WMIN-MOBILE: A Mobile Learning Platform for Information and Service Provision

Daphne Economou, Alex Keable-Crouch, Vassiliki Bouki, Arti Basukoski, and Vladimir Getov

School of Electronics and Computer Science, University of Westminster, 115 New Cavendish St, London W1W 6UW, United Kingdom
{D.Economou@,a.keable-crouch@my,basukoa@, boukiv@,V.S.Getov@}westminster.ac.uk

Abstract. Educational organisations hold lots of valuable information and material in different forms that needs to be communicated to people with different profiles anytime, anywhere. Mobile phones offer great opportunities of accessing such information and services by using hardware owned by Educational Organizations' members. This paper studies the requirements for such mobile learning (m-learning) tools for information and services provision to support learning and teaching and enhance student experience and satisfaction. To demonstrate this it uses the WMIN-MOBILE project as a case study. The WMIN-MOBILE is a prototype that provides general information about the School of Electronics and Computer Science (ECS) at the University of Westminster (UoW) and services like announcements, timetable and lab facilities and availability. The paper justifies the educational value of such m-learning tools and reports requirements for developing such tools. It further describes the WMIN-MOBILE system design and architecture and concludes with lessons learned and further work.

Keywords: m-learning, educational mobile, market analysis, web services, J2EE, JDBC, SOAP.

1 Introduction

Over the last decade information and communication technology have transformed the way in which we communicate, interact and learn as a community to our own sense of personal space, time and privacy. New forms of learning have emerged like e-learning which is the most recent development of computer-supported collaborative learning (CSCL) [1] – one of the most promising innovations to improve teaching and learning with the aid of modern information and communication technology. Networked communication systems serve as specific media to support e-learning processes [2]. E-learning applications and processes include Web-based learning, computer-based learning, virtual classroom opportunities and digital collaboration. The content which is disseminated to support e-learning has the form of text, images, animation, streaming video and audio.

N. Venkatasubramanian et al. (Eds.): Mobilware 2011, LNICST 93, pp. 23–33, 2012.

Mobile devices and wireless technologies nowadays offer a number of important characteristics including: increasing portability; functionality; multimedia convergence; ubiquity; personal ownership; social interactivity; context sensitivity; location awareness; connectivity and personalisation [9], that makes them attractive from an educational perspective and expand on e-learning. Those capabilities of mobile and wireless technologies support new models of learning, that are provided "just-in-time, just enough, and just-for-me" [3]. The use of mobile and handheld IT devices, such as personal digital assistants (PDAs), mobile phones, laptops and tablet PC technologies, in teaching and learning is known as mobile learning (m-learning). M-learning has always implicitly meant mobile e-learning and its history and development have to be understood as both a continuation of conventional e-learning and a reaction to this conventional e-learning and to its perceived inadequacies and limitations [3].

However, despite the almost ubiquitous ownership of mobile phones, the adoption of mobile technologies in higher education is still in its infancy. Given the current financial climate it is decisive for educational organizations to make use of hardware owned by students to deliver content and services, rather than investing in procuring equipment. What needs to be understood thought is how students want to use m-learning and deliver against their needs.

The remainder of this paper is organized as follows in order to investigate ways of providing mobile applications and services to enable communication and collaboration among university students, faculty and staff to support education, learning and teaching and enhance information provision, communication and improve student experience and satisfaction. In Section 2 the benefits of m-learning are discussed. In Section 3 a marketing analysis is provided that demonstrates that there is a substantial market that possesses the technology based on which m-learning services can be provided and to justify the directions towards which m-Learning applications and services should be developed in order to satisfy student needs. In Section 4 a review of current m-learning platforms is provided, while in Section 5 the WMIN-MOBILE prototype is described as a means of evaluating user and technical requirements. Finally, Section 6 presents the conclusion and proposed future work.

