

Bringing the technical and didactical perspective together in the design and development of a Moodle App within the FRAME (Framework for the Rational Analysis of Mobile Education) model

Ioana Porumb¹, Stefano Tardin², Per Bergamin¹, Anna Picco-Schwendener²

1 Swiss Distance University of Applied Sciences, Institute for Research in Open- Distance- and eLearning, Ueberlandstr. 12, Brig, Switzerland

2 eLab USI/SUPSI, Università della Svizzera italiana, Via Buffi, Lugano, Switzerland

Abstract

The fast pace with which new technologies, like smartphones and tablet computers, have been adopted in the last years since their appearance, has created a didactical gap on the side of the educational institutions. This gap is also created by the fact that design and development of mobile applications in educational institutions has been mostly technology driven and not merely enough didactically driven. Schools need scenarios that allow them to integrate the increasing informal and non-intentional learning activities that are taking place with the help of these technologies into their curricula. The mobile learning devices have become one of the most prominent interfaces with which learners interact with their learning tasks. This interaction with information is mediated through technology and as such, the design and development of applications that aim to support these scenarios need a framework that takes into account the main three aspects of mobile learning: the device, the learner, the social aspect. As mobile devices like smartphones and tablets are used as satellites for the main learning device and are not meant to replace it, we speculate that a Moodle App should implement only some of the activities that are possible in Moodle. The App that we designed and developed sets out to be one implementation that fits to all frontends and implements a limited set of activities. As an outlook we propose further research and development on the mobile aspects of Moodle with the focus on personalisation aspects and extending the service by implementing functions that support the main activity in the learning context of the users on mobile devices, which is reading.

Keywords

Mobile learning, Moodle App, FRAME, e-reading

Introduction

Research in the field of mobile learning is on the rise and with the increased coverage of wireless networking around the world we witness a major growth in mobile access to information. Visionaries believe mobile learning offers learners quicker access to information, reduces the cognitive load in the process of learning, and increased collaboration and communication. Equipped with a mobile device, the mobile user can choose to consult a web page, access audio or video tutorials on dedicated sites, send a query via instant messaging to a friend, or attend a web conference with an expert for practice or guidance. He may use one or several of these techniques simultaneously or successively. How can a mobile learner take full advantage of this experience? How can software developers design and develop mobile applications that assist the learner rather than hinder or overwhelm them? How can mobile learning be effectively implemented so that it supports both formal and informal learning? And for higher education institutions, how can they offer such services at an affordable price and integrated it in the already existing e-learning products? In order to be able to answer these questions properly the technical development and the didactical design of such solutions have to be brought together.

In the Moodle community there are two major mobile developments that have to be considered: the official Moodle Mobile App and the Moodbile Project. The official Moodle App was up to July 2012 only as a iOS version available and was therefore very restrictive. Also the roadmap did not show a change of direction towards a HTML5 solution until then. Moodbile (Mobile Learning for Moodle) developed by the SUSHITOS Research Group of the UPC Universitat Politècnica de Catalunya was presented in February 2012 and the

project description declares "Rather than just creating mobile Apps that replicate the LMS functionalities on a mobile device, Moodbile provides the developers of Apps for Education with the necessary tools to talk with the LMS." (<http://www.moodbile.org/>) Also the project was still in the early stages and did not offer one major attribute that is crucial for the Swiss higher educational market, the Shibboleth authentication.

The SWITCHaai -interface is a unique Swiss-wide authentication standard which allows the user to access institutes' backend services with personalised information. Most of Swiss higher education institutions already have implemented this interface. The uniqueness of the interface also permits a single login to every service. Thereby, the user only has to login once to get access to all provided services.

A valuable analytic framework for mobile learning is the FRAME Model (Koole, 2009). The purpose of the FRAME Model (Framework for Rational Analysis of Mobile Education; see figure 1) serves a heuristic allowing to analyse given phenomena of mobile learning in a broader didactical context of HCI.

