Mobile Learning: The Next Generation of Learning

FernUniversität’s Contributions to the 2nd Year of the Project

Technical Working paper

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August 2005
Version 1

Abstract

This paper presents FernUniversität’s conceptual and technical contributions to the second year of the Leonardo project “Mobile Learning: The Next Generation of Learning”. We address the motivation behind the second application we developed, describe the challenges and design solutions we identified, and report on first feedback we acquired from our students. We also sketch a third learning application for mobile devices, which exploits the increasing popularity of mp3 players and the concept of podcasting. In our discourse we derive some requirements for useful mobility functions of learning management systems. Finally we also present some new evaluation data related to our first application, the Java-based learning object Histobrick.

1 Introduction

FernUniversität’s educational mission is higher education off campus serving distant students who prefer to study anywhere and anytime as they are working professionals, need to take care of their family or have other reasons to avoid physical classrooms. The advent of the World Wide Web offered new options to extend traditional means of distance and campus education towards online distance learning and blended learning styles, respectively. Web-based and offline learning with digital media, briefly: e-learning, provide new options to involve remote students actively in (cooperative) learning and research tasks. Learning on the move with mobile devices – short: m-learning - stretches the concept of anywhere-anytime learning even further by use of the wireless Internet and other wireless communication facilities and supports the seamless continuation of interaction when the learner is away from the desktop PC (Bull et al, 2004).

The advantages of improved access to online learning resources and services have a price, however (Houser et al., 2002), including low data transfer rates, high running costs, and slow text input speed. In the following sections we are going to discuss alternatives to fight such obstacles and we present core characteristics of our second application and the rationale behind it.
2 Setting the Scene

The project we report on here and a few other projects at FernUniversität set out to investigate the potential and limitations of mobile devices for different types of mobile learning applications as a supplement of FernUniversität’s current e-learning services. They also aim to explore the acceptance of different m-learning solutions. From the users side, m-learning services would increase the students’ flexibility in time and location independent learning options and would allow them to access content and services on demand. In principle, all educational services, including:

- provision of learning content,
- specification, support and management of learning activities,
- maintenance of personal data,
- tutoring and consulting,
- communication and collaboration,
- performance of exercises and tests,
- access to virtual and physical laboratories (wherever reasonable) or
- access to the university library

could be provided for students on the move.

The idea underlying this research is not to put learning completely on mobile devices but expand the learning space to the mobile world, focusing particularly on the support of spontaneous short learning phases. Look at a typical scenario for mobile learning:

Peter is preparing himself for the examination in the course Object-oriented Programming. Unforeseen, he has to visit an important customer for his company. Before leaving his office, he had no time to select proper learning materials to take with him on the journey. But his e-learning campus provides the possibility to download typical examination problems on his Palm PDA or mobile phone and allows him to test his knowledge against a pool of questions about object-oriented programming.

Fig. 1 illustrates a remote access with a mobile phone. The question (Frage, in German) to the left asks for distinguishing characteristics between parallel and distributed computing and the hint (Hinweis) to the right refers to the fact that all processors share the same clock in parallel computing.

![Figure 1: Knowledge test with a mobile phone: question (left) and hint (right)](image-url)
Besides a hint and a correct answer (Antwort) to a question, we also provide a link to related course materials a student may want to look at spontaneously to get a full grasp of the topic. Fig. 2 depicts an access to a related section in the course (left), which talks about the properties and inner working of a semaphore, and an access to the course glossary, in particular to the entry for semaphores (right). As modern cell phones offer megabytes of memory these days and even come with memory expansion cards, students may want to download the complete course locally via a Bluetooth or infrared connection to save connection costs on the route.

Figure 2: Viewing course material (left) and a glossary entry (right) on a mobile phone

In the remainder of this report we present the m-learning application we developed in the second year of the project “Mobile Learning: The Next Generation of Learning” including the underlying rationale, design alternatives and core aspects of the final solution. Before we conclude, we also sketch an ongoing trial application exploiting the idea of podcasting and list a few requirements future m-learning management systems should provide.