2 Market Analysis

2.1 Mobile Phones Marketing Analysis

Analysis of student IT services surveys conducted amongst various UK universities during the last 5 years shows that all students own increasingly sophisticated mobile phones [10]. In particular, approximately 80% of students have smart phones, 80% can access the Internet, 96% have a camera, 86% can record video and 80% can record audio. A US market survey showed that an average of 50% of students access email, Facebook and Twitter through their mobiles several times a day [12]. Research by Kaiser Family Foundation conducted within 2010 reported that children in the US spend approximately 8 hours a day using media, 20% of which is using cell phones. Those numbers are by much larger in Eastern countries. Those figures indicate that

there is a valuable audience that processes the required technology, has the technical skills and would be willing to use mobile technology as a means of communication with the university environment to get information related to their study and work literally on-the-move, anytime, anywhere, without the need to carry special equipment or being fixed in an environment with particular settings and get the required information "just-in-time, just enough and just-for-me".

2.2 User Requirements for Effective M-Learning Tools

In March 2010 the Edinburgh University Information Services undertook a survey of approximately 2000 students to gather student requirements for developing a pilot "Mobile Campus" set of applications [1]. The survey asked the students what type of devices they owned, what they used them for and which University Information Services they would mostly prefer to see delivered on a mobile platform. The survey indicated that the top three University services which students would most like to see becoming available to their mobiles would be:

- course information , like deadline notices, messages about courses, etc.;
- exam and course timetables;
- PC availability in open access labs.

In November 2010 the Information Systems and Library Services (ISLS) of the UoW performed a similar online student survey that showed that 99% of the students would like to use dedicated applications and 96% of the students have or plan to get a smartphone whilst at the University. The survey also showed that the most desirable applications for students would be the following:

- Blackboard access 96%
- Library search 83%
- Timetable 80%
- Email/calendar 79%
- Notifications 62%
- Staff directory 61%
- Events 57%
- PC availability 51%
- News feeds 50%
- Student handbook 50%
- Course Directory 45%
- Maps 39%
- Find a friend 36%
- Social networking 28%
- Video 24%

Those results indicate that there is great demand for developing m-learning applications and services for information provision, dissemination of material and communication supporting different user profiles and mobile platforms and devises. This means that there are two important issues to be addressed:

a) developing student centric m-learning applications to aid higher education studies, improve retention, engagement and outcomes;
b) bring together existing information in various platforms and formats and presenting it in existing technology that students use for their own communication and entertainment.

An administrative statistics report for Blackboard usage created in March 2011 for modules registered for one of the four campuses of the UoW helped into understanding which are the most desirable services provided by this widely used amongst universities e-learning tool [13]. The report showed that 5420 modules have been set up for the New Cavendish campus only. From those:

- 4396 have at least 1 student registered meaning that 1024 modules have been set up but there are no students registered with 81.10% of the modules with at least one student;
- the course content area is populated in 2354 modules;
- announcements are used in 2005 modules;
- online tests are used in 108 modules;
- assignments area is used in 130 modules;
- wikis are used in 98 modules;
- external links are used in 501 modules;
- forum posts are used in 149 modules;
- forums are used 350 modules.

The difference between 'forums' and 'forum posts' seems to indicate that although a forum has been set up in a module, there are no posts on this. Actually there are forum posts in 149 modules out of the 350 modules where forums have been set up – this means that less than half of the forums are used as 42.57% of the forums have forum posts.

The following percentages saw the usage of different areas and facilities on Blackboard out of the 4396 modules that have at least one student. Apparently the other modules are not used:

- the course content area is populated in: 53.54%;
- announcements: 45.60%;
- online tests: 2.45%;
- assignments: 2.95%;
- wikis: 2.22%;
- external links: 11.39%;
- forum posts: 3.38%;
- forums: 7.96%.

