

PERVASIVE E-EDUCATION SUPPORTS LIFE LONG LEARNING: SOME EXAMPLES OF X-MEDIA LEARNING OBJECTS (XLO)

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In our e-Society the concept of Life Long Learning (LLL) is not merely a buzz word but a necessity. Pervasive e-Education is a challenging way to assist both Life Long Learning and Continuing Engineering Education (CEE). However, research in these areas must bridge the gap between Psychology and Computer Science. Furthermore, research and development must be carried out together. Whichever perspective you take into account, pervasive e-Education requires a complete independence of location – which is more than just being mobile. Text, image, audio, video via Desktop, Television, Pocket-PC, iPod, Mobile Phone – each and every medium and terminal has individual advantages and disadvantages. However, this purely technological perspective is not yet enough. Every Learning Object (LO) must be adjusted to the needs and requirements of the learners and, most of all, it must correspond to a model of psychological learning and motivation including cognitive style, learning strategy and preliminary knowledge. In this paper, we concentrate on our first experiences with X-Media Learning Objects (XLOs) and on how the standard Learning Management System Moodle delivers the X-Media content and which psychological concepts we consider suitable for the use with XLOs.

Introduction

Within our e-Society, it is clear that knowledge acquired at schools and universities – whilst being a necessary basis – may be insufficient for the whole life span. Working and learning are parallel processes, consequently, Life-Long Learning (LLL) cannot be considered a mere buzz-word. LLL is an undisputed necessity within our society (eEurope, 2005). Today, we are facing a tremendous increase in educational technologies and although the influence of these new technologies is enormous, we must never forget that learning is both a basic cognitive and social process (Holzinger, 2000a). Education cannot be replaced through technology (Salomon, 1984), (Kozma, 1993), (Clark, 1994). However, the complete independence of both location and time is often emphasized as *the* main advantage of e-Learning (Collis, 1997), (Maurer, 1998), (Holzinger, 2000b). Nevertheless, traditional e-Learning is generally designed for desktop computers. Even the use of notebooks cannot completely fulfill the aim of learning “wherever and whenever a learner wants to”. Mobile learning (M-Learning), based on mobile devices (Sharples, 2000), (Tatar et al., 2003), (Holzinger et al., 2005a), can address the above mentioned criteria. One advantage is the high availability of such devices, e.g. mobile phones. According to the 5th Telekom report of the European Commission, the market penetration of mobile phones in Austria is currently at a level of 99% (although not all of these are suitable for M-Learning). It can be emphasized that the majority of the population have a mobile at hand most of the time. The application of such technologies in conjunction with appropriate Learning Objects (Holzinger et al., 2005b), enable constructivist learning approaches (Papert and Harel, 1991). Such approaches include for example

Situational Learning (Schank, 1993) or *Just-in-Time Learning (JIT)* or *Learning on Demand (LoD)* combined with *person-centered approaches* (Motschnig-Pitrik and Holzinger, 2002). Successful LLL requires both technological and psychological concepts to enable learners of all age groups to access Learning Objects, which are adapted to their needs, knowledge, abilities, and the learning contexts and environments (Holzinger and Nischelwitzer, 2005), (Holzinger et al., 2005a), (Holzinger and Motschnig-Pitrik, 2005).

From traditional e-Learning to pervasive e-Education

The landscape of modern e-Learning is dominated by Learning Management Systems (LMS) whether open systems such as Moodle (Chavan and Pavri, 2004) or commercial systems such as WebCT (Garrett, 2004). These are widely used amongst universities and continuing education institutions. Successful pervasive e-Education must include solutions for the interoperation with these systems in order to bring available content to *every end-device* and to assist with the aim of maximum benefit for the learners. In this paper, we expand M-Learning to X-Learning and present working examples of X-Media Learning Objects (XLO) for five target media, i.e.: Personal Computers; Television; PDA's; Audio devices (MP3 players), and Java-enabled mobile phones.

The iXmedia Learning Engine

The vision of the iXmedia Project (www.ixmedia.biz) was the creation platform for almost every type of learning technology and learning methods in order to address various types of learners (e.g. audio; visual; night; day; situational etc.). The central administration and content management was done with Moodle.