3 Approach

Supporting mobile learners, in particular those who have a mobile phone at their disposal, was a key part of this subproject. The aim was for learners to be able to continue learning on the move, use tutoring and organisational services or access exercise and lab servers spontaneously as short periods of concentration occur.

3.1 Challenges

Devices like mobile phones pose, however, some challenges that need to be addressed.

- Occasionally intermittent connections, slow connection rates and limited storage capacity require special packaging, uploading, caching, and pre-fetching of content.

- The small screen (often still black and white) limits the amount and type of information that can be displayed and, thus, requires the adaptation of presentation data, scrolling and navigation elements.
• Often, the lack of appropriate player and viewer software (flash, video etc.) on mobile phones disallows the use of moving graphics.
• The small screens render it difficult to read the details of (animated) graphics and video.
• The lack of input devices like mouse, keyboard or stylus pen slow down text input speed and reduce the device’s usability with respect to man-machine interaction.
• Not every type of media or learning scenario is applicable under all circumstances (e.g., practicing a foreign language course with audio output in a bus and in the subway).

Fig.3 illustrates the constraints that have to be dealt with when developing content and services for use on mobile devices (adapted from Kuszpa, 2004). Special versions of standard markup languages like compact HTML (cHTML) proposed by W3C¹ or XHTML mobile profile (XHTML MP) proposed by the O Mobile Alliance (OMA²) define subsets of HTML suited for small information appliances such as smart phones, smart communicators, or mobile PDAs. The rationale behind XHTML MP was to converge the mark-up languages for wireless devices (WML) with the one used for the World Wide Web. The developers of cHTML also announced their plan to converge with XHTML, too.

![Figure 3: Constraints of mobile devices](image)

But in spite of such standards and the existence of proper viewers, a range of presentation elements including tables, (animated) graphics or video pose obstacles with respect to preserving the intended meaning when switching form desktop screens to mobile devices. Tables, for instances, can be totally messed up in HTML when rows are presented as columns due to lack of sufficient screen width.

### 3.2 Assumptions

The application was developed under the assumption that

- students use their mobile device particularly for spontaneous, short study phases;
- mobile devices are typically used for repetition, for examination preparation or for quickly looking up details when knowledge gaps are detected in the process of testing the learning progress;

primary learning has taken place before accessing mobile versions of learning materials, i.e., students have a basic understanding of the learning content.

3.3 Effective Content Authoring and Management

A particular idea underlying the design of our second year application was to use a novel learning content management system, FuXML, and experimentally extend its cross-media publishing features from paper and laptop to mobile devices (cf. Fig. 4).

FuXML has been developed at FernUniversität recently (Steinkamp et al., 2005) and aims at providing a tailor-made and efficient solution for authoring, maintaining, producing and distributing online and offline distance learning material from a single source encoded in XML. Further objectives of this development include:

- Simplification and standardisation of the content authoring and material production process.
- Separation of content, structure and layout of learning materials to allow authors and design experts to work independently on content and layout, respectively, and support the reuse and recombination of both.
- Reduction of the technical overhead in content production for different media and devices so that authors merely need to focus on content and pedagogy.

![Diagram of FuXML content management and cross-media publishing system](image-url)

**Figure 4:** FuXML content management and cross-media publishing system
The content author typically uses an XML editor loaded with the FuXML DTD to edit textual parts of a course, including appropriate media objects like graphics, photographs, sound and audio elements, animations, videos, simulations etc. and organise the logical parts of the course. The layout designer specifies presentation templates and cascading style sheets (CSS) to define different layouts for different presentation media. Configuration files allow design or configuration experts to customise all relevant attributes of a course including labelling and numbering schemes, the layout and structure of different course elements and their appearance. The configuration file also allows content producers to use switches for different target media if, for instance, a compound media object in the XML source includes an animation, a still graphics (e.g., a suggestive screenshot of the animation), a text object, which transcribes the events in the animation, and an audio file providing spoken explanations. In the online version the graphics would be used as a button to start the animation play together with the audio explanation, while the graphics and the transcripts would be used in the print version of the same content.

