

# M-LEARNING SYSTEMS DESIGN - TECHNOLOGY AND PEDAGOGY ASPECTS

Elissaveta Gourova<sup>1</sup>, Asya Asenova<sup>2</sup> and Pavlin Dulev<sup>3</sup>

<sup>1</sup>Assoc. Professor – 125, Tzarigradsko shosse Blvd. blok 2, 1113 Sofia, Bulgaria

<sup>2</sup>Ass. Professor – 8 Dragan Tzankov blv., 1164 Sofia, Bulgaria

<sup>3</sup>PhD student – 5, James Bourchier blvd., 1164 Sofia, Bulgaria

## ABSTRACT

Technology developments face universities with many challenges – to integrate technologies in educational processes, design new electronic materials, change teaching styles, and better meet the demands of the technology-savvy generation. The paper considers problems of m-learning adoption in Bulgaria at one Faculty of the Technical University – Sofia.

## KEYWORDS

m-learning, learning management system, courses design.

## 1. INTRODUCTION

Today, technology trends in informatics and telecommunications are behind a change in educational service provision – from e-learning to mobile learning (m-learning). Technologies provide users with opportunities to communicate and access information, learning content and services everywhere, at any time. Their use in the educational process enables universities to offer flexible training and a better quality, and allows access to education at anytime and anywhere. However, the design of courses and lecture modules accessible at various devices, and the preparation of educational materials provide many challenges to the rapid uptake of m-learning (Gourova et al., 2013). While students, equipped with up-to-date portable devices and skills to use them, are generally ready for m-learning, the technology environment in universities and especially the teaching staff are lagging behind. Some of the problems are linked to the lack of skills for m-learning courses design, lack of methodology, and lack of user-friendly technology environment that facilitates fast and easy access to content. All these problems are addressed by a current project at the Technical University – Sofia (TU). The project foresees the development of a knowledge management system at the English Language Faculty of Engineering (ELFE) and the integration of new forms of education such as m-learning, video lectures and virtual labs. This paper presents the main challenges identified by the ELFE team for m-learning at TU. Subsequently, the paper provides a brief description of the Learning Management System (LMS) to be developed at ELFE, and the pedagogical framework considered for preparation of the learning materials.

## 2. M-LEARNING CHALLENGES FOR UNIVERSITIES

Technologies have changed the way people live, work, entertain and communicate. The changes in Internet technologies from Web 1.0 to Web 2.0 and Web 3.0 (the Semantic Web) have caused the development of new business models and innovation concepts, as well as institutional and educational changes. While scholars discuss about Learning 2.0 and Learning 3.0 concepts (Rubens et al., 2011), the appearance of various portable devices and the rapid uptake of mobile communications has facilitated the emergence of m-learning. Although related to e-learning, it differs in its contexts and the devices used. As defined in (Vinu et al., 2011), m-learning '*happens when the learner is not at a fixed, predetermined location, or ... when the learner takes advantage of the learning opportunities offered by mobile technologies*'. As Naismith and Corlett (2006) stress, some critical factors are in place in m-learning projects:

1. *Access to technology*: making mobile technology available where and when needed, either by developing solutions for various devices, or by providing learners with devices they can use.

2. *Connectivity*: using wireless connectivity to provide access to learning resources, to link people across contexts, and to allow students to capture material that can be sent to a personal media space and shared.

3. *Integration*: integrating mobile learning projects into the curriculum, the student experience, or daily life. Strategies for achieving integration include extending a successful form of learning onto mobile devices and proving technology that augments the student experience.

4. *Institutional support*: for mobile format of resources, training staff, technical support.

While the first two are generally solved by technology providers, the last two create big challenges for educational institutions. On the one side, the old generation of teachers is not ready to change teaching style, courses design and collaboration channels. On the other, university technology platforms in most cases do not integrate collaborative and sophisticated searching tools, and do not offer flexible and easy navigation opportunities. Last, but not least, the overall educational environment, including regulatory framework, hierarchical structure, culture, norms, etc. does not support revolutionary changes. It should be taken into account, however, that the users of educational services are technology savvy young people that grew up with the Internet and the computers, with mobile phones and other portable devices. Present learners have other requirement than the former generations. They use intensively technologies in their everyday life, and would like to use them also in the educational environment. Obviously, a change towards m-learning is needed.

Unfortunately, m-learning systems are not very popular in Bulgaria although several pilot projects are underway (Georgieva et al., 2011; Gourova et al., 2013). The widely adopted model for e-learning in the country is based on a Moodle platform, where teachers create courses and upload educational content for students, mainly lectures, study tasks, self-study materials. The teachers are skeptical about m-learning. A serious barrier for them is the lack of training and technical expertise. Adapting educational methods to m-learning needs, redesign course materials and activities could also impose difficulties for them.

