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Procedia - Social and Behavioral Sciences 182 (2015) 613 – 618

Procedia
Social and Behavioral Sciences

4th WORLD CONFERENCE ON EDUCATIONAL TECHNOLOGY RESEARCHES, WCETR-2014

A comprehensive set of mobile services supporting education process

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Abstract

Nowadays many universities are using Internet and mobile services to support various activities in education process. However, these services often provide incomplete functionality and are not connected to each other. To address this problem, the paper overviews existing services and requests from students and academic staff members and proposes requirements for a new system. Based on the analysis, the paper proposes a comprehensive set of seven mobile services: attendance monitoring, performance monitoring, timetable management, interactive teaching, testing and exams, course materials, distribution of course tasks and group work. The paper presents architecture of the system based on Mobile Device Management followed by a description of mobile services' functionality.

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Peer-review under responsibility of Academic World Research and Education Center.

Keywords: Mobile Device Management, Mobile Services, Education Process

1. Intoduction

Nowadays mobile applications are actively used for different purposes in education, such as organization and management of education process, remote access to information resources and services, as well as solving other information and education tasks (Ivanchenko, Popov, & Khmelkov, 2013; Samochadin, Raychuk, Voinov, et al., 2014)(Alzaza & Yaakub, 2011; Mtega, Bernard, Msungu, & Sanare, 2012). One of the main directions is using

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Peer-review under responsibility of Academic World Research and Education Center.
doi:10.1016/j.sbspro.2015.04.793

electronic tools to support education process. For example, tools to support learning activities, such as lectures, workshops and classes in laboratories, course works, exams, as well as support for tasks relevant for the whole education process, such as timetables management and students' performance monitoring. Many of world leading universities actively use some of these tools (mainly timetable management, performance monitoring, and interactive teaching tools) and report that these tools increase the productivity of learning process (Ivanchenko, Popov, & Khmelkov, 2013;Samochadin, Raychuk, Voinov, et al., 2014;Alzaza & Yaakub, 2011). For example, mobile and e-learning services are provided in the following universities: Massachusetts Institute of Technology, Stanford University, Harvard University, Oakland University, University of Leeds, University at Buffalo. However, in most of the cases these tools are isolated from each other, i.e., they do not provide a comprehensive solution to support the education process (Samochadin, Raychuk, Voinov, et al., 2014). In some universities in developing countries, mobile services are considered to be one of the most effective means to improve education level (Mtega, Bernard, Msungu, & Sanare, 2012;Valk, Rashid, & Elder, 2010).

Mobile services in education are also an active topic in research. Several recent papers discuss use of mobile learning services in higher education (Alzaza & Yaakub, 2011;Mtega, Bernard, Msungu, & Sanare, 2012). In (Alzaza & Yaakub, 2011), authors discuss a concept of m-learning, i.e., e-learning using mobile devices. Based on a study where students ranked different services, they conclude about the most popular services and the most important concerns. They discuss requirements and limitations of m-learning and claim that this approach will become more popular in future. In (Mtega, Bernard, Msungu, & Sanare, 2012), authors conducted a survey of staff and students to study how mobile services facilitate higher education processes.

Organizations working in education domain in Russia still have rather limited experience in using mobile technologies in education (Alzaza & Yaakub, 2011). However, there is an interest and possibility to use these technologies. According to the studies conducted in Russian universities (Samochadin, Raychuk, Voinov, et al., 2014; Alzaza & Yaakub, 2011), both students and academic staff members have reported that they are interested to use mobile technologies in education process.

According to the survey conducted by «IBS» and Russian Public Opinion Research Center (VTsIOM) in nine Russian federal universities, 95% of academic stuff and 99% of students use mobile devices with Internet access. 100% of them are ready to use various mobile applications for education. At the same time, they consider that the most essential services (94% of academic stuff, 72% of students) are tools supporting education process; slightly less popular (73% of academic stuff, 52% of students) are tools to access various information resources.

A more detailed survey was conducted in Saint Petersburg State Polytechnic University (Samochadin, Raychuk, Voinov, et al., 2014) to investigate what kind of supporting services are requested by students and academics. Participants especially valued notifications about changes in timetable (97%), mobile support for tests and examinations (97%), and interactive teaching tools (68%). Academic staff members also requested services supporting attendance and performance monitoring.

2. A structure of a system supporting education process

We have analyzed existing services provided by foreign universities as well as information about mobile services requested by students and academic staff members in Russian Universities. Based on the analysis, we propose the following list of basic features the system should support:

- Access to information about timetable, changes in timetable, various events
- Access to information about organizational procedures
- Interactive teaching tools
- Support for surveys, tests, and exams
- Distribution of tasks among students, group work support
- Support for certification committee work
- Student attendance monitoring
- Student performance monitoring

These features are highly interconnected with each other, thus it is not possible to support them with a set of isolated applications. For example, attendance monitoring requires up-to-date information about timetable and its changes. Student performance monitoring is not possible without information about attendance and results of tests and exams.