The current version of FuXML produces two types of presentation materials: Extensible Hypertext markup language (XHTML) documents designed for online use on desktop or laptop screens and PDF documents to be printed for off-line use. Figures 5, 6 and 7 show two different presentations (HTML and PDF, respectively) of sample material of the course “Programmierkonzepte” (Advanced Programming Concepts).

![Image of the HTML page of the online version of the course “Advanced Programming Concepts” (in German)](image)

**Figure 5:** HTML page of the online version of the course “Advanced Programming Concepts” (in German)

Both versions are not suited for presentation on mobile devices as they are.
dritte Spalte gibt an, von welchen anderen Ereignissen das in derselben Zelle davor stehende Ereignis kausal abhängig ist.

**Tab. 2.2-1: Ereignisse des Radwechselvorgangs und ihre kausalen Beziehungen**

<table>
<thead>
<tr>
<th>Ereignis</th>
<th>Aktion</th>
<th>Vorangegangenes Ereignis</th>
</tr>
</thead>
<tbody>
<tr>
<td>locF</td>
<td>Lockern der Radmuttern auf der Fahrerseite</td>
<td></td>
</tr>
<tr>
<td>locB</td>
<td>Lockern der Radmuttern auf der Beifahrerseite</td>
<td></td>
</tr>
<tr>
<td>anh</td>
<td>Anheben des Wagens locF, locB</td>
<td>locF, locB</td>
</tr>
<tr>
<td>lösF</td>
<td>Lösen der Radmuttern auf der Fahrerseite</td>
<td>anh</td>
</tr>
<tr>
<td>lösF</td>
<td>Abnehmen des Rads auf der Fahrerseite</td>
<td>lösF</td>
</tr>
<tr>
<td>anbF</td>
<td>Neues Rad auf der Fahrerseite anbringen</td>
<td>anbF</td>
</tr>
<tr>
<td>befF</td>
<td>Radmuttern betesigen auf der Fahrerseite</td>
<td>anbF, lösF</td>
</tr>
<tr>
<td>lösB</td>
<td>Lösen der Radmuttern auf der Beifahrerseite</td>
<td>anh</td>
</tr>
<tr>
<td>abnB</td>
<td>Abnehmen des Rads auf der Beifahrerseite</td>
<td>lösB</td>
</tr>
<tr>
<td>anbB</td>
<td>Neues Rad auf der Beifahrerseite anbringen</td>
<td>abnB</td>
</tr>
<tr>
<td>befB</td>
<td>Radmuttern betesigen auf der Beifahrerseite</td>
<td>abnB, lösB</td>
</tr>
<tr>
<td>abl</td>
<td>Wagen am Wagenheber ablassen</td>
<td>befB, befB</td>
</tr>
</tbody>
</table>


Ereignisse wie das Lockern der Radmuttern des Rads auf der Fahrer- und Beifahrerseite können nebeneinläufig (engl. *concurrent*) auftreten. Nebeneinläufig heißt, dass sie zeitlich gleichlaufend, zeitlich überlappend oder in beliebiger

**Figure 6:** PDF page of the print version of the course “Programmierkonzepte”
The online version is decomposed in a header, a navigation section on the left, the main content window, and a foot line. The header includes the university logo, number and title of the course, the logo of the chair of data processing technology offering the course, and an indication of the section currently visited. The navigation section to the left gives access to the home page (Startseite), the beginning of the course unit visited (here: Kurseinheit, i.e., course unit, 4), its table of content (Inhalt) and a link to a cooperative learning environment. Except for the latter all links are defined in a context-dependent way. So are links in the foot line, which give one-click access to the examples (Beispiele) of the current course unit, exercises (Übungen), figures (Abbildungen), multimedia objects, a general index, a glossary and a link to the course newsgroup. All this would, of course, not fit in a readable way on the small screen of a mobile device. Often proper players and software for animated or simulated elements are also not available on mobile devices.

