MobiDics: Cooperative Mobile E-Learning for Teachers

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ABSTRACT

We report on *MobiDics*, a mobile learning platform for professors, lecturers and tutors. In a survey with 100+ participants, we revealed that young, inexperienced teaching personnel at universities rarely use specific didactic methods to plan and structure courses. Such methods play an important role in learning processes since they, for example, activate students and contribute to more profound and sustainable learning experiences. Based on learning phases and social forms, *MobiDics* is able to suggest didactic methods that are adequate to a specific teaching situation. Parameters such as class size, teaching tool support, room constraints, etc. can additionally be incorporated. Learning settings can thereby be formalized and reconstructed based on the building blocks in form of didactic methods.

MobiDics encourages and supports the targeted use of didactic concepts with the long-term goal of increasing the quality of university education. A particular focus lies on cooperative learning through community-based features. Users report on their experiences how well certain methods worked by a commenting function, and exchange tips and feedback with peers and experts. While user-generated content can comfortably be added through the web frontend, a mobile application allows dynamic adaption of didactic planning to contextual conditions such as the current lecture hall.

In a two-step evaluation, *MobiDics* was adopted positively in the target group and its features highly appreciated. Our results motivate a further long-term study where we will evaluate *MobiDics* in the field.

Author Keywords

E-learning, m-learning, didactic toolbox, academic, teacher support

INTRODUCTION AND MOTIVATION

Computer-supported learning (e-learning) is meanwhile an established component in school and university teaching, and used as a complement to traditional, “offline” learning. Such combinations are referred to as *blended* or *hybrid* learning (Martyn, 2003). The risk is, however, that educational games, e-learning and simulations in learning contexts replace a didactically grounded course preparation (Glusac et al, 2007). Teachers still need a profound didactic knowledge to develop learning concepts and to structure their courses, be it offline, online or any combination of them (Ramsden, 2003).

In many countries, university courses are not held by dedicated, full-time lecturers, but by associates without explicit didactic education or PhD students (Winteler, 2001). Such personnel often have little teaching experience and often a limited didactic knowledge, which was confirmed by the results from a survey we conducted with more than 100 people involved in university teaching. We therefore argue for increased awareness for didactically profound course preparation, and for tools that provide teachers with the necessary didactic knowledge to manage this task.

We address this problem with *MobiDics* (“Mobile Didactics”), “a didactics toolbox for the pocket”. *MobiDics* is a mobile e-learning platform aiming at university teaching personnel. Both available mobile learning apps on the market and currently ongoing research focus mainly on learners, i.e. students. With our work, we address teachers and lecturers at universities. Based on the knowledge they acquire when using our system, they can improve their lessons, from which, in turn, the students benefit. Of course, teachers in that context can be seen as learners as well. The system encourages the use of didactic methods, adapted to a particular teaching situation. It thus goes not towards blended or online learning like other student e-learning platforms, but explicitly focuses on improving learning in classic classroom settings. We see our tool as a connecting link between mobile e-learning systems and traditional offline learning.

In this paper, we report on our development of the *MobiDics* platform, consisting of a server, a web application and a mobile application for the smartphone. We outline the state of the art in mobile learning and motivate our system by results of an online survey we conducted with professors, lecturers, PhD students and didactic professionals. We gained insights about information sources for lecture preparation and associated problems. Afterwards, we present our *MobiDics* system and describe its features and implementation. The last part discusses evaluation results and future work.

SURVEY OF DEMAND

In order to lay the basis for target-oriented development of mobile learning applications, we conducted an online survey with 103 people involved in university teaching – mainly PhD students (43%), lecturers, professors, etc. (Möller et al., 2011b). Our goal was the assessment of demand for tools supporting them in course preparation. We also evaluated general smartphone usage in the target group to find out whether a mobile application has the potential of being applied. Data on that specific group had so far not been available. Furthermore, we asked for their problems with lecture preparation, consideration of didactic methods, and whether people were satisfied with their current lecture preparation from a didactic point of view.

Method and Participants

The survey was conducted using an online questionnaire. Participants were recruited from didactics courses at the Centre for Higher Education associated with our university (Carl-von-Linde-Akademie). 53 participants were female, 50 were male; the average age was 32.9 years (standard deviation=8.8).

