A Blended Mobile Learning Context Oriented Model in a Cloud environmemt applied to a RE course

Fernando Moreira [1], Maria João Ferreira[1,2]
[1]*DICT, Universidade Portucalense, Porto, Portugal*
[2]*ISTTOS, Universidade Minho, Braga, Portugal*
{fmoreira, mjoao}@upt.pt

Keywords: Blended Mobile Learning, m-learning, learning context, cloud environment, Bloom Taxonomy.

Abstract: The increasing number of mobile devices on day-to-day of the general population and particularly among youth people, leads to the emergence of new paradigms in several areas of activity, particularly in education. As an example of a new paradigm in the teaching / learning process can be invoked the mobile learning supported by a cloud environment and by Bloom Taxonomy. In this paper and in the context of three-year courses Bologna Process European Degree structure at school, in Portugal, following the Curriculum Guidelines for Undergraduate Degree in a Information Systems from ACM/AIS, we intend to test Mobile Google Docs system, aligned with Bloom's Taxonomy, in our BML Context Oriented (BML-CO) model into a Requirement Engineering (RE) course.

1 INTRODUCTION

The world is facing a paradigm shift concerning technologies used in day-to-day life of every citizen, as well as in the teaching-learning processes. According Schubert, et. al (2012) information technology and communication (ICT) are subject to constant change. Thus, it is necessary to identify the major changes that can be expected in the next 5-10 years in order to prepare and make reflect those changes in the teaching-learning process. In this context, even according to the authors, in 2015 the concepts BYOD (bring your own device) and cloud computing are practically widespread.

Mobile devices are becoming ubiquitous and mobile learning is ever more an option (Quinn, 2011). According to a report by Ambient Insight Research, the U.S. market for mobile devices reached $ 958.7 million in 2010 and a projection for 2015 of 1.82 billion dollars. The ubiquity of heterogeneous mobile devices is hard to ignore. However, to take advantage of this trend is necessary to think beyond the formal, and start thinking about the performance of the support, i.e., the devices today's mobile capabilities has unimaginable a few years ago, namely, persistent storage, displays, main memory and communications, among others. Thus, associated with distance learning, but with mobile devices, the mobile learning concept (m_Learning) has been being observed with great attention by the teaching and learning community (Xxxx, 2010).

Higher education has had a major evolution with regard to approaches used in teaching/learning process. These approaches range from traditional classroom lectures, going through eLearning, and the combination of the two forms – Blended Learning (b_Learning) model, and more recently, to the Blended Mobile Learning (BML) model. (Khaddge, Lenham, & Zhou, 2009). Thus, it is necessary to, firstly, examine whether the solutions are according to the pedagogic aspects needed to be considered for a training (Xxxx, 2011) and, secondly, determine which type of content and how they should be available to students, i.e. to identify the learning context.

Currently, there is no consensus on the cloud computing definition, however, there is consensus that the definition produced by NIST "*Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction* " (NIST, 2010) is the most suitable. A key feature of this paradigm is scalability on demand, where the user pays for the amount of services that are really

used (Armbrust, et. al, 2010). Thus, the problems of space and sharing of documents has become a reality facilitated through the use of the cloud, particularly, Software as a Service (SaaS).

Although the need to use of cloud computing will continue to grow, you can find activity sectors that contribute to European leadership in this field, among others, counseling and education to create the next generation of leaders by cloud enthusiasts (Schubert, Keffery & Neidecker-Lutz, 2012).

In this paper and in the context of three-year undergraduate courses Bologna Process European Degree structure at school, in Portugal, following the Curriculum Guidelines for Undergraduate Degree in Information Systems from ACM/AIS, we intend to test Mobile Google Docs system i.e., in a cloud environment in our BML Context Oriented (BML-CO) model (Xxxx, 2010) to an Information Systems (IS) undergraduate degree, particularly in a Requirements Engineering (RE) course. With the proposed model, firstly, the teacher will have the necessary information to evaluate and revise the available tools in the area that teaches and, secondly, the student will have complementary tools that allows not only acquire new knowledge but also test their skills. The mote followed by the proposed approach fits in the mote of the IADIS 2012 conference "Free as Birds Learning in the Cloud".

The paper is organized as follows. In section 2 cloud computing technologies and bloom taxonomy are presented and discussed. In section 3 related work is presented, and in section 4 is presented an overview of the requirement engineering course. Research progress is the main goal of section 5, and finaly are presented some final considerations in section 6.

2 CLOUD COMPUTING TECHNOLOGIES AND BLOOM TAXONOMY

Computing technologies in the cloud (Google Docs and Microsoft Office 365), present, on the one hand, a great potential to improve teaching methods based on constructivist and cooperative learning and, on the other hand, go against the student profile that arrives to higher education.

