecture for a Geo-LMS consisting of a web-based client for creating content that can be attached to geo-spatial coordinates (teacher interface), an LBML app providing the content to the student on a mobile device based on the location, and a server component for managing the data. One key design goal for a Geo-LMS is the high usability for non-IT experts, decreasing the barriers for teachers and enabling them to integrate LBML modules in their regular teaching with acceptable effort. An evaluation study for our envisioned Geo-LMS with lecturers and students at the university level is outlined.

2. RELATED WORK

As we enter a new world of global digital communication, it is no surprise that there is a growing interest in the relations between mobile technology and learning. Sharples et al. pointed already in 2010 to the well-publicised convergence of mobile technologies, as market mobile computer-communicators, combining into a single device the functions of phone, camera, media player and multimedia wireless computer. Based on a variety of previous research studies Sharples et al. observe another equally important convergence between the new personal and mobile technologies, and the new conceptions of learning as a personally-managed lifelong activity. The criteria for a theory of mobile learning are presented in Table 1.

Table 1. Convergence between learning and technology

New Learning	New Technology
Personalised	Personal
Learner centred	User centred
Situated	Mobile
Collaborative	Networked
Ubiquitous	Ubiquitous
Lifelong	Durable

Both aspects of mobile learning (learning with portable devices and learning while mobile) are starting to converge, as handheld and wearable devices interact with their surroundings and static objects respond to people on the move as shown in the Caerus project (Naismith et al., 2005) where visitors to the University of Birmingham's botanic gardens were given handheld location (GPS) devices that automatically offered audio commentary on the flowers and shrubs as they walked around the gardens.

A specifically promising type of mobile learning is LBML. From research on LBML it is known that the placement of learning content locally with digital mobile and multimedia technologies may constitute a useful addition to traditional didactic methods. Learning with location-based environments can be achieved through arranged field trips, outdoor education, environmental studies, and field-worker training. It is important to know that in this framework, learning is still guided by a curriculum, and it is conducted by the instructor or teacher to fulfill the course learning objectives (Tan et al., 2013).

There are several research projects which have proposed to utilize location for mediating knowledge about the outdoor environment. For example, in a field trip study based on curricula in the natural and social sciences, two positive effects were identified: students were engaging in "mobile-technology-supported" observation as well as "mobile-technology-supported" manipulation during their scientific inquiry (Liu et al., 2009).

In contrast to formal learning, location-based environments for informal learning usually take the form of casual and self-motivated learning. Students can learn with location-based environments without waiting to receive instructions from the teacher or course guide. Informal learning with location-based environments could happen in the context of experience, and even if it is spontaneous, it is still intentional (Clough, 2010).

A number of case studies with location-based learning applications have been performed. One recent study analyzed iCollaborator, an iPhone application developed at the Athabasca University which provides multimedia mobile meetings and interactive virtual whiteboards in which participants can communicate and exchange ideas in real time with location-aware aspects (Tan et al., 2010). Another study describes the design and development of a system that facilitates location-based, situated and collaborative language learning incorporating the potential of Internet-based television and mobile phone (Fallahkhair, 2011).

To handle all aspects of the mentioned learning process, e-learning must be organized and managed within an integrated system which is the common idea behind learning management systems (LMS). An LMS serves as the infrastructure that delivers and manages instructional content, identifies and assesses individual and organizational learning or training goals, tracks the progress towards meeting these goals, and collects and presents data for supervising the learning process of the organization as a whole (Szabo, 2002).

Different tools are integrated into a single system as learning activities, which offers all necessary tools to run and manage an e-learning course. Typical tools contained in an LMS include syllabi, discussion forums, file sharing, management of assignments, lesson plans, chat, etc.

As early as in 2006, the emergence of social software has questioned the use of integrated LMS. The integration of educational social software tools in LMS was an important topic in LMS and pedagogy research. Dalsgaard (2006) argued that it is necessary to move e-learning beyond LMS in social software and networks to support self-governed learning activities of students.

Geographic Information Systems (GIS) have a long tradition as software tools for handling and processing geographic information for spatial decision-making (Goodchild, 2011). With the rapid development of mobile technology a broad range of Internet-based GIS-platforms have become available. Using Global Positioning System (GPS) data to pinpoint geographical location together with the rapidly evolving Web 2.0 technologies supporting the creation and consumption of content suggest a potential for collaborative informal learning linked to location (Clough 2010).