Results and Implications

92% of the survey participants are smartphone owners and use it regularly. After email (92%), information search was the second most widely performed activity on the smartphone (79% of smartphone users). These numbers show that the technical basis for mobile didactics (smartphone coverage) is available in the target group. They also indicate that the smartphone usage for information research and consumption (thereby also potentially on didactics), seems adequate for the target group. Asked about their course preparation, a considerable number of subjects stated in the free text answer field that they rarely used specific didactic methods. We identified the following main reasons for spare usage of didactic methods based on subjects' answers:

- They miss substantiated knowledge about which didactic methods exist
- Subjects have too little experience in teaching and the appropriate use of didactic methods
- The preparation time for courses and lectures is limited, especially for active researchers besides teaching
- They lack feedback on the success of didactic methods; course preparation becomes a cost-benefit calculation (how much time to elaborate a new concept is it worth, if the benefit is unknown?)

Currently, teachers gather information about didactic methods through the internet, books, colleagues and advanced training courses. With *MobiDics*, we address the problems identified in the survey, as it provides the educational background of didactic methods, suggestions tailored to personal teaching needs, and feedback about successful methods usage from other lecturers, as well as from professionals (see also Möller et al., 2011b). The fact that especially young people are potential *MobiDics* users adds to the long-lasting impact of our system.

BACKGROUND

Computer-supported learning (e-learning) has become mature (for an overview of technologies sees e.g. Zhang et al, 2003) and has moved from research labs to the field, e.g. the Moodle e-learning platform (Moodle, 2012). Learning on mobile devices is recently explored more extensively with the rise of tablets, handhelds and smartphones. Thereby the new field of m-learning is defined (Sharples, 2000; Tatar et al., 2003). Those devices allow using learning materials on the go, such as lecture notes in PDF format or podcasts. They facilitate time- and location-independent learning, e.g. on journeys or outdoors. Infrastructures like iTunes U[1] facilitate the distribution and download of digital educational resources or even complete online courses. Beyond that, digital market places, such as the Apple App Store or Google Play (formerly Android Market), offer apps that are targeted at specific learning tasks and contexts. They range goes from vocabulary trainers to simulations and educational games. Mobile learning applications are also suitable for experience-based learning in mobile contexts, e.g. in the medical area (Sharples, 2000; Holzinger et al., 2005), apprenticeships (Tatar et al., 2003), and they can be used for lifelong learning (Pham-Nguyen et al., 2008). Besides offline learning and conventional e-learning, mobile learning is an additional way of accessing resources and acquiring knowledge. This is supported by the possibility of the mobile app to suggest didactic methods e.g. based on user preferences or user or lecture context, such as the configuration of the lecture room. This information can e.g. be retrieved from a university campus information system based on device positioning using e.g. WLAN signals indoors (Kranz, 2010). Its increased flexibility in time and location opens up new learning scenarios, in which traditional e-learning material is not or only in a limited way accessible.

MLE (Mobile Learning Engine) is an extension of Moodle for mobile devices (Holzinger et al., 2005). The original Moodle system[2], which is meanwhile quite established as e-learning platform on many universities, offers online e-tests and learning units as complement to traditional courses. In MLE, so-called MILOs (Mobile Interactive Learning Objects)

[1] Apple. iTunes U. http://www.apple.com/education/itunes-u/. Last visited May 24, 2012.

[2] Moodle. http://www.moodle.org. Last visited May 28, 2012.

adapts this functionality for mobile devices. MILOs contain small pieces of information, e.g. text, images, questions or multimedia elements. This chunk structure shall foster explorative learning where the learner can choose the amount and order of units. In addition, interrupting and continuing learning, which is typical for mobile settings, is better supported. Self-organization of learning content is seen as an additional motivational factor. However, the lack of a predefined learning path makes the system probably not appropriate for beginners. A further extension of this system are XLOs (X-Media Learning Objects), which make the learning content accessible on a greater variety of devices, e.g. MP3 players, PDAs or TVs (Holzinger et al, 2006). They thereby transport the idea of "pervasive learning": learning can take place at every location at every time, and content is seamlessly accessible over heterogeneous devices.