For each medium the focus of the presentation must be carefully chosen:

- WWW: text, pictures, movies, MP3 files;
- MEDIA CENTER: pictures, movies, MP3 files, little text;
- PDA: text, pictures;
- MP3: MP3 audio files;
- MOBILE: text, pictures; animations

For the experiments the following Hardware was used:

- WWW: Standard Desktop-PC (with internet access), resolution ranging from 768 × 1024 px to 1200 × 1600 px
- Microsoft® MEDIA CENTER and a standard television set, resolution 640 × 480 px
- PDA: Pocket PC with Windows Mobile (with WLAN and USB connection to the PC), resolution 320 × 240 px
- MP3: Apple iPod Audiodevice
- MOBILE: Mobile Phone (with GPRS and Java capability), resolution from 160 × 132 px to 176 × 208 px, minimum display size: 150 × 130 px; In order to use audio and video: MIDP 2.0 or MMAPI 1.0, or a higher version of this Java APIs;

Besides a functioning Moodle Server for the experiments the following Software was necessary:

- MCL File for the Windows Media Center (in order to directly open the learning engine);
- AvantGo-Client for the PDA;
- Microsoft Active Synch (in order to synchronize PDA with PC)
- Podcast for MP3-Players
- Remote Display Control for the PDA (in order to access the PDA via PC or notebook and work on it by using the display and keyboard).
- Mobile Learning Engine (MLE, www.elibera.com) for the mobile phone (in order to connect to the server to download contents)

Technologically, PHP was used as basic technology for all media. PHP is a script language, which is mainly used in the development of dynamic web applications. One advantage of PHP is that the client does not need to download PHP as for example with JavaScript. The source code is generated directly on the server and pure HTML files are forwarded to the client. The content of the iXmedia Engine is stored in a MySQL database on a central server. The different devices are connected to this database and the content is downloaded and presented on each end-device. Due to the central storage of the data in a well-designed database conforming to the normal forms, redundant data can be avoided and the content can be updated quickly.

The MP3 player is the only exception: It does not connect directly to this database. A PHP script provides the content loading feature via pod cast directly to iTunes and afterwards to the MP3 player. Pod casting is the distribution of audio or video files, such as radio programs or music videos, over the Web using either RSS or Atom Syndication for listening on mobile devices.

The Creation of X-Media Learning Objects

The central administration is done with Moodle (<http://dmt.fh-joanneum.at/upm/xlearning/Moodle>). The teacher creates a WWW course by creating a new category. This is the main course (standard Moodle Web course) and can be specified using any name. Within this course, four sub-courses can be created, each corresponding to one of the four supported media types and which must therefore be named: TV, PDA, MP3 or MOBILE. These are hidden, only the main course is visible to the end-user and can contain any files.

- In the WWW course, teachers can create HTML or text sites and can upload all the data they want to or they can link this content to other websites.
- In the TV sub-course directory, teachers can create HTML or text sites or they can upload pictures, videos or Flash files. These data can be optimally displayed on the Media Center.
- To achieve a learning success on the PDA, teachers can create HTML or text sites.
- MP3 files are created through Text-To-Speech conversion but it is also possible to use any self-recorded audio files.

To enable access of content via a mobile phone, teachers can create Learning Objects directly in Moodle within the MOBILE sub-course directory, where the MLE-Editor is automatically launched (see figure 1). This is a WYSIWYG-Editor, where the dimension of the created Learning Objects on the target device can be adjusted. After completion this content is automatically converted into XML-format, which can be displayed on a mobile phone.

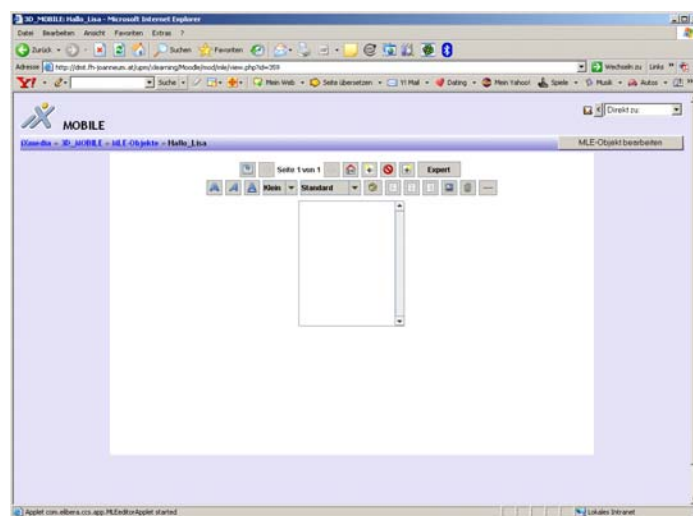


Figure 1: The content creator shows how the content will look within the target environment