Also, according to the surveys described above, both students and academic staff members would like to use services supporting education process from their personal mobile devices. This leads to additional requirements related to secure access to internal university information and resources from personal mobile devices.

Based on the above, we formulated the following primary requirements for the architecture of the system that provides services supporting education process:

- Centralized data storage that supports all required data
- Secure access to internal information from personal mobile devices (for major platforms, including Android, iOS, Windows Phone)
- User access rights management for data and applications
- Possibility to customize password policy, such as restrictions on the use of applications and resources for specific groups, users, devices
- Remote distribution and update of applications

In order to meet these requirements, we propose to use centralized Mobile Device Management system (MDM), which is a promising approach for mobile technologies in education (Emery, 2012). MDM provides secure access to internal information resources and management of software distribution, policy, security, and services being provided (Gartner, 2013). We suggest architecture of a system which consists of a set of mobile applications and a centralized mobile device management system.

3. System Architecture

The system includes three main parts (see Fig.1):

- A set of mobile applications that support education process
- Centralized mobile device management system (MDM)
- Enterprise system

MDM supports inter-communication between applications and enterprise system of an educational institution. The enterprise system includes various existing administration systems used in the university. It contains the information needed for mobile applications (student and employee register, timetables, course materials etc.). This information is produced both by existing enterprise applications as well as mobile applications themselves.

The system uses the following data from the enterprise system:

- *Curriculum*, including study programs, disciplines, lesson types, evaluation types;
- *Disciplines*, including learning materials for lectures, practical lessons, workshops, coursework, etc., as well as ready-to-use questions for surveys, tests, and exams;
- *Teachers*, including general information and information about lessons and activities
- *Groups*, and group members;
- *Students*, including general information, information about attendance and results of tests, surveys, exams, etc.;
- *Classrooms*, including information about the location and equipment
- *Timetable*, including information about groups, disciplines, teachers, lesson types and locations.

Applications communicate with the enterprise system through MDM, which ensures that the access from mobile devices is secure. MDM allows to remotely deploy applications on a mobile device automatically depending on a

user's groups and rights. Groups, such as student groups and teacher groups, are maintained in the enterprise system. In addition, MDM allows to monitor if a mobile device is connected to the system at the moment, e.g., whether a user is receiving required information. Application's functionality can vary for different groups of users, e.g., for teachers and students.