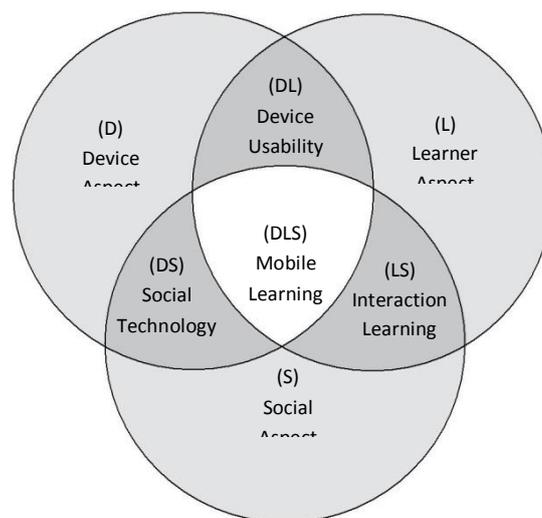


Figure 1: Components of the FRAME-Model (Koole, 2009, p. 27)

The three circles represent the interplay of characteristics of the device(s), the learner and social aspects of learning. The *Device-Aspect* takes into consideration the physical and technological properties of the device(s) e.g. input/output components, processor capacity, storage or screen properties, etc. If other technologies are used, other characteristics come into play. The *Learner-Aspects* takes individual learning characteristics into consideration like pre-knowledge, knowledge in different contexts, learning experiences, learning strategies, transfer skills, memory, emotions, beliefs, etc. The *Social-Aspect* focuses on activities like interaction, communication, cooperation, social, cultural beliefs and values in the learning process of the involved participants (learner, teacher, peers) and technology. In our view, it is important to take into account all the involved stakeholders in the learning process, in the sense of a community that learns in a flexible way together. From this we follow that, even if there are individual reading and learning phases, in the collaborative mobile learning aspects (e.g. reading and public annotating of a text) the learning responsibility shifts from individual to collective cognitive responsibility (Laouris & Eteokleaus, 2005). This means that the learner accepts and fosters collaborative learning attitudes.

At the intersection of the main aspects respective at their overlap emerge interesting behavioural and functional variables. The interface between Device and Learner is called *Device Usability Intersection*. Hereby usability elements come into the focus. This means elements like portability, information availability, comfort/ergonomics and satisfaction. In the *Social Technology Intersection* (the interface between Device and Social aspects) one looks at the interaction of people acting as a group or community via technology respectively Devices. Therefore networking, connectivity and collaborative functions and tools are hereby in the foreground. The third interface is named as *Interaction Learning intersection*. Here collective influences to individuals and oppositions come into the viewpoint. Therefore interaction types, situated cognition and learning

communities are regarded. Considering that the different elements will deliver a reasonable picture of mobile learning processes (centre of the model) last but not least relevant elements as information access and selection, mediation and knowledge navigation, construction should also be considered. The model is not a theory for mobile learning but can be used as a heuristic tool to understand mobile learning processes.

By considering the FRAME model in the design and development of a Moodle App, one can bring together the technical and the didactical perspective and make sure that all major aspects are all being considered and the result lays at the converging point of all circles, in the mobile learning intersection.

Methodology

Research project Mobile Uni-App

At the Università della Svizzera italiana (USI) a research project was initiated in September 2011 that laid the foundation for a Swiss-wide standard for university apps. University apps are applications (native or web-based) for smartphones (e.g. the iPhone or Android Phones) or tablet computers (e.g. the iPad or Samsung Galaxy Tab) that provide students and university staff with supportive functionality (e.g. schedule of lectures, register of persons, different directories, campus map, and cafeteria menu plan.).

Results of surveys on the state of practice of university apps in the USA show that most universities that offer Uni- apps don't use a standard framework for their apps. As most of the functionality of university apps is transferable to other universities, this is a waste of resources as each university is "reinventing the wheel". By bringing together Swiss universities and using the same standard framework for mobile apps, we can save resources and accelerate the development and rollout of such apps. The app itself creates benefit for students and university staff by supporting them on different tasks.

In the beginning we evaluated available technologies for the implementation of mobile solutions / apps. As students and staff use different smartphones and tablets (frontends) from different vendors with different operating systems, one of the major requirements to us was that one implementation should fit all frontends. The same requirement was given for the backend services. The solution should be compatible with different communication and data standards. To meet these requirements we were looking for a middleware that can be connected to different backend services and that generates an output that fits all frontends (see Figure 2).

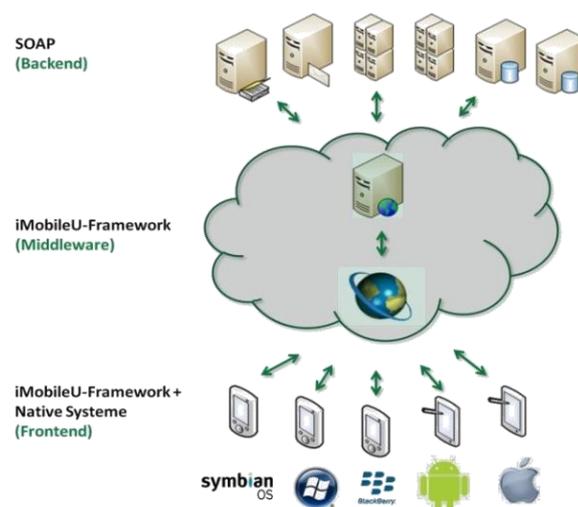


Figure 2: Overview of the Architecture

We evaluated the Kurogo framework to best meet the requirements and implemented a first and in terms of user acceptance and technical capabilities very successful prototype (supporting more than seven different features: access to different news-feed, a generic timetable and list of events, people directory, campus map / campus navigation, public transportation schedule, emergency information and cafeteria menu) using the Kurogo