![Figure 7: Marginal notes in the PDF version of the course “Programmierkonzepte”](image)

In principle, the PDF version could be viewed on PDAs and smart phones - provided a PDF reader is installed. But the table in Fig. 6 and the marginal notes in Fig. 7 would become unreadable on such small screens.

An obvious solution to adapt our FuXML based learning content hence is to provide adequate style sheets and templates and exploit the configuration file concept to control the layout and structure of the presentation format for mobile devices.

4. Results and Achievements

A decent study of different m-learning projects revealed a range of alternatives to make learning content fit the constraints of mobile devices.

4.1 Alternatives

(Laakko and Hiltunen, 2005) comprehensively addresses the challenge of adapting Web content for use on mobile devices. The authors distinguish between server-side, intermediate and client-side
adaptation and compare different solution for each category including their own design of an automatic adaptation proxy for Web pages.

In a parallel m-learning project colleagues at FernUniversität began to build an intermediate including a mobile device profile database and a range of filters that exploit the information provided by a mobile browser to communication the web content through appropriate filters matching the actual device’s profile. Unfortunately, the solution is not yet available outside this project and the amount of manpower and money necessary for this kind of development by far exceeds the possibilities of our project so that we have to wait for such developments to become open source.

In our project, we did not have the resources at our disposal to provide similarly costly solutions.

4.2 Solution

The context described in Section 2.3 suggests us to offer a server-side solution with a pre-processed presentation version of the course for PDAs, smart phones and cell phones. This version was produced by creating an additional output channel on the production side of our content management system FuXML as depicted in Fig. 4.

Reformatting the presentation output of FuXML.

We have developed special templates and style sheets and set particular parameters in the configuration files to produce rather plain XHTML pages supplemented by very scarce navigation lines at the top and bottom of every page (cf., e.g., Fig. 8).

Figure 8: Viewing the HTML version of the course on a Palm PDA
Link “navigation” refers to a navigation page (Fig. 9), which contains all links but the reference to the cooperative learning environment, as it is not usable at the moment on mobile devices.

Figure 9: Navigation Page on the Palm including the new section “Fragen und Antworten” (question and answers)

Resizing and transcribing figures

In addition, we provided smaller versions of figures and Flash animations to be included in the mobile version of the course. The current standard of FuXML is that authors have to provide both a set of high-resolution figures for the print version (PDF) and a low-resolution version fitting on typical computer screens for the online presentation, anyway. Our new set of figures and animations was designed for viewing on PDA screens using the zooming feature of the viewer if details need to be studied (see Fig 10).

We played with varying resolutions to find a compromise between readability and context. If the resolution is high, all details are presented but the section visible on the screen may be too small to grasp the larger context of that figure and students have to use the pen or navigation buttons to move the viewable section over the figure surface. If the resolution is small like in Fig. 9, a larger section of the figure fits on the screen but its details may become fuzzy. To provide redundant information, we added a transcript to every figure in the course. Transcripts for animated graphics were already available for the print version.
Adding questions, hints and answers

A third element we added to the course to provide an added value for mobile phone users as well was the addition of a set of questions, hints and answers (Frage, Hinweis, Antwort in German), which students can access with any gadget using wired or wireless connections to our server. These questions are topically organized and the presentation page shows a link to the course material relevant to answer that question. If students are unable to find the answer even after having read the hint or if they gave a wrong answer, they can follow the link to the course to fight that knowledge gap. The glossary of the course is also a resource that is useful to be accessed with a mobile phone.

Viewers

The XHTML version can be viewed with any PDA or mobile phone running an HTML-capable browser.