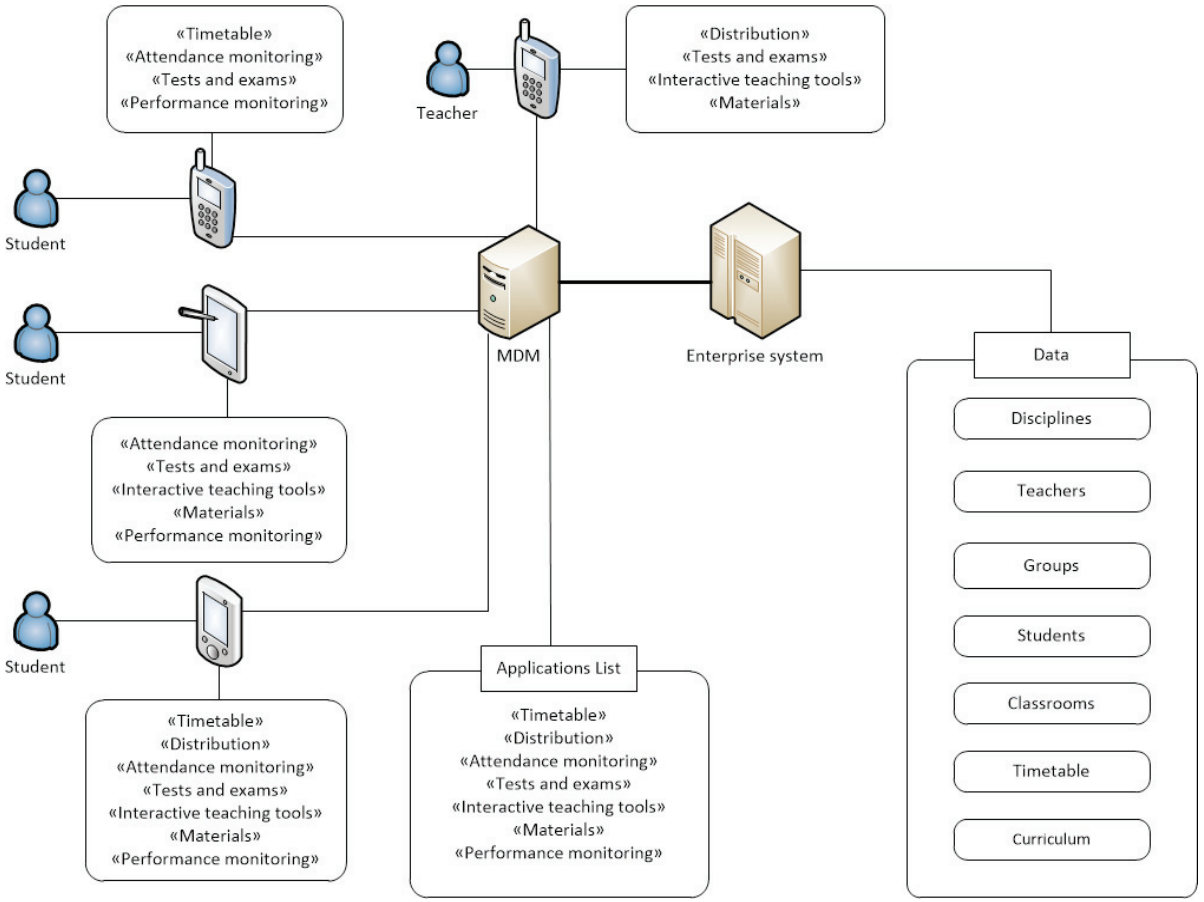

Fig. 1. Architecture of the system

To meet the requirements described above, we suggest the following set of mobile applications:

- *«Timetable»*
- *«Distribution»*
- «Attendance monitoring»
- «Tests and exams»
- «Interactive teaching tools»
- «Materials»
- «Performance monitoring»

3.1. «Timetable»

This application provides up-to-date information about timetable and various events to students, teachers, and administration staff. In case if timetable is changed, all related users (e.g., members of a group, participants of the course, etc.) are notified. In addition, teachers and administration staff can also add changes to the timetable using a mobile device (e.g., change location or time when lessons are organized, or add a substitute teacher).

3.2. «Distribution of tasks and group work»

This application supports student group work. It allows to organize students into groups according to the policies defined by a teacher, distribute tasks, and monitor work progress. A student could look through topics and tasks available to select the one he/she is interested in and sign up for it. A student can also enroll to be a part of study group for a workshop, etc. Using this application, teachers can review and edit enrollments and generated group lists.

3.3. «Attendance monitoring»

This application allows to monitor student presence at lessons, such as lectures, seminars, and workshops. The application uses information from the enterprise system about timetable and group members, as well as information about equipment available in the classroom. Depending on the equipment, the application selects the specific technology that will be used for attendance control. Possible technologies are QR-codes, Bluetooth, Wi-Fi, NFC (Bhalla, Singla, Gahlot, & Gupta, 2013; Masalha & Hirzallah, 2014; More & Nayak, 2013; Ayu & Ahmad, 2014). Results are saved in the enterprise system. The application provides real-time progress report about the attendance monitoring process as well as aggregated history information about the attendance.

Using the application, students can register for the current class and check history information about classes they participated and missed. Teachers can perform the following tasks: open and close registration for the class, review and edit registration results, review aggregated attendance information for the past classes and events, review aggregated attendance information for particular groups and students.

3.4. «Tests and exams»

This application provides information about tests and exams. Students can check information about upcoming tests and exams in the current semester and in general in curricula according to their study plan. They can also check their results for the past test and exams. Teachers can also see history information about past tests and exams, both aggregated and specific for a particular student. In addition, using this application teachers can add information about results of tests and exams.

3.5. «Interactive teaching»

This application supports interactive teaching and communication between teachers and audience, such as in-class surveys and tests. Materials for surveys and tests can be retrieved from the enterprise system or added by the teacher in the class; results are saved to the enterprise system. The application supports real-time monitoring of the answers as well as access to the aggregated history information about the results.

Using the application, students can participate in a survey and check its results. In addition, teachers can view list of available surveys and their content, start and close a survey, and check history information about survey results.

3.6. «Learning materials»

This application allows students to access learning materials, which are published by the teachers in the enterprise system. The application makes it easier to access the materials and distribute them among student groups.

3.7. «Performance monitoring»

This application calculates performance indexes using data about attendance, results of tests, exams, etc. received from the enterprise system. A course teacher defines rules used to evaluate execution of a course work, while overall performance indexes are calculated according to common rules defined by administrative staff members. This allows calculating performance indexes in real time and publishing them for both students and teachers. In addition, it is possible to send notifications when there are delays in execution of the study plan.

Using the application, students can access information about own performance indexes, rules used to calculate them, and existing issues. Teachers can view performance indexes both for specific students and aggregated by subjects or student groups.

4. Conclusions and future work

This paper addresses the problem of isolated and incomplete services used in universities to support various tasks in education process. To solve the problem, the paper analyses existing solutions and demands of students and academic staff members. Based on the analysis, the paper proposes a comprehensive set of seven mobile services and describes their functionality. The paper presents an architecture of the system based on centralized Mobile Device Management (MDM) concept, which allows to securely use students' and teachers' personal mobile devices to access the services.

We have implemented the first version of the system. At the moment, we are planning a trial study in Saint-Petersburg Polytechnic University. We aim to investigate the effectiveness of the system in education process and collect requirements for further development.

Acknowledgements

This research is a part of the joint project by IBS (Moscow, Russia) and St. Petersburg State Polytechnic University (St. Petersburg, Russia). This work is financially supported by the Ministry of Education and Science of the Russian Federation (state contract № 02.G25.31.0024 from 12.02.2013).

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