framework. The prototype is available as web-app (which is supported by nearly any device on the market, no matter if it is a smartphone or tablet, an Android or iOS device) and as wrapper-app (native for Android).

About the Kurogo Framework (cf. <http://modolabs.com/framework.php>).

Kurogo started as a fork of the highly-regarded MIT Mobile Framework, an ambitious open source project started in 2007. It has since been adapted by multiple education institutions in the iMobileU community. iMobileU is a community of educational institutions with a shared interest in mobile development including institutions such as MIT and Harvard.



Figure 3: Web -Standards that a compatible with Kurogo and Phone Gap. The same code can be used as Kurogo module and to generate native apps using Phone Gap (<http://www.phonegap.com>).

Kurogo is an open source mobile development framework that emphasizes clean integration, exceptional cross-platform user experience and deep customization possibilities. The focus of Kurogo is on refining essential functionality, flexible development options that improve efficiency and reduce maintenance overhead and optimized user interfaces that adapt to device requirements without bias. It's designed to accommodate best practice user experiences across all platforms and devices. No mobile device gets left behind. Also the Kurogo framework is compatible with any web-technology.

In Phase 2 our target was to develop and deploy university apps based on the same standard to leverage synergies and save development costs. We have extended the existing solution with modules that support more sophisticated features and adapted existing modules for the specific requirements of Swiss higher education institutes. Our focus was on modules with functionality that are on the one hand strongly demanded by students (survey results) and on the other hand functionalities that many institutes need, respectively can use. Summarized, we developed the following modules:

3. E-Learning Functionality: Integration of the Moodle LMS
4. Native Apps: Kurogo modules that use HTML5 can be used to generate native Android and iOS apps using Phone Gap.
5. Library-Interface: Mobile access for different library-services including the library catalogue (ALEPH and Swiss Bib).
6. AAI-Interface (Shiboleth): Allows user authentication and access to protected content / services.
7. Personal timetable: Access to a personal timetable that shows the next lectures of a student / lecturer.

Another important target is to establish a network of Swiss universities where each university shares their new modules and developments with other universities. We see this network and the open source policy we use for our developments as a big step towards the sustainability of our project and any other project of a Swiss higher education institute that is concerned with mobile solutions. For that purpose we try to integrate the Swiss community into the existing iMobileU community and publish our source using GitHub.

Development of a User Authentication (AAI-Interface)

The results of the initial survey demonstrate that both students and lecturers do not only ask for general information, but also for personalised data.

Furthermore, a local storage of the user's account information accelerates this login process. Due to legal requirements the protection of personalised data, especially account information, is highly important and a must-have. The data has to be transmitted in a secured way and login-information will be encrypted when sent. Both the single sign on as well as the local storage augment the usability and the user's satisfaction. The existing module "Authentication" of the Kurogo framework will support the implementation of the functionality.

As a result, the integration of the AAI-interface is obviously the best choice to meet the users' need of easy access to their personalised information. Besides, every Swiss higher education institution can re-use the implementation of the AAI-interface.

Development of a Mobile LMS / Moodle-Interface

The interface was developed as self-standing HTML5 module and is available as native iOS and Android app. The HTML5 module is compatible with Kurogo and can be easily integrated into the already existing Mobile Uni-App application.

Research project MobiLER

The internal research project „Mobile Learning Environment“ (MobiLER) of the Institute for Research in Open-Distance- and eLearning aims at introducing mobile learning content and scenarios in teaching at the Swiss Distance University of Applied Sciences. The introduction of MobiLER aims to support the learning process of students in the following aspects: higher degree of mobility, personalization of learning environments, personalization of learning materials (books and hand-outs), integration of the learning management system (Moodle) activities in the mobile learning process. This will lead as well to a higher flexibility of students (individual time management, simplified/accessible distribution and communication, choices in the selection of learning materials) in order to support the learning process (Bergamin, Ziska, Werlen & Siegenthaler, 2011).