Nowadays the progress of technology has again speeded up significantly. Web resources are operated by service-oriented architectures and web services. Why not integrating GIS and social network technologies in mobile devices by means of an integrated LMS?

3. A MANAGEMENT SYSTEM FOR LOCATION-BASED MOBILE LEARNING

Many of the aforementioned examples, which have a strong teaching and learning context, focus on the advantages of mobile technology to engage students in a particular subject-based learning activity. This paper takes a more technology-oriented perspective by suggesting an approach which integrates GIS technologies into an LMS in order to close the gap between the theoretical study of place-related teaching content, and students' direct experiences at the respective location. As an add-on to existing didactical concepts, the platform allows for creating location-based learning modules, which can be used in a mobile app.

Geographic Information (GI) can relate unrelated information by using location as the key index variable. Locations or spatial extents on Earth may be recorded with dates/times of occurrence, and x, y, and z coordinates representing longitude, latitude, and elevation, respectively. Integrating GI in a LMS focuses learning activities within a defined spatial context.

The purpose of the proposed Geo-LMS is that the system allows assigning learning contents to places in an intuitive map interface. The primary goal is testing the efficiency and effectiveness of Geo-LMS for mediating current didactic concepts in a spatial environment using GIS technology. A second goal is the development of an intuitive map interface which strives for high usability for both, the lecturer and the student, leading to low technical, administrative, and cognitive barriers for usage in actual education scenarios. The Geo-LMS further features an interdisciplinary conception, long-term maintainability, and adaptability to new technologies.

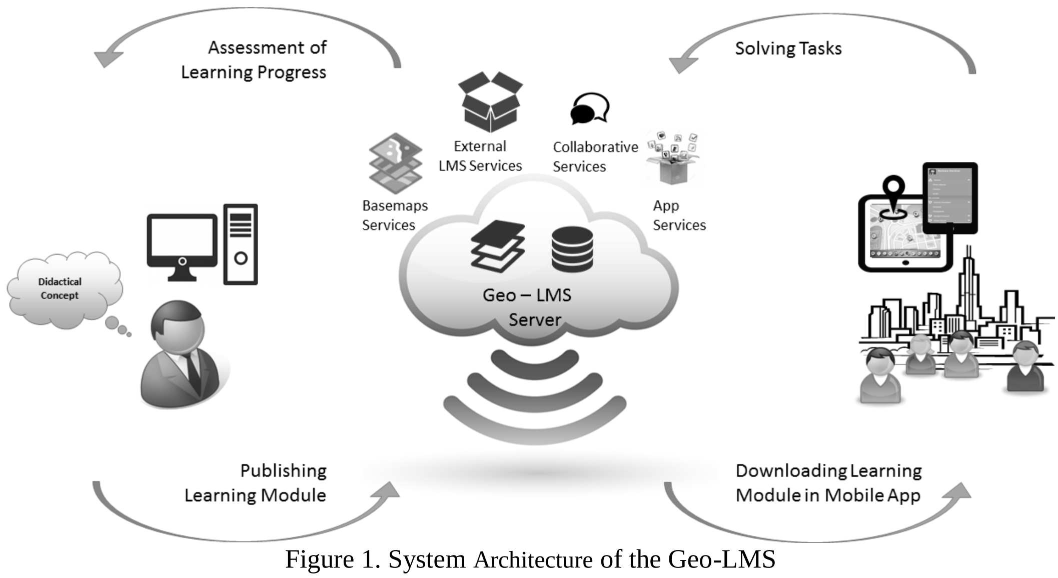

Figure 1. System Architecture of the Geo-LMS

Figure 1 provides a schematic overview of the proposed Geo-LMS platform. The interface for the creation of learning units is a web application, which can be accessed with conventional browsers by the user group of lecturers (*producers*). A web application has the advantage of being independent of an operating system. The learning units are stored with their geographical footprint, i.e., a trigger polygon in geographic coordinates, in a spatial database. The Geo-LMS offers a number of learning unit types which can be combined flexibly, depending on the didactical and educational approach. Examples include: context-information by text or photo; task solving by text, multiple choice, picture, voice or video recording; seeking and documenting real-world objects in collaboration with other students. Some information is stored directly in the Geo-LMS database, other information for learning units can be stored in linked external LMS or third party applications or services (multimedia, social networks or specialized applications). All the service units are seamlessly integrated in the creation interface for the editor (lecturer).