From the above analysis, it becomes apparent that the 'course content area' is the most popular area of Blackboard and 'announcements' is the second most popular tool. Tools that facilitate interactivity and communication among students and among students and lecturers (such as forums, forum posts, wikis) are used in few modules. The most popular of these tools is 'forums', used by only 7.96% of all modules and the least popular of all tools is 'wikis' with only 2.22% of all modules to use it. This is quite remarkable. It seems that Blackboard is mainly used as a static tool where

lecturers can upload information for students in the form of 'course content' or 'announcements' but it is not used for students to express their opinions or to interact with the rest of the class. The communication seems to be in one direction only: from lecturer to students.

3 The Benefits of M-Learning

Education is being constantly transformed with possibilities offered by technology. It is the new technology that allows educators to explore and improve new teaching and learning processes as well as different pedagogical methodologies. Several e-learning platforms (such as Blackboard and Moodle) and applications (such as test builders) have been developed and offered learners a different learning experience.

Research has provided clear evidences that e-learning applications have positive impact for learners. Learners become more engaged in the learning process and learning goals accomplished more successfully. Several studies have shown that the use of e-learning leads to better results for students: pass rates are increased and failure rates fell [5, [6].

The main advantage of these applications that makes this possible is that they allow students to personalise the learning process according to their needs and abilities. Learning process becomes really learner-centred. An e-learning application could serve this goal by allowing learners to personalise their learning experience while it offers them the chance to discover and build the knowledge by themselves.

Furthermore, knowledge is socially and individually constructed on the basis of experience. e-learning applications and especially m-learning applications facilitate students to networking and communicate.

In the last few years, it became more apparent the need of mobility: learners should have access to learning material regardless of time and place. The focus shifted to m-learning platforms. A large number of universities – initially in the US – provided their students with portable and mobile devices where they can download specially formatted versions of lectures [7]. The development of m-learning platforms was the next step. The first step in this direction was the transfer of original web pages to mobile screen and also the incorporations of new modules such as feedback and quiz for mobile devices [7]. M-learning has all the advantages of e-learning: personalisation of studies; better engagement of students; communication. In addition, m-learning provides mobility and the possibility of delivering applications and services on students mobiles that address the learners' needs. At the same time m-learning tackles the issue of financial tighter funding opportunities for higher education as it provides the opportunity of using existing hardware infrastructure.

4 Status and Trends

There are various products and platforms that offer the infrastructure of providing campus information and services on-demand. Research incorporating over 40 of the UK's leading e-learning companies and a number of other organizations and

individuals across Europe and North America, reported recently that European e-learning market enjoys strong growth and that the UK remains the largest market within the continent [16]. The report estimates that, in 2010, the UK e-learning market will grow approximately 4.76% on the 2009 figure, which shows that there is a valid market to justify research and development towards this direction.

The current mobile learning market has been driven by consumers and healthcare buyers, who spent more on mobile learning technologies despite the recession. However, academic institutions still contributed to the growth. Campus technology noted that Blackboard's Mobile Learn [14] was cited as "the most significant product in terms of a market catalyst", something which indicates that Blackboard access is one of the most desirable services for students. Students and faculty require to be provided with opportunities to experiment with new forms of informational, social and media access to next-generation digital platforms including Android, BlackBerry, iPhone, iPad and other smart phones.

From another view point platforms like Blackboard Mobile Central [14] and CampusM [15], give students, faculty, and alumni information related to campus life and library access. There exists significant potential of further increasing this type of mobile services and support by engaging new forms of social and media communication paradigms. One such example is the Mobile Campus Assistant (MCA) software, which is a part of the MyMobileBristol project, that provided students with time and location sensitive data, like: where is there a PC available; when is the next bus to a certain destination; what events are happening today and so on. This in turn creates some questions and requires scalable solutions about the integration of these new services and infrastructures with the existing university systems in such a way so that the upgrade comes at the lowest cost and requires minimum disruption.