In Phase 1 of the project two classes (about 60 Students) and their teachers were equipped with iPads™. The results of the survey at the end of the semester showed that the usage of tablets in a learning context focuses on rather receptive learning activities like reading, editing and viewing of documents. We had expected that the students will engage in communication, dispute and collaboration as main activities. These activities were been acted upon but rather in a non-learning context.

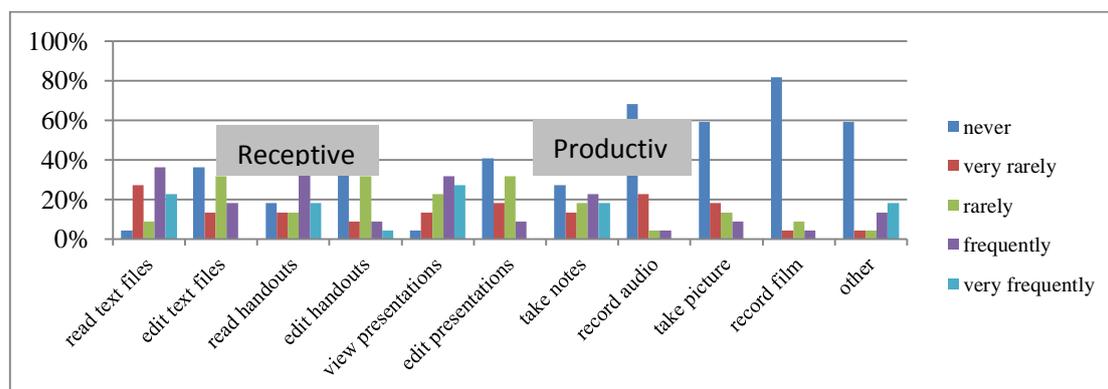


Figure 4: Distribution of student learning activities on tablet computers

On the basis of Bloom's taxonomy of learning objectives (Bloom, 1956) and its revision by Anderson and Krathwohl (Anderson & Krathwohl, 2001), and the results of the surveys we defined twelve didactic functions, which must be supported in order to optimally support the student's mobile learning activities.

Taxonomy Knowledge dimensions	Components Trans. Distance	Functions in E-Book
Metacognitive K.	Autonomy	1) Learning goals before each chapter/ section 2) Chronological learning strategy
Factual & Conceptual K.	Structure	3) Chapters as structure in Moodle 4) Information about the text: mandatory, relevant for exam, supplementary 5) Annotation 6) Highlighting
Procedural K	Structure	7) Multimedia enrichments
Conceptual & metacognitive K.	Dialogue & Autonomy	8) Notes for chapter synopsis Procedural 9) Tests with feedback 10) Assignments 11) Transfer assignments
Conceptual & Procedural K.	Dialogue	12) Communication

Figure 5: Didactical functions in an iE-Book

Based on these functions we developed a framework on the basis of the FRAME Model that included the results of our surveys.

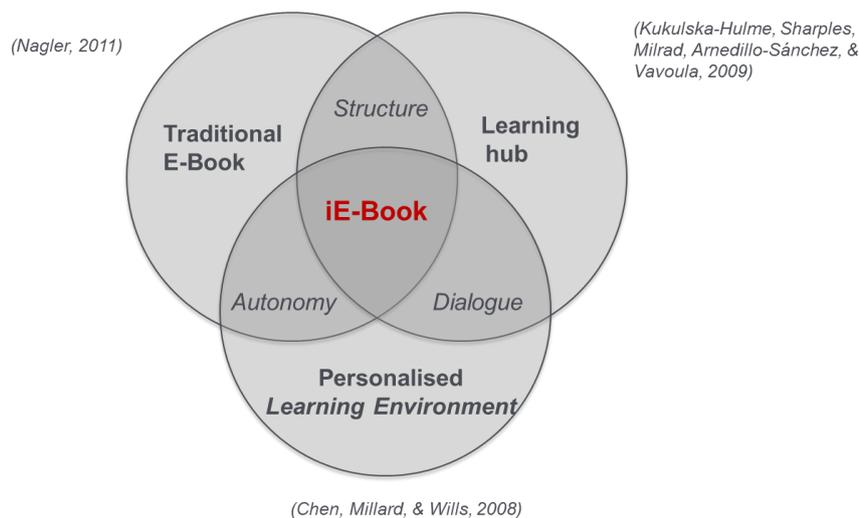


Figure 6: iE-Book Model

Traditional E-Book

The generally accepted definition for e-books is the one corresponding to the digitisation of printed books of libraries. This includes not only digitised releases of real books but also the online book stock of a library; e-journals cover the range of online newspapers and magazines. So this definition includes all readable or downloadable documents (books, other publications, etc.) offered by a library portal or similar institutions. These documents are of PDF format by default. Possibilities for interaction are not usual for such e-books. E-Books in that sense are well-known by students of today. One big advantage is its easy and quick availability. Additionally libraries offer very often a good search system in that context. (Nagler, 2011)