As we also wanted to experiment with special viewer software and explore the possibility of offline reading as well, we chose Palm OS® as the target platform and used Plucker\(^3\) to produce a Palm pdb file, which can be downloaded to a PC or Mac and installed on the Palm via hotsync or similar. Plucker is a free offline Web and e-book viewer for PalmOS® based handheld devices and PDAs. Plucker comes with a range of tools and scripts for major platforms (Unix, Linux, Windows, Mac

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\(^3\) [http://www.plkr.org/](http://www.plkr.org/)
OSX) that allow us to process and compress the content prior to transferring it to the PDA for viewing by the Plucker viewer. As newer PDAs are equipped with flash cards, downloading a whole course on a Palm or other type of PDA and then accessing the materials offline may be a cheaper and more convenient way of m-learning.

The pdb and zipped HTML versions for downloading and the online version for remote access can be found at http://mlearning.dvt.fernuni-hagen.de/. Mobile phone users may want to download just the glossary and the questions and answers. Both are separately listed as zip archives and as HTML files at http://mlearning.dvt.fernuni-hagen.de/.

Figures 1 and 2 show a knowledge test scenario with the mobile phones.

### 4.3 Podcasting Trial

Today, nearly every mobile phone includes an mp3 player that allows the phone user to listen to audio data while on the move. The audio data are either stored on the phone or are streamed dynamically to the mobile device. In addition, many mobile phone users own a separate mp3 player among which Apple’s iPod takes the largest share on the market. The term podcast combines the words iPod and broadcasting and gives name to a novel method of publishing audio broadcasts via the Internet that become popular in 2004. The term is somehow misleading as neither an iPod nor a portable mp3 player is required to subscribe to a feed of new audio files (usually mp3) and automatically download them to appropriate players. Podcasting enables independent producers to create self-published, syndicated “radio shows” and distribute them via the Internet. Listeners may subscribe to feeds using “podcasting” that periodically checks for and downloads new content automatically. More and more broadcasting corporations and even professional print media are now jumping on this bandwagon and offer regular news, sports, entertainment and cultural programmes via podcast feeds. Fig. 11, which was borrowed from http://www.podcast.de, illustrates the production and use process of podcast applications.

![Podcasting process](http://www.podcast.de)

**Figure 11: Podcasting process**

Our group has just set up the first podcast channel for educational content at FernUniversität in Hagen (http://podcast.fernuni-hagen.de/DVT/mp3/beta-podcast.xml). The trial phase started end of August 2005 and serves to understand our students’ interest in this type of educational offer
and gain practical experiences in producing useful and usable content. The material we chose is related to the course “Object-oriented Programming”, which we discussed in Section 3.3 before.

To produce content that meets the criteria of the medium radio, we sought advice from experts in FernUniversität’s media design centre ZFE\(^4\) who have ample experience in producing professional TV, video and audio productions. Some of the lessons we learned to observe in creating an audio book for learning include:

- People listening to the radio cannot affect the speed of the presentation process other than in reading learning content online or in a textbook.
- Readers can stop reading spontaneously, follow a link to another chunk of text and go back to the original location. If listeners are distracted or lost due to lack of information while the audio book continues to play, they experience a break in the learning process.
- Listeners are likely to be more distracted than readers as listening often takes place in parallel to other activities or in noisy locations.

Some rules of thumb exist to increase the listener’s attention:

- Avoid using only short sentences. Variety is pleasant for the human ear.
- Present the most important information first.
- Verbs should come first (this may be different in other languages than German) and verbs should be preferred to noun forms (again a specific issue of German).
- Important information should be repeated. For example, a quotation should be presented first, then its meaning should be explained and finally the quotation should be repeated.
- Radio language should be close to colloquial language.
- The speaker should provide orientation in larger sections, for example, repeat the context in an enumeration like: … the third topic of our enumeration of …
- Prefer graphic notions to mere quantities such as “more than a third” rather than “37%”

Hints for the technical implementation of an audio book we were given include:

- Involve different speakers:
  - one speaker for organisational issues such as chapter headings or cross references to written material,
  - one speaker for the text flow,
  - one speaker for quotations.
- Combine female and male voice.
- Specific sounds like ringing a bell can be used for emphasis (corresponding to presentation markup like bold or italics in texts).