5 WMIN-MOBILE Case Study

5.1 WMIN-MOBILE Requirements and Specifications

Experience at the UoW showed that various centralized ISLS services are very difficult to be managed and updated and do not always deliver the required information. Thus various schools have adopted home solutions to serve their needs. For example the ECS is using their own timetable services, which is more reliable and customized to the schools needs. The WMIN-MOBILE prototype application is targeting in providing information and services initially to students and staff at ECS, at UoW in order to study the ways m-learning tools could deliver effectively and efficiently information and services that address directly user requirements, support education, learning and teaching, enhance communication and improve student experience and satisfaction. It is also an exercise that allows understanding the technical implications of adopting an off the self solution or developing an m-learning platform from scratch.

The WMIN-MOBILE application focuses in delivering initially the following information and services:

- information about the ECS, like location;
- information about courses offered by ECS targeting current students, like modules per course level, short description, semester of delivery, module leader;
- events at ECS;
- timetable;
- lab location, availability and facilities;
- social networking by participation in a blog.

The following section provides a technical description of the system architecture.

5.2 WMIN-MOBILE System Architecture

Faced with a fast changing mobile market (Android, Apple, Microsoft) and rapidly evolving technologies, the WMIN-MOBILE system strives to be as platform neutral as possible. To achieve such platform neutrality there must be a separation of concerns between the data model, data access, and user interface. Such an approach enables each domain to be developed independently, and assists in the adoption and evolution of the prototype to new technologies.

The WMIN-MOBILE system follows a typical service-oriented architecture (SOA) and is comprised of three distinct elements: an external database; a web-service; and a mobile web-service client (see Fig. 1).

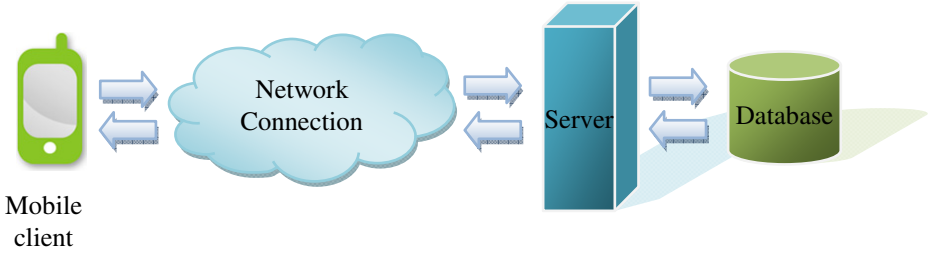

Fig. 1. WMIN-MOBILE system architecture

A web service is essentially a standardised way of communicating with web-based applications that share data and/or application logic over a network. In order for a mobile application to access the network, a client-server relationship between the web service and application is required. As such it is typical for mobile applications to act as a consumer (client) and the web service act as a provider (server). The mobile Web-service client is the actual WMIN-MOBILE application that is being installed locally on a mobile device. This locally installed application functions as the web-service consumer, and requests and receives application data over a network connection such as WiFi or 3G. The web-service retrieves and serves data from the database, to the installed WMIN-MOBILE application as and when required.

The database contains the course data that is provided by the application. Other data is being accessed via the Google API and other web services as necessary. It can be located on the same or a separate server to the web-service. Web-services also allow the system to be scalable since the web-services are essentially standardised enterprise applications that are hosted on publicly accessible servers. This means that the web-services can theoretically be used by thousands of users at a time, on a wide range of mobile and desktop platforms (for example Windows, Mac OS, Linux, Unix, Android, BlackBerry and iPhone OS).

For the locally installed application Google's Android platform has been chosen mainly due to minimal development cost. The targeted android versions is 2.2 and above, however earlier versions can be supported if there is a demand for it. Because of the Google maps integration in the application, the Google API needs to be present in the android version in order to be able to run the application.

Android applications are essentially a mix of XML and Java which is converted into android bytecode that is eventually executed by the device. To port the application to iPhones the user interface can be implemented using Objective-C. The database and web services can then be accessed in a similar manner.