Learning Hub

Fixed technology environments like desktop PCs play already an important role in the boundary crossing between different learning contexts. Actually tele-enhanced learning mostly takes place in a multiple device environment. Thus the role of mobile devices and technologies in fact are very important for situated learning in authentic context. Learning activities overall are not and should not be limited to a mobile device but should take place on multiple devices that provide an adequate implementation of the learning experience (Kukulska-

Hulme, Sharples, Milrad, Arnedillo-Sánchez, & Vavoula, 2009). If within a learning scenario the learner uses for example a PC with a Windows operating system, his tablet that operates on iOS and his smartphone that has an Android system he has to adapt to the programs and applications every time he changes the device. He has to make sure that he can transfer the documents and the notes he made with the specific programs and applications onto the other devices. In order to not burden the user with multiple usability and usage problems it is suggested that a learning hub should be implemented. This means the learning hub consists in big parts of a stable main learning management system of the institution. It should use for each device the same design and functions (recognition value) in order to guarantee effective learning processes. The learning hub supports the learning activities of the students in the context of the affordances the learning organisation (e.g. solving learning tasks while and after reading relevant literature).

Personal Learning Environment

Finally, the Personal Learning Environment (Chen, Millard, & Wills, 2008), which describes software systems that users choose and tailor to fit their own learning needs and preferences e.g. by managing their time, helping to organise learning goals and activities as well as gathering and archiving reference material.

The technical solution of the iE-Book has to support the most widely used devices like PCs, tablet computers, smartphones, and systems like Windows, Android, MAC, iOS, Linux which will most likely be deployed by the students to access the desired learning materials and activities.

Results

By bringing the two perspectives together, the technical and the didactical we designed a Moodle App that supports the following activities:

- accessing general information about the courses one is enrolled,
- grades,
- the list of participants,
- accessing the Moodle calendar
- interacting in course forums,
- accessing courses' resources
- a SCORM viewer for the iE-Books that has these functionalities on the mobile device:
 - display of HTML content (including play of multimedia materials)
 - navigation bar, that can be hidden
 - completion marker (flag that indicates whether a page has been opened by the user)
 - adjustment of the font size
 - bookmarks
 - search (text & notes)
 - highlighting
 - textual annotations

Conclusions and outlook

Rather than trying to keep up with quick changing markets in technologies and applications that offer support for eLearning activities we propose a deep analysis of user behaviour on mobile devices in the learning context and the development of a modular Moodle application that can be personalized. As our surveys show, the main activities of learners on a mobile device are fairly passive and not active. The users view as the most important features of the mobile device the portability and the high degree of personalisation. In order to not fragment and disperse the learner and the content between multiple applications that have to run on a device with limited capabilities we prefer a solution that is more integrative. The existing standards in Moodle, such as SCORM offer a user experience that is platform independent as it is based on other web/internet standards like HTML and XML. The SCORM standard offers a wide option of learning activities that can be integrated, monitored and personalized on the mobile device as well as on the Moodle platform.

We believe that such a solution is scalable in the sense of the materials that can be distributed to the learners, the learning activities that can be integrated into the app, and the degree of personalisation of the content, the communication and collaboration. The possibilities that emerge by integrating in such a way the reading activity into the LMS activity and offering personalisation tools as well as communication and collaboration tools will increase authentic learning experiences and allow on the other hand educational institutions to track the student learning progress.

Without a doubt there is a great need in developing new strategies in the teacher/learner scenarios in order to fully accept the new technologies into the higher education landscape. Encompassing context variables that come into play should also be systematically evaluated. One of the crucial points hereby are the topic of copyrights and the availability of e-Books. While research literature is widely available, publishers are just beginning to give access to digital forms of classic books. Just the concept of making them available and allowing them to be enriched needs new business and licensing model by publishing houses as well as universities. The above mentioned project at the Swiss Distance University of Applied Sciences showed that about 25% of the books used in the curriculums are available as E-Books with a relevant licensing model.

It remains to be determined who will offer the interface, the publishing houses or rather the universities as they have an interest to maybe distribute them through their learning management platforms. Who will determine the extent of the enrichments? It is of course desirable that the authors and the publishing houses start the enrichment process as they develop the E-Books, but still offer the universities the possibility of adding and customizing the product.

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