In addition, there are some course-specific challenges for which we need to acquire more experience such as the presentation of complex formulae or program texts. It is also unclear to us as yet whether the explanation of animations, diagrams and other types of media objects is always sufficient.

Due to the summer vacation and semester break, we were not able to collect substantial feedback from students. It will be presented on the project site, however, as it becomes available.

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\(^4\) We are particularly grateful to Werner Vitalis who gave us valuable hints for producing proper audio files from our course material.
5 Requirements for useful LMS Functionality

In this section we list a few requirements that we want future learning management systems serving mobile users should offer.

5.1 Personalisation to facilitate learning

In previous sections we argued that students have different learning styles and preferences and that there exists a broad range of technical diversity, in particular, among mobile devices, including screen size, mode of operation (pen, keyboard, voice etc.), storage capacity, or operating system functionality. In addition, mobile device producers implement standards with varying accuracy (Ströhlein, 2005) and service providers compete with incompatible services. Personalisation is therefore a necessary ingredient of learning management systems that aim to serve mobile users. Personalisation of an educational service requires a mechanism that allows a student to adapt the service so as to fit this student’s particular needs.

Besides the classical voice communication a range of services for mobile communications system is available today. They include browsing (WAP, i-mode, HTTP, voice-enabled), messaging (SMS, MMS, email, push-to-talk), presence-based and location-based services, data synchronisation (calendars, contacts, files), data services (file transfer, email download), gaming (download, interactive) and more (Jørstad et al. 2004b). All these services bear a potential for mobile learning applications, not just for business and entertainment. Browsing can be used for accessing learning content like we do in our second application discussed in Section 3.3), messaging provides asynchronous person-to-person or person-to-machine communication and synchronous group communication facilities, data synchronisation and data services can be used for (learner) group collaboration, and gaming services can be used for edutainment applications like Histobrick (Ströhlein, 2005) or for interactive group work.

A personalisation mechanism would need to address the following functions (cf. e.g., (Jørstad et al. 2004a):

- Gathering, persistent maintenance, retrieval and automatic exploitation of
  - learner and
  - device profiles;
- adaptation of content;
- service subscription;
- personalised service composition.

The learner profile maintains information about a student’s personal data, learning objectives, study portfolio, preferred learning resources, performance information and the like, which would be accessed as a student performs a learning task on the move.

Mobile device profiles capture characteristic parameters of mobile devices such as system transmission capabilities (GSM, GPRS, UMTS, EDGE, WLAN etc.), supported presentation standards (WML, cHTML, HTML, XML, Java, Flash etc.), technical parameters such as display resolution, storage capacity, system and application software, performance parameters or operation modes.

Server-side content adaptation is particularly important for mobile devices, as there capabilities are usually too limited to allow client-side content adaptation. Depending on the capabilities of the actual device and the learner’s profile, content should be adapted automatically, e.g., by rearranging and refitting navigational elements, resizing und decomposing presentation pages, resizing figures, videos and animations. Server-side adaptation also has the advantage that it provides the content author
maximum control over content delivery for mobile devices (Laakko and Hiltunen, 2005).

The subscription service would maintain information about all information channels and services a mobile user has subscribed to together with all necessary use and access parameters. An example is the podcasting service introduced in Section 3.4. It might also offer auto-discovery features, e.g., to find a site’s RSS feeds resembling the user’s preferred feeds’ content.

Service composition refers to the process of combining educational services to support the different steps of a particular learning activity or of a particular educational scenario that occurs frequently.