The heterogeneity of learning tools not only comprises their size (from the small smartphone to the large television set), but also the involved senses. Multimodal learning includes more than one single information channel; it combines e.g. vision, sound and haptic experience. The learning process thereby becomes more sustained, but also more playful, which increases fun while learning (Holleis et al., 2006, Vodvarsky et al., 2007, Leichtenstern et al., 2007). Such multimodal learning systems can be created by enhancing physical objects with digital technology and thereby combining them with the advantages of e-learning. These so-called "smart" or "tangible" objects allow situational and playful learning by experimentation. An Example is the SensorVirrig (Schmidt, 2004), a cushion with integrated ball switches, a compass and a pressure sensor, that can be used to control objects in learning games, or the display cube (Terrenghi et al., 2006) as a playful interaction device for kids. Besides "pervasive learning" at home or other places, such smart objects could also be used at schools or universities and enhance traditional lessons.

Existing e-learning and m-learning systems focus on tools, but not on the methodology of learning concepts that are appropriate from a didactic point of view. Hence, existing didactic knowledge is required for using these tools. Information on the didactic background of tool support, course structuring and knowledge transfer can be found online in form of wikis or training videos. However, to our knowledge no e-learning or m-learning tool includes didactic background knowledge for university education.

MOBIDICS – A MOBILE DIDACTICS TOOLBOX

MobiDics supports the preparation, structuration and execution of university courses on mobile platforms. It is thereby an e-learning/m-learning system targeted at people involved in teaching, with the goal of increasing satisfaction with teachers and improving the quality of education (Möller et al., 2011a; Möller et al., 2011b). We here report on our iterative design of the initial prototype we have presented in our previous work. In the following, we will describe the didactic content, functionality and implementation of *MobiDics*.

Didactic Methods

The learning content in *MobiDics* consists of a collection of didactic methods, which represent a classic link between didactic background concepts and the formulated educational goals in class. Well-considered use of specific didactic methods plays an important role in learning processes (Light et al., 2009; Ramsden, 2003). Such methods can, for example, activate students and contribute to more profound and sustainable learning experiences (Fink, 2003). At the university, where lessons and individual units are often longer and comprise more content than at schools, didactic methods have high relevance. They can support individual learning phases (e.g. knowledge transfer, repetition, assurance of understanding) and thus increase the effectiveness of university education.

The methods we consider have been provided by PROFiL[3], Sprachraum[4] and the Centre for Learning and Teaching in Higher Education (Carl-von-Linde-Akademie/ProLehre[5]) which are professional training institutions at Technische Universität München and Ludwig-Maximilians-Universität Munich. The *MobiDics* database currently contains about 50 didactic methods and is continuously growing.

Learning goals at the university often have a cognitive character. In order to apply the acquired knowledge, often additional social and affective goals are required (Fink, 2003). In *MobiDics*, didactic methods are organized based on ARIVA, a classification that supports multiple of these goals. The scheme has been developed at TU Zurich (Kiel, 2008, p. 30ff) and classifies didactic methods according to the learning phase it which they can be applied. The ARIVA scheme comprises five phases:

- Alignment: Introduction and motivation of the learning content, creation of attention, match with the learner's world and experiences
- Reactivation: Activation of previous knowledge to provide a link for embedding the new learning content
- Information: Active or passive knowledge acquisition, conveying of the learning content

[3] http://www.profil.uni-muenchen.de. Last visited May 24, 2012.

[4] http://www.sprachraum.lmu.de.Last visited May 24, 2012.

[5] http://www.cvl-a.de.Last visited May 24, 2012.

- Processing: Deeper, more extensive and reflective processing of the content, e.g. by answering additional questions, integrating the learned content in larger contexts
- Analysis: Rehearsal of the learned content, answering of open questions that might have occurred in the processing phase, meta-analysis of the learning methodology.

In *MobiDics*, we combine these phases with different social forms, such as work in pairs, small groups of three/four/five people, discussion in the plenum (entire class), or didactic teaching (class is listening). The result is a two-dimensional matrix for method classification, e.g. group work methods suitable for the reactivation phase, or plenum methods for the analysis phase. Since each method already incorporates an educational goal through this classification, teachers can use them to create learning situations that are appropriate for their needs. At the same time, they create a sustained learning experience, as all methods are didactically well founded. Since methods also incorporate the form of cooperation of lecturer and students, as well as of students between each other, changes between social forms (e.g. alternating plenum and group work phases) support the maintenance of attention over longer periods of time. Learning settings can thereby be formalized along the structured dimensions of social form and learning phase, and can be reconstructed based on the building blocks in form of didactic methods.