With mobile devices, the learning units can be executed by the students (*consumers*). When learning takes place, the learning contents associated with spatial information will be retrieved from the Geo-LMS as soon as the mobile device's current location intersects the footprint of the content. The content then appears automatically on the learner's mobile device and, if applicable, the learner is asked to solve a task.

The Geo-LMS server works as the connecting element between the web application for the creation of the learning units and the mobile devices for consuming the learning units. The learning contents are stored in learning repository databases with identification attributes tagged with the location information.

4. CONCLUSION AND OUTLOOK

In this paper we have argued that LMS can be enhanced by GIS technology to support mobile learning in location-based environments. The spatialization of learning may influence learning theories by modifying existing ones or creating new ones.

Sharples et al. (2010) postulate different criteria on their theory of Mobile Learning that is supported by portable devices, wireless networks and universal as well as subject-specific applications. Mobile Learning at school means that computer technology is no longer locked away in separate computer rooms, but flexibly and readily available for both learners and teachers in their everyday activities. The integration of location-based environments into the context-aware mobile learning systems opens up great opportunities for teaching, learning, learning content management and delivery, and educational administration.

At the same time it is apparent that there are many challenges for those who seek to employ Geo-LMS. How do we design such system effectively in considering the learning technologies, the pedagogy and learning administration, such as educational and social criticism, financial and personal reasons, school policy, legal issues and privacy, and very important technical reasons and technical skills of the users (Döring and Kleeberg, 2006, Tan et al., 2013, Lude et al., 2013)? Even the limited capabilities for teacher-student dialogue enabling influence and feedback during learning are an important challenge and an open research topic (Sharples et al., 2010).

The first study on the impact of LBML technology for teaching will be performed in a course for one semester at university level at ETH Zurich by the Institute of Cartography and Geoinformation in collaboration with the Institute for the History and Theory of Architecture. The project targets the development and evaluation of location-based mobile learning modules about Architecture and Urban Design in Zurich with the goal of closing the gap between the theoretical study of place-related teaching content in the classroom, and students' direct experiences at the respective location. Thanks to the mobile app of the Geo-LMS, the required documentation, such text or images, is always available at the right location. In the same way methods such as performing tasks (take a picture/video, answer a multiple choice question) or comparing one's own observations of the real environment with the data model of the app (display/hide geoinformation on 2d or 3d maps, or display objects in augmented or virtual reality) will be part of the toolset.

With its experience of spatial methods and algorithms, GIS can contribute to the progress of education. Similar concepts in social, collaboration and continuous learning in the environment context are known from GeoGames (Lude et al., 2013, Kiefer et al., 2006). However, these GeoGames are not developed for educational formal purposes, which means that a directed effort is necessary to develop educational collaborative learning elements to support learning activities.

Plenty of computer game-based learning exists, which fortifies the positive aspects of merging the motivational effects of playing games with the intellectually demanding aspects of learning. As in the case of pure mobile learning, stationary computer games do not inherit spatial and temporal grounding of the educational content (Kiefer et al., 2006).

In fact, there are these components, spatial and temporal, which we suggest produce the desired value propositions for a Geo-LMS. The effectiveness still needs to be evaluated. First, the results of the students learning tasks get checked and evaluated in a "quantitative" way and compared with students doing the same tasks in the traditional way of classroom-learning. The performance is evaluated through real examinations at the end of the learning period.

A second, equally important evaluation tool for education we will use, is the student's reflection journal which has become very popular for the evaluation of learning progress. Likewise the teaching progress, creating the app and executing it with the students and evaluating their results have to be reflected in journals and surveys. These records help evaluating the design, structure and also popularity of Geo-LMS and return essential insights for future work.

Based on the concepts, implementation and evaluation of the existing prototype of OMLETH, future work includes finding existing and new didactical concepts for LBML. Another question is whether the proposed location-based mobile platform and workflow generates long-term learning effects.

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