The use of the iX-Media Learning Engine: Technological Aspects

After registration in Moodle, the end-users receive all relevant access information and are able to choose between different courses. After downloading the software required for different end-devices the end-users are able to use the content on the selected end-devices. It is also possible to inform users about news via E-mail or RSS-Feeds. Of course, the use of other standard modules, which are included in Moodle, including chat, forum, glossary, tests, Wiki and workshops, is possible. The application is also compliant with SCORM (Holzinger, 2002).



Figure 2: From left to right: Examples on Moodle, TV, PDA and Mobile phone

The use of the iX-Media Engine: Psychological Aspects

The ability to access XLOs with a variety of different end-devices in different situations, contexts and environments is a major challenge for both Computer Science and Psychology.

Situated Learning, which can be seen as a combination of both cognitivistic and constructivistic approaches (Brown et al., 1989), (Billett, 1996) permits the acquisition of knowledge in an *everyday situation*; this means that learning can be seen as a *socio-cultural phenomenon* (Kirshner and Whitson, 1997). Situated Learning places the learner in the center of an instructional process consisting of content, environment, community and participation. This supports the argument that learning is both a cognitive and social process (Holzinger, 2000a).

This is similar to the idea of *Collaborative Learning*, which refers to an instructional method in which students at various performance levels work together in small groups towards a common goal. The students are responsible for one another's learning as well as their own and the success of one student helps other students to be successful. Evidence for positive effects of such approaches were found early by Vygotsky, who discovered that students are capable of performing at higher intellectual levels when asked to work in collaborative situations (Vygotsky, 1978). Meanwhile, many researchers proved that such methods improve problem solving strategies and even if collaborative learning does not necessarily lead to better factual learning, there is a large body of evidence that the environment in which the learning material is presented (independent of social interactions) significantly affects the recall of learned information.

In an old but extraordinarily interesting experiment, (Godden and Baddeley, 1975) compared the learning performance of scuba divers 20 feet under water and onshore. The results of this experiment showed that the recall rate of learned material was significantly higher when the recall was required in the same context (under water versus onshore) as in the context the material was learned. Similar effects were found for emotional and physical states (Teasdale and Russel, 1983). Moreover, there is some evidence that the depth of interaction with learning material significantly affects the learning performance and also the preferences towards certain learning modalities.

For example (Mannes, 1988) found, that students who were required to memorize content, preferred text objects, whilst students required to solve problems preferred graphical objects; additionally, problem-solving settings depended more on prior knowledge than memorizing settings. Applying all those theories to LLL, X-Media Learning Objects used in a multitude of contexts and accessed with a multitude of devices enables collaborative learning. In our experiments, learners got certain XLOs via mobile phones just-in-time; parallel they were able to start collaboration and discussions. This possibility is definitely not provided to such an extent by traditional E-Learning solutions.

Conclusion

Our first experiences with X-Media Learning Objects (XLOs) showed that these have enormous potential for future pervasive e-Education and are thus ideally suited for LLL and CEE. However, since the first step is always technological development, the inclusion of psychological considerations as early as possible is a necessity in order to adequately develop user-centered technology, consequently applying Usability Engineering Methods (Holzinger, 2005). Our first experiences with XLOs suggest that *situation learning* and *collaborative learning* by means of these can be a valuable contribution to e-Education. It is essential, that by combination of real-life problems, parallel to adequate information, thinking processes of learners are activated. Hence, we are optimistic that X-Media will be a substantial part of future (continuing) education. Future research must address questions as to both acceptance and learning success with XLOs accessed with different end-devices.

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