Functionality

The features in *MobiDics* follow the four paradigms of *Everywhere Use, Better Understanding, Context Sensitivity* and *Pervasive Cooperation* (Möller et al, 2011a). In more detail, the system supports the features described in the following.

Method Management

The entire catalogue of didactic methods can be browsed by name, ratings, actuality, and frequency of use or relevance. Relevance is hereby calculated from both the number and recency of method access (similar to auto-complete suggestions in the browser address bar). The rankings do not only contain own usage statistics, but also incorporate data from other *MobiDics* users, so that users can see what methods are popular with peers. Methods can be rated and marked as favorites, so that every user can create their own collection of personally valuable methods for their own courses.

The didactic methods are available on the *MobiDics* server and synchronize with the client application. The entire content is, after the first synchronization, also available locally and without active internet connection. This enables the entirely mobile use of the system also at areas without connectivity. All local changes are synchronized the next time when a connection is available, either WLAN or UMTS, based on the user's preferences.

Didactic methods comprise extensive descriptions of their appropriate and correct execution. They include examples and ideas for the practical implementation of the method "model", tips from didactic experts and potential problems (e.g. what to do when students are not participating as intended). Besides the initial organization along the dimensions of social form and learning phase according to the ARIVA scheme, each didactic method contains information on the ideal group size (is it suitable for larger lectures with 300 participants or only for smaller lab courses with 10 students?), the expected time needed, material that is required or optional (e.g. a flip chart, paper, a ball) and more. All this information is organized in searchable fields, enabling to perform very detailed searches using logical operators (AND, OR, NOT) and quantifiers (more than, less than). For example, it is easy to find methods for the reactivation phase, applicable for courses with more than 50 students that do not take more than 20 minutes.

Explanations

The usage of e-learning to communicate didactic methods enables a new level of explanations. Group work and games can be illustrated with animations and videos. Self-learning phases or group phases involving varying constellations of students can be simulated and evaluated on the device. *MobiDics* therefore contains a "gallery mode" in which multimedia elements (images, videos, animations) as enhancements for the selected didactic method are available. Methods can additionally link to external resources such as Flash applications or interactive simulations to allow further look into the matter.

Collaborative Learning and Exchange of Experience

Collaborative learning has been proven as effective in the "real world", but is not yet naturally included in e-learning applications. We believe that learning from the experience of others is a central factor of learning success. The big advantage of e-learning is the simplicity to find people with similar interests or level of knowledge out of a large user basis, compared to a class where students often have different previous knowledge (especially in professional education). This is why we included a number of collaborative features to *MobiDics*, such as a community feature for peer exchange.

Users can share their own didactic methods and add them as new entries to the system. This user-generated content is then browseable and searchable just as the editorial content. The only difference is a small symbol that allows other users to identify such methods as user-generated content, since the quality and didactic success cannot be guaranteed. Still, we did not want to implement a quality control instance in form of an editorial team that continuously filters and checks new submissions before making them publicly available. The idea behind *MobiDics* is an platform to which every interested and committed person can contribute, be it the senior professor or the student tutor with only one year of experience.

Instead, we included a rating system that allows users to evaluate the quality of user-generated content themselves. A didactic method can receive a rating from 1 to 5 stars, which also influences the method order in the main screen when the sorting by rating is enabled. The rating is also used for the order of search results when methods would otherwise have the same level of adequacy. User ratings are thereby a democratic, implicit method of "pushing" qualitatively high content to users.

Besides overall quality control, ratings have the function of determining the adequacy of methods for specific subjects and disciplines. Teachers will rate methods better when they used them successfully in their courses. Sure enough, people will rate methods not objectively, but according to their own perceived utility: A certain didactic method that is suitable for a social science seminar might not be appropriate for a math tutorial. A method suitable for a 20-person lab course might not be applicable in a computer science freshman lecture with 500 students. As a consequence, the social scientist will rate methods differently than the mathematician and the lab course tutor differently than the professor.