### 3. CONCEPT FOR LEARNING MANAGEMENT SYSTEM AT ELFE

Most Bulgarian universities have developed their own platforms with the objective to facilitate educational and administrative processes. TU has a decentralised information technology (IT) infrastructure, whereas all Faculty maintain their own resources, and use the common IT resources at TU, which include:

- *University information system (for students management)* – contains information about TU students – their learning status, notes on exams, thesis information, social insurance, etc.;
- *System for staff management* – includes information on full-time and guest teachers at TU, their work load, courses, exams' responsibilities, work reports, etc.;
- *System for records management* – focuses on generation, control and publishing of exam records;
- *System for publications* – provides information on all publications of TU researchers.

TU information systems provide different access options according to the level of security envisaged (Figure 1). All lecturers could access with a digital certificate the systems for publications, staff management and students' notes and records. The system for students' management is accessible for students only for reading after online authentication. The internal administration is managed by authorized personnel at all TU Faculties using a specially installed application on their computers. The main problem is that all systems are developed and maintained separately, and there is no integration option presently.

ELFE maintains a separate web portal with information for students and lecturers, with access to ELFE annual conference and projects. One of the problems of the portal is that it is not user-friendly, does not provide single entry to all Faculty resources, and does not offer collaboration opportunities. Therefore, within the ongoing project is developed a concept for a new web platform which envisages a single sign-up process for accessing administrative and educational resources, scientific information and research data bases (Gourova et al., 2012). Some of the essential functionalities which will be added will facilitate:

- *Learning processes management* – for courses selection, assessment, thesis management, etc.
- *Human resources management* – for career promotion, training, evaluation of lecturers' performance;
- *Knowledge and technology transfer* – access to scientific data bases, partners' search, etc.
- *Collaboration facilities* – for internal and external communication, alumni fora, social networks, etc.

The most important issue is to overcome the fragmentation of ELFE IT resources (common TU systems and own systems). While the integration of all databases is not considered at TU, the users access could be facilitated by redesigning the ELFE platform and providing single sign-in to all IT systems.

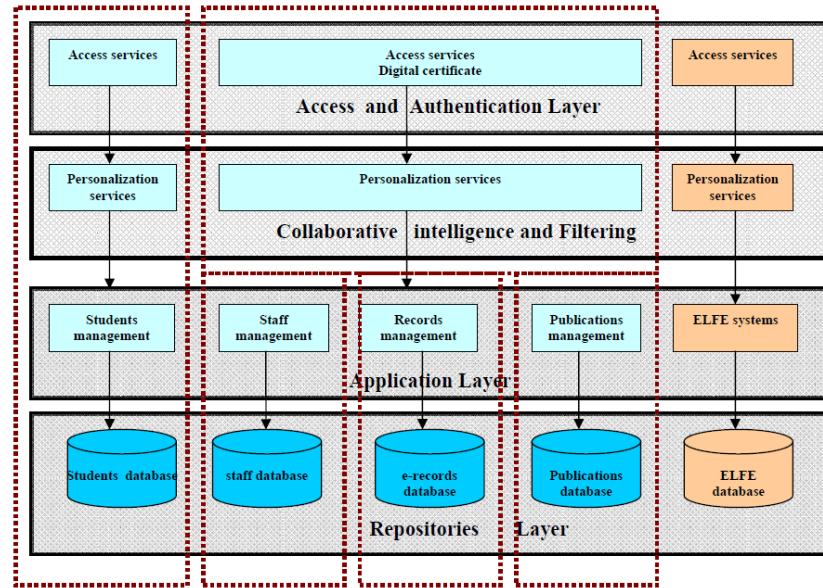


Figure 1. Available IT infrastructure at TU and ELFE

The concept for a new ELFE LMS (Figure 2) addresses the requirements for digital content presentation (to be used on both, mobile devices and desktop computers) and the opportunity for different type of content – text, audio and video. It is essential to ensure device-independent applications, modular structure of courses, extensibility and reusability of content. Additional features could be added such as reminders, tasks management, access to on-line libraries, communication tools, etc. The LMS functionalities should ensure to be easy-to-use (in terms of access, content management, presentation and navigation), intuitive and to support all users' profiles, educational needs and roles. It should also take advantage of the opportunities offered by Web 2.0 for social interaction. As distance education is presently not offered at ELFE, the LMS development will go in parallel with the design of electronic educational materials. A special Handbook is envisaged to be elaborated with guidelines to tutors, and training and expert consultations.