5.2 Support for self-organising learner groups

An LMS for mobile users should also provide functions that allow geographically dispersed students to organise in learning groups. Learning groups typically want to share learning and demonstration materials they found most useful, exchange personal learning experiences, and collaborate on homework assignments. (Yang et al., 2005) proposed a recommendation approach that helps learners to set up trusted neighbour connections to peer students with similar study situations. Students can get useful recommendations for proper learning resources from their peers. A recommendation platform has been developed that enables a learner to enquire recommendations, vote on recommended resources and communicate with neighbour learners. The recommendation platform currently provides a rich user interface that is meant to be used through PC screens. It could, however, be adapted for use with mobile phones by splitting up the different panes of the interface window, which maintain three lists of items to update, choose from or vote on: learned resources, recommended resources, and neighbour list. The LMS would need to be able to recognise the actual client device and accordingly communicate the proper information from the recommendation platform to its user and pipe back her feedback.

5.3 Access to library catalogues

Mobile users should also be given the possibility to use their mobile phone for searching literature in university libraries remotely, reserve or order books and articles, or read through abstracts. This requires authentication and security services as personal information like passwords or user codes are communicated. In addition, online resources must be automatically transformed on the server side into a format that can be used on mobile devices.

6 Conclusions and Future Plans

In this report we have presented design alternatives and final solutions for the second application planned in this project. We showed that existing content management facilities could be adapted and reused to produce mobile device-capable content. We argued that the adaptation process cannot be a fully automated as certain presentation elements such as tables or animations cannot simply be downsized. We further experimented with redundant content elements including transcripts of animated content, videos and figures and we finally proposed a novel presentation concept exploiting the audio book and podcasting hype.

In a parallel m-learning project, colleagues at FernUniversität have developed a first version of a database maintaining a pool of several hundred flashcards maintaining questions and answers for a mathematics course on linear algebra. The flashcards aim to support online and mobile preparation for exams. Currently they are optimized for the use on the web. They can also be downloaded as PDF documents for printout and in plain text format for use on PDAs. Students have several choices to continue with another questions: They can choose the next question from the thematical context,
from a related context or they can make an original choice among all possible topics. The first two options are made possible by organising all flashcards into a thematic tree. When the first option is selected, the next question is taken from the same topic; in the second case, a question from another branch in the same tree or a parent topic is taken. The tree as a whole supports the navigation within individual learning packages. All flashcards are equipped with metadata describing the course context, the thematic (here mathematical context), and a few soft criteria organising the questions into categories like basic knowledge, survey knowledge, ponder or cram question. A joint plan of this and our group is to make the access to the flashcard database available also for mobile phones. This would allow us to employ the flashcard solution to our programming topics as well and thus replace the current static arrangement of questions we currently offer.

Another project at FernUniversität is currently designing a development environment to become the heart of a pocket university. The main purpose of this project is to make learning, teaching and collaborating via mobile devices accessible to students, no matter where they are currently located. A current research topic is pedagogic profiling (Becking et al., 2004), which basically aims to match mobile Learning Resources with learners’ current needs. To achieve this, the learning management system controlling the delivery of content is assumed to maintain context sensitive information about the mobile learner herself and her current situation. This includes technical and didactic profile information. The former refers to infrastructure-related prerequisites in the current mobile learning setting such as available bandwidth, protocols and transfer rate of networks, the type of mobile device in use (PDA, smart phone, cell phone) and features of the end-user-device including size of the display, resolution, storage space, memory, type of browser and input device. Non-technical attributes, which are typically related to pedagogic dimensions of mobile learning, address a learner's qualifications and requirements, learning objectives, preferred method of teaching, communication and collaboration settings, and a learner’s progress and learning portfolio. Pedagogic profiles together with technical profiles will operate as a filtering mechanism for mobile learning settings and provide the learner with a personalized access to suitable didactic resources, due to the given circumstances and prerequisites.

We will observe the outcomes of these projects and adapt and apply them to our own needs, if useful. We will also continue the testing of our PDA and mobile phone based solutions and we will evaluate the podcasting approach with future generations of students to gain a deeper insight into more and less useful m-learning applications.

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