We see this subjectivity of ratings as an additional chance for *MobiDics*. The old problem of learning didactic methods with books is that they are generic. In particular less experienced tutors will be uncertain whether a described method is actually applicable for their subject and teaching situation. *MobiDics* partly solves this problem already with the filter search, which allows limiting method choices to learning settings, such as "lab course with less than 20 participants". Ratings in combination with a search filter on disciplines now even allow verifying the adequacy for one's own subject: All users who rate a method have a user profile in which they specified their discipline. That way, *MobiDics* can use statistical information on ratings to find out the amount of ratings of a certain subject, faculty, or scientific direction (e.g. life sciences, engineering, and social sciences). The information that most people who rated a didactic method with more than 3 stars were engineers tells with certain reliability that this didactic method is suitable for engineering courses.

As an additional step on top of the user-generated content and rating system, we added a function for commenting methods. Besides the anonymous, fixed-scale ratings, users can report on their experiences with a specific method in detail using a free text field. This opens up the space for discussion and exchange. Teachers can not only describe the effectiveness of a method in a specific context of use, but also directly address problems and potential solutions. The feedback of colleagues and peers can likewise bear great potential, since they have probably experienced similar problems in their own courses and can now share their advice. Last but not least, didactic professionals can hook into the discussion and provide their professional view or provide additional tips and tricks. Users can reply on particular comments, creating a nested structure similar to a discussion board. Comments can, again, be rated with "thumbs up" or "thumbs down" symbol. The ratings can help users to quickly estimate how the quality of a comment was perceived by other users. Besides sorting comments by date, ratings can be used to show high-quality comments on top.

Besides the public sharing of methods, users can also decide to keep their newly added methods private. This allows using *MobiDics* as a personal, privacy-sensitive, readily available toolbox of methods with all advantages of digital search and presence in the pocket.

Context-Sensitive Integration in Teaching and Learning Environments

With *MobiDics*, the user can quickly react on context-specific conditions, such as the room size and equipment. In case of unexpected changes of the room or broken or missing equipment, didactic concepts might have to be revised. For example, the prepared didactic method could require a whiteboard, which is not available in the current lecture hall. The search function in *MobiDics* allows dynamic re-planning of methodical concepts based on the room context.

MobiDics also supports the integration in existing teaching and learning environments such as room management and reservation systems (e.g. TUMOnline[6] at our university). Such databases contain information on room sizes, equipment (e.g. whether chairs can be moved around for group work or whether the room has fixed rows), as well as lecture plans (when does which lecture take place in which room). By an interface to this database, *MobiDics* can dynamically adapt its content to the available facilities for a planned lecture and context-sensitively react on e.g. room changes. Moreover, *MobiDics* can retrieve a location estimate from the phone platform's location provider, so that it can be coupled with an indoor localization service or other location providers implemented on the smartphone.

Multilingualism

MobiDics is designed to support multiple languages seamlessly within one system. The need for multiple languages emerges not only from the fact that many universities offer courses in different languages (e.g. German and English at our university), but also because didactic content is managed best in the original language it has been developed for. Wordings and concepts are often difficult to translate and known under their original terms in the didactic community.

MobiDics users maintain a list of their preferred languages that determines the order in which multilingual content is selected and presented in the user interface. Let's assume a user's preference list is "English, German, Spanish". In that case, for a method available in English and German, the English translation would show up, while a method available in German and Spanish would show up in German. A method only available in French would not be listed at all. Users can

[6] https://campus.tum.de/tumonline

add translations to methods by selecting a language in which the method is not described yet. Numeric fields (such as group size, estimated time, etc.) are automatically copied to the new language, only the translations of the textual fields have to be added.

User Management

Every user of *MobiDics* creates an account with a nick name and additional optional information, such as age, profession (PhD student, tutor, professor, lecturer, …), discipline, courses teaching, experience, etc. This additional information is helpful for estimating the relevance of a user's contribution in search queries. For example, the profession of a user who rated a method can be an indicator for the appropriateness in one's own course, or the comment of an experienced professor might be especially valuable. Users can choose which fields are publicly visible to others to keep their desired level of privacy. This shall encourage e.g. newly appointed faculty members to use the app without the colleagues knowing this and thereby lower the border to use didactic methods in their lectures.