The enterprise server environment for the current application is hosted on the UoW glassfish server that is administered by the ECS School. The web-service is a J2EE application that receives a request from the locally installed application, and responds with the required data. Communication between the mobile application and the web service uses the Simple Object Access Protocol (SOAP). A SOAP message that is transmitted over a network connection is an standardised XML document. This standardised web-service protocol is what allows the web-services to be consumed by different mobile and desktop platforms (see Fig. 2).

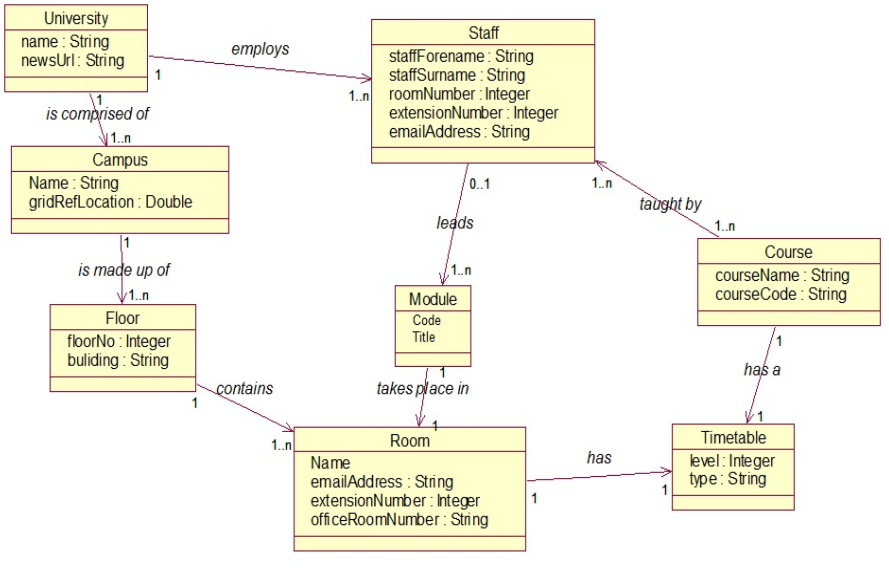

Fig. 2. WMIN-MOBILE system data flow diagram

Unfortunately all of the mainstream mobile programming languages (including Android) do not offer any libraries for making web-service calls using SOAP. This means that the programmer has to create this functionality or use a set of third party libraries. In the case of the prototype WMIN-MOBILE application the 'KSOAP2 for Android' libraries are being used in order to provide the programmer with a convenient and effective way of making web-service calls using SOAP.