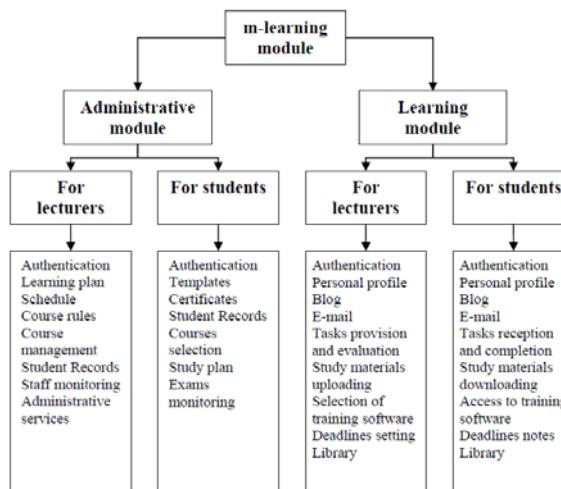


Figure 2. Concept for ELFE LMS, adapted (Ilcheva, 2013)

## 4. PEDAGOGY FRAMEWORK FOR M-LEARNING

M-learning faced researchers and practitioners with several questions that need to be resolved. Some challenges are linked to the development of m-learning standards as m-learning systems do not support e-learning specifications (Georgieva et al. 2011). These problems are taken into account in the ongoing TU project, which will integrate innovative forms of education such as m-learning, video lectures and virtual labs. It is considered to prepare a common design of courses and lecture modules accessible at various devices. This requires to develop as well an appropriate pedagogical framework according to different educational goals, and to determine the type of learning activities and the devices to be used for m-learning.

According to (Park, 2011), the most serious issue faced by mobile learning is the lack of a solid theoretical framework. Thus, he proposes a conceptual and pedagogical framework based on high versus low transactional distance and individualized versus socialized activity. According to his model, the following types of m-learning could be considered: (1) high transactional distance socialized m-learning, (2) high transactional distance individualized m-learning, (3) low transactional distance socialized m-learning, and (4) low transactional distance individualized m-learning. Park (2011) further points out that m-learning based on high transactional distance and the individualized mobile learning (type 2) require more psychological and communication space with the instructor or instructional support; tightly structured and well organized content and resources accessible by mobile devices; control over the learning process.

The interactions mainly occur between the individual learner and the content. This type demonstrates an extension of e-learning which allows greater flexibility and portability. Individual learners could incorporate this flexible learning into their mobile lifestyle. The pedagogical design of learning activities suitable for m-learning could be accomplished using the following steps:

- definition of learning objectives and accordingly formulation of a few basic types of activities;
- adaptation of the activities to the used learning styles;
- activity breakdown into individual actions and operations;
- technological and functional support of the activity for the appropriate mobile device.

Taking into account the success factors for m-learning given in (Naismith et al., 2011), the ability to acquire information about the user and his/her environment presents a unique ability to personalize the learning environment. This suggests studying the users' behavior in order to facilitate the navigation in the LMS and the usage of its resources. An essential component of the concept for m-learning at ELFE is to use well-structured and well-organized resources like video lecture, which should meet the following criteria (Gourova et al., 2013): clear pedagogical model for the formation of an audio-visual presentation; easy navigation within the platform; improved access to services; easy navigation within the module; brief description of the module; maintenance of high video quality; availability of options for generation of different image sizes and video quality. It is essential to follow some basic principles (Mayer et al., 2003):

- *Principle of multimedia* – improved retention by the use of words and images (double encoding);
- *Principle of spatial continuity* – better learning when words and images are placed close to each other;
- *Principle of continuous time* – simultaneous presenting corresponding words and pictures;
- *Principle of coherence* – removing superfluous words, images and sounds from multimedia content;
- *Principle of modality* – better learning through animation accompanied by voice, not by text;
- *Principle of redundancy* – presenting information in a single modality, without excessive repetition.
- *Design principle* – multimedia design influences better entry-level students than advanced learners;
- *Principle of direct manipulation* – The influence of changes in the speed of the animation or broadcast on the transfer of knowledge increases collinearly to the complexity of the material.

When creating video lectures for m-learning, it is important to notice that the design of lessons should adapt to the expertise and the prior knowledge of the learner, the complexity of the content, and the interests of the learner. Experienced researchers recognize that the use of multimedia technology and resources can vary in the level of interactivity, modality, sequencing, pacing, guidance, prompts, and alignment to student interest, all of which influence the efficiency in learning (Clark et al. 2006).

## 5. CONCLUSION

M-learning is not going to fully replace traditional learning approaches. However, it provides an excellent option for teamwork, interactivity, and seamless collaboration of students in a group or with their teachers. It is a new trend in education reflecting the changes in technologies but also the habits of the new generation of computer-savvy students. The functional abilities of mobile devices for text, audio, and video lectures pointed out in the paper are a motivation factor for widely using these opportunities in future m-learning systems. Several challenges for m-learning still remain – to develop m-learning standards for learning objects, to ensure device-independent and interoperable applications, etc. The development of learning management systems using Web 2.0 and Web 3.0 tools at Bulgarian universities could further facilitate users. The most essential is, however, to train teachers and motivate them to use the new educational opportunities available with the development of ICTs in order to better meet students' demands and to ensure higher quality of teaching and to better prepare the future employees for the labour market.

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