Implementation

The *MobiDics* infrastructure consists of a server, a web interface and a mobile client application, which are illustrated in Figure 1.

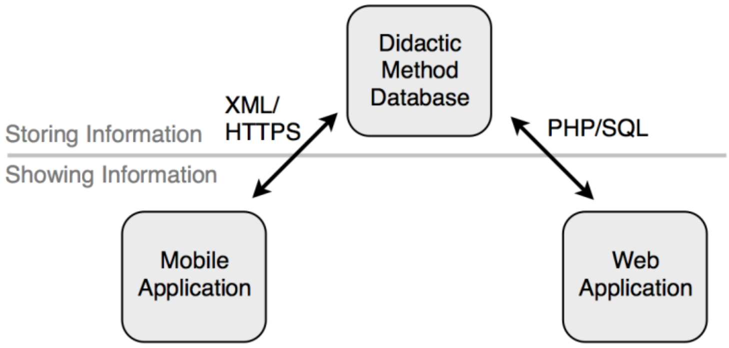

Figure 1. A schematic overview of the MobiDics infrastructure. MobiDics consists of a mobile Android application and a web application, which both synchronize with the database of didactic methods in the background.

Server

A SQL database holds all methods that are currently available to the system and manages their appearance on user's devices based on language flags and access control information. With SQL queries, even complex searches with multiple conditions can be performed quickly in a large amount of data. The server also manages the user account system. Each time a user starts the local *MobiDics* application or logs into the web interface, she is authenticated with the server and potential changes are synchronized. Synchronization works in two directions: both new methods and comments are downloaded to the client, and local changes are uploaded to the server and delivered to other users. When the client application is used offline, the last synchronized state is used (a previous authentication must however have been successful to prevent unauthorized access). Changes are then transmitted on the next login. A XML-based data format is used to exchange information with the server and the mobile application. For all traffic between clients and the server a secure connection is used.

Client

The client application is programmed in Android, thereby supporting a wide variety and a large heterogeneity of devices (smartphones, tablets of different sizes). The user interface is automatically adapted to different screen sizes and ratios for optimal use of the available space. The client implements the platform-typical interaction paradigms such as gesture-based navigation (using a swipe to switch between methods), pinch to zoom, context-sensitive action bar menus etc. for a quick learning curve when interacting with the application and "feeling at home". An incremental search shows results already while typing. Besides automatic content update through synchronization, also the application itself is updated automatically so that entirely new features can be added. The screenshots in Figure 2 illustrate the user interface.

Web Application

The entire functionality of *MobiDics* is also available in a web application implemented with AJAX. The interface available in the browser allows a more comfortable navigation in non-mobile settings, e.g. in the office or at home, and provides more screen space. It is also the convenient way to enter longer portions of text, e.g. for commenting on methods or uploading own content. The web application communicates with the database using PHP and SQL.

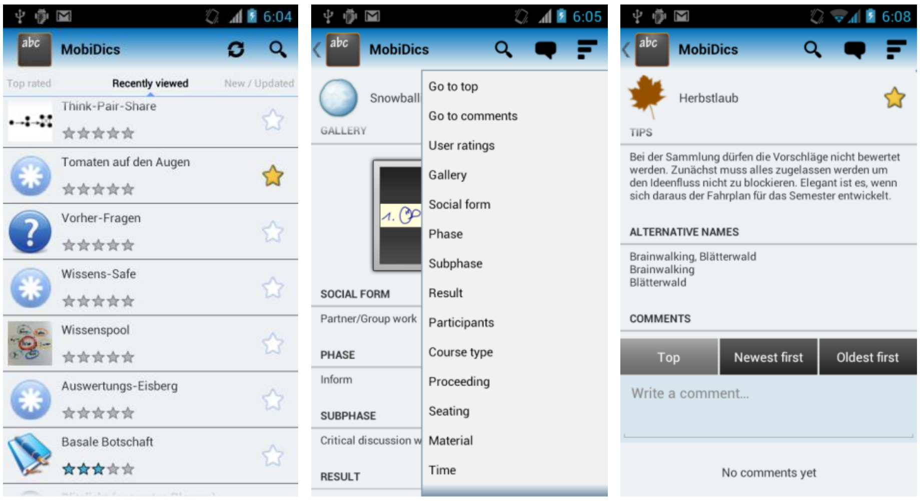

Figure 2: Screenshots of the mobile application. Left: The main menu of didactic methods, sorted by "recently viewed". Middle: The method description view with jump list to different sections. Right: The commenting function for methods.