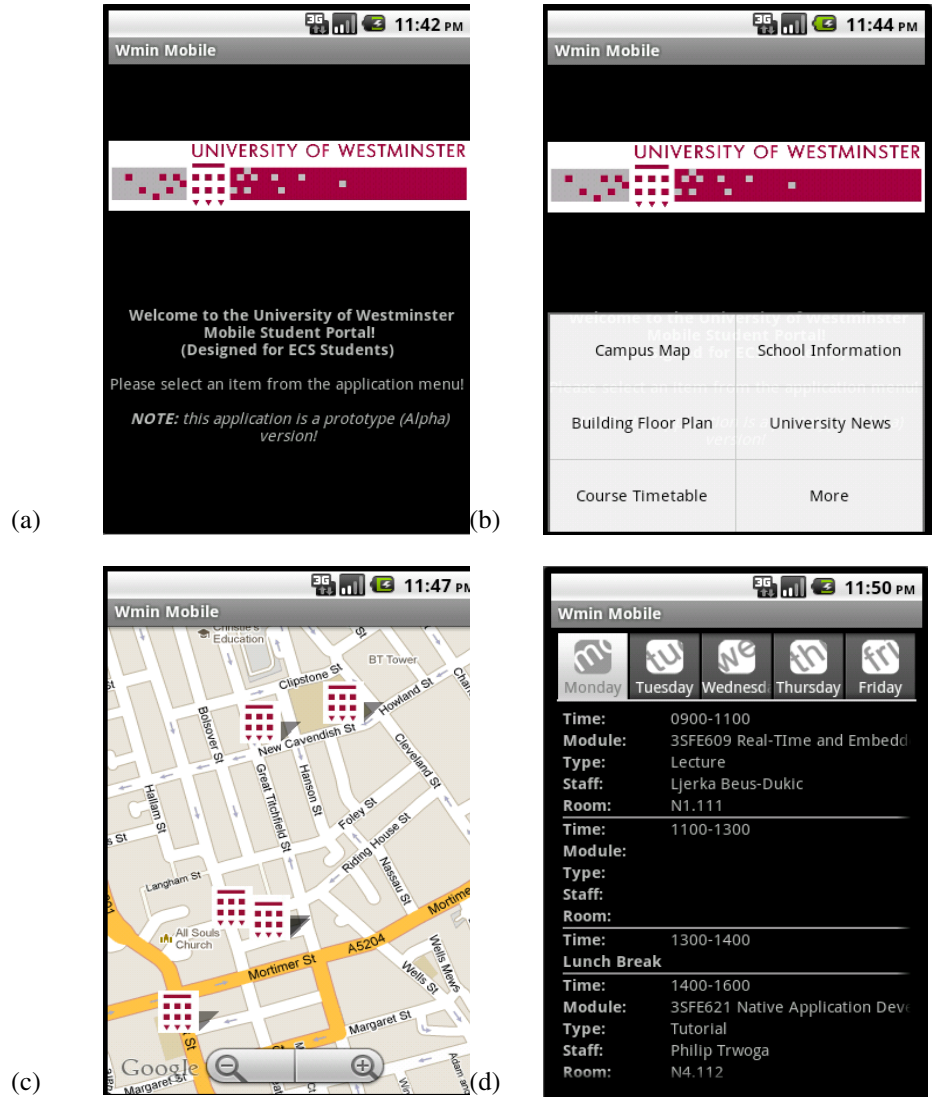

Fig. 3. Example screen shots of the WMIN-MOBILE application: (a) main screen; (b) main menu; (c) map Screen; (d) timetable screen

The web-service interacts with a MySQL database that resides on the UoW database server that is administered by the ECS school. The initial data model is designed to meet the main needs mentioned in Section 5.1. A secondary aim was to make it fully customisable so it can easily be adopted by other Universities. Any interaction between the web-service and database server is done using the appropriate Java Database Connector (JDBC) and using the structured query language (SQL).

Web-services provide a convenient way for applications to serve dynamic data to users regardless of their location (if they have a working network connection). This ability to retrieve accurate and up to date information allows an enhanced learning experience by reducing the risk of old incorrect information. Figure 3 presents example screen shots of the application.

The aims of the prototype were to provide for the most often used Blackboard functionality in order to deploy a useable system for further study. Once adequate useage statistics have been gathered the next step will be to identify course content for the most frequent users, and to study effective ways of dissemination and presentation of that content.

6 Conclusions and Future Work

The advance of new technologies including powerful, small devices, improved connectivity and has affected the nature of the way we as a society communicate, access information, and connect with friends, colleagues, staff and institutions. Provided the increasing use for smartphones and the critical financial situation globally higher education is facing a growing anticipation to make use of and to deliver services and content to students' own mobile devices. Smartphone technology is powerful and affordable offering considerable potential to improve how higher education institutions channel relevant information and services to students especially when combined with back-end University technology. Students demand and expect better m-learning tools to enhance their learning experience, and given the raising fees in UK in particular this issue will be even more eminent. Smartphones technology presents an opportunity for higher education to reach its members in new and compelling ways, in addition creating the anytime, anywhere benefits of these ubiquitous devices.