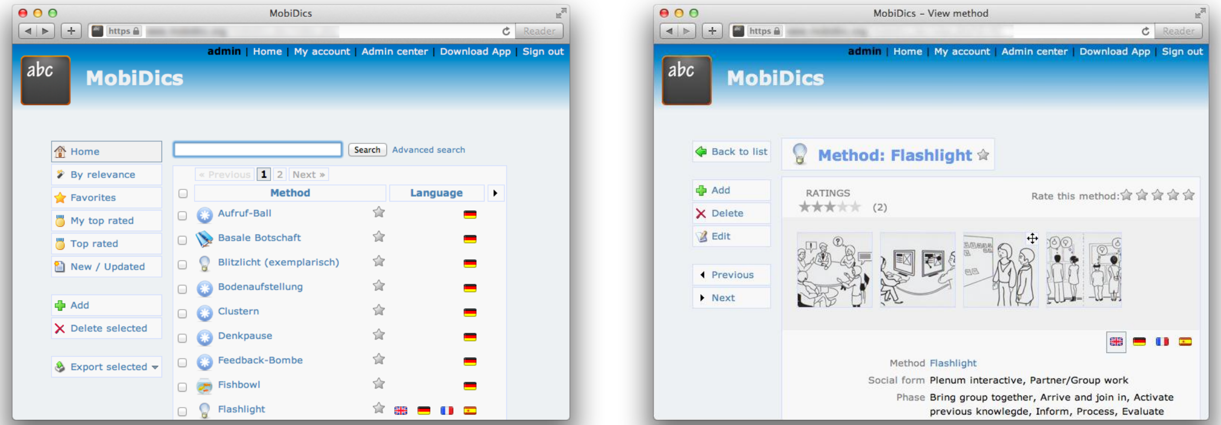

Figure 3: Screenshots of the web interface. Left: The main menu of didactic methods (with language indicators). Right: the detailed description page of a method with multimedia content, such as images or sketches..

DISCUSSION AND FUTURE WORK

We evaluated *MobiDics* in a two-step process. An initial prototype was evaluated online based on a video review (Möller et al., 2011a). We used this assessment for first feedback and estimation whether users would adopt the system. From the 103 users who saw the video demonstration and owned a smartphone, 51% declared that they would use *MobiDics* themselves "likely" or "very likely". Asked for most appealing features, people named the criteria-based search (92%), illustrative multimedia examples (80%) and expert knowledge (63%). People here mentioned particularly features that are not available in traditional information sources. In a second step, the subsequent iteration of the system (as described in this paper) was informally evaluated by a group of users from the target group. Here, particularly the rating function and the ability to comment methods and contributions of others were highly appreciated.

We are aware that *MobiDics* lives from its users and their social interaction within the system. In future work, we are planning to conduct a long-term evaluation in the field. Observations and user feedback how the interactive tools of *MobiDics* (ratings, discussions, new method contributions) are used will hopefully help us to adjust the system to users' needs. In particular, we strive to understand which learning processes *MobiDics* sets in motion through synergies and collaboration between peers. We are also interested in quantitative measurements of improvements of teachers' satisfaction. Another scientific goal is a theoretical formalization of how didactic methods can be classified. The present version of *MobiDics* already integrates alternative names for methods. In the next step, differently described but similar methods should be matched to one and the same method entry (comparable to an alias). Subsequently, we aim to generalize this problem and deduce similarity models for methods, which could then better be matched with the user's profile and interests.

We plan to conduct a long-term study with a larger number of people from different disciplines to gather more insights on the usage and acceptance of the current prototype and to identify future improvements for a release of *MobiDics*.

ACKNOWLEDGMENTS
We would like to thank our student Yeray García Quintana for his work on the implementation and the institutions *Carl-von-Linde-Akademie/ProLehre* from Technische Universität München, *PROFiL* and *Sprachraum* from Ludwig-Maximilians-Universität for their valuable support as well as all study participants and software testers for their feedback.

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