This paper justified the educational value of such m-learning tools and demonstrated such tools requirements, like information and services provision to support learning and teaching and enhance student experience and satisfaction. It demonstrated how partially those requirements can be met with the development of the WMIN-MOBILE application that provides general information about ECS, at UoW and services like announcements, timetable and lab facilities and availability.

In order to test if the provision of such services can enhance student experience and satisfaction the application needs to be developed a bit further and get populated with real data, which is currently under development. Once the prototype is completed the application will be offered to new students at ECS, UoW in September 2011. A short period of time after the application will be offered to the students a usability testing study will be conducted to evaluate the effectiveness and efficiency of the application and test if it aids the learning experience and increases satisfaction. It will also gather

directions that the application should develop in terms of services and information to be provided via the application, technical aspects of the application, as well as platforms for which such applications should develop in order to be flexible and scalable.

Acknowledgement. The authors are grateful to John Cronin for providing the statistics results from the UoW included in Section 2 of this paper.

References

[1] Stahl, G., Koschmann, T., Suthers, D.: Computer-supported collaborative learning: An historical perspective. In: Sawyer, R.K. (ed.) Cambridge Handbook of the Learning Sciences, pp. 409–426. Cambridge University Press (2006)

[2] Tavangarian, D., Leypold, M., Nölting, K., Röser, M.: Is e-learning the Solution for Individual Learning? Journal of e-Learning (2004)

[3] Traxler, J.: Current State of Mobile Learning. In: Ally, M. (ed.) Mobile Learning: Transforming the Delivery of Education and Training. Athabasca Press (2009).

[4] INTEL – white paper, The Positive Impact of eLearning (2010), http://download.intel.com/pressroom/archive/reference/Positive_Benefits_of_eLearning_whitepaper.pdf

[5] JISC. Exploring Tangible Benefits of e-Learning: Does investment Yield Interest? (2008), http://www.jiscinfonet.ac.uk

[6] Cook, J.: Unlocking Potential: harnessing the pedagogical benefits of e-learning. Investigations in University Teaching and Learning 5(1), 57–61 (2008)

[7] Basogain, X., Izkara, J.L., Borro, D.: Educational Mobile Environment with Augmented Reality Technology. In: Proc. International Technology, Education and Development Conference (INTED 2007), Valencia, Spain, March 7-9, p. 369 (2007)

[8] IS Survey Results: Mobile Services 2010, University of Edinburgh (2010), http://www.projects.ed.ac.uk/areas/itservices/integrated/ITS045/Other_documents/MobileSurvey2010.shtml

[9] Pachler, N., Bachmair, B., Cook, J.: Mobile Learning: Structures, Agency, Practices. Springer, New York (2010)

[10] Bradley, C., Holley, D.: An analysis of first-year business students' mobile phones and their use for learning. In: Creanor, L., Hawkridge, D., Ng, K., Rennie, F. (eds.) Proc. 17th Association for Learning Technology Conference (ALT-C 2010), Intosomething Rich and Strange – Making Sense of the Seachange, pp. 89–98 (2010), http://repository.alt.ac.uk/797

[11] Bradley, C., Weiss, M., Davies, C., Holley, D.: A little less conversation, a little more texting please - A blended learning model of using mobiles in the classroom. In: Proc. Fifth International Blended Learning Conference "Developing Blended Learning Communities", University of Hertfordshire, Hatfield, UK, June 16-17, pp. 1–11 (2010)

[12] Adkins, S.S.: Ambient Insight Comprehensive Report: The US Market for Mobile Learning Products and Services: 2009-2014 Forecast and Analysis (2010)

[13] http://www.blackboard.com/

[14] http://www.blackboard.com/Platforms/Mobile/Overview.aspx

[15] http://www.ombiel.com/campusm.html

[16] Patterson, D., Glynn, J., Broadhead, G., Renate, H.: The UK e-learning market 2010 (2010), http://www.e-learningcentre.co.uk