The use of solutions to support teaching-learning process in the cloud is already a practice in several educational institutions in the U.S.A., for example, the use of Google Docs in the State of New York, reached three million students and 200,000 teachers (Claburn, 2010). Another example is presented by Wood (Wood, 2011) that used Google Docs in an undergraduate course where students collaboratively prepare lab reports. In the same way, Bonham (Bonham, 2011) used Google Spreadsheet and Google Forms so that students could collect data and produce charts during a laboratory experiment.

The choice of tools used in the respective courses should consider a theoretical framework that allows performing such selection and adoption appropriately. Thus, the use of Bloom's Taxonomy (Krathwohl, 2002) appears as a suitable referential.

The educational objectives of Bloom's Taxonomy (Krathwohl, 2002) present a framework to classify what students should learn as a result of their education. The author describes a variety of thinking skills, starting with the thinking skills of lower order, which form the basis of a hierarchy and that, culminates in thinking skills of higher order. The Bloom's Taxonomy presented by Cheong, et. al (2012) specifies the following classification from the low level to high level: Remember, Understand, Apply, Analyze, Evaluate and Create, where each level has a set of verbs to be used in the definition of the learning objectives achieving students. Bloom's revised taxonomy is specified as shown in Figure 1.

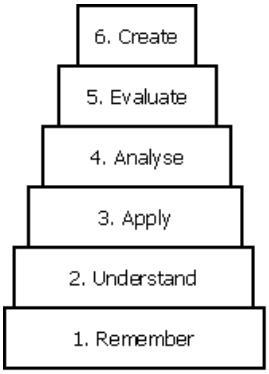

Figure 1: Bloom's taxonomy revised of educational objectives (based on (Cheong, Bruno & Cheong, 2012).

As referred the levels shown in Figure 1, have different aims:

1. Retrieving relevant knowledge from long-term memory.
2. Determining the meaning of instructional messages, including oral, written, and graphic communication.
3. Carrying out or using a procedure in a given situation.
4. Breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose.
5. Making judgments based on criteria.

6. Putting elements together to form a novel, coherent whole or make an original product.

In this context, in addition to the referential used, it is necessary to analyse/select learning theories that best fit to the use of cloud computing technologies.

Denton (2012) suggests constructivism and cooperative learning. In the first case, Denton shows that constructivism suggests that students integrate previous knowledge to create new knowledge, which is verified in cloud applications that contain tools that support activities to access previous knowledge, such as retrieving and sharing information. Furthermore, according to the same author, constructivism suggests that knowledge is created collaboratively and the results of this construction are influenced by time and place. In the same way, the model presented in Xxxx et al (2010) shows that time and place has a direct influence on the type, number and duration of learning activities, i.e. there is a direct dependency with the learning context. Many characteristics of cloud-based applications emphasize these characteristics, such as synchronous write and publish on the Internet.

The use of cloud computing technologies, including Google Docs can lead to questioning that the information is not on the owner, i.e., at any time the information can be eliminated by the service provider, however, is given the opportunity for students and teachers to record and save the changes over time, either in the cloud or on the device itself. Additionally, files can be saved and shared from a lesson to the next; this operation go against to the theoretical referential, the constructivism.

In the second case, as mentioned the same author suggests that cooperative learning is another teaching approach that is aligned with the technologies of cloud computing. The justification for this alignment is supported by all the possibilities that Google tools offer, including the possibility of sharing and publishing on the Internet.

The selection of the best tool(s) to implement the tasks necessary in order to answer to the several skills to be acquired by the student, according to Bloom's Taxonomy, is always a difficult task, since it force to do a study and experimentation of each one. However, Kathy Schrock (Schrock, 2012) proposes a classification of how Google applications can be aligned with Bloom's Taxonomy.

Based on this classification (Schrock, 2012) it is possible to define a set of strategies for integration of cloud technologies. Denton (2012) proposes several strategies that takes into consideration the incorporation of characteristics of constructivism and cooperative learning within each strategy and the most appropriate tools: (i) group projects (Google Docs, Google Sites or Blogger), (ii) Peer review (Google Docs, Google Talk, Google Forms), (iii) Presentations built by students (Google Presentation), (iv) Simultaneous discussions in class (Google Presentation); Collaborative reflection (Google Docs), (vi) Written assisted (Google Docs See revision history feature. Gmail, Google Talk), (vii) Class Inventory (Google Forms), (viii) Collaborative construction of rubrics (Google Spreadsheets Google Forms) and (ix) Publish website (Blogger, Google Sites).

3 RELATED WORK

The teaching/learning process based on a BML model, whatever their field of knowledge, on one hand, leads to the (1) necessity of the existence of applications for mobile and fixed devices, and (2) the study of learning context, i.e., when? where? and why? a student intends to study with the support of a mobile device. On the other hand, since the introduction of mobile devices in teaching/learning process, a large number of software applications for different domains have been identified. In most cases this software are represented in a 'flat' fashion making their use difficult especially when there is a large number of applications to consider in a particular area and/or scenario.

In this context a Web-based architecture was developed from a BML-CO model, for the programming (Xxxx, 2010) and computer networks (Xxxx, 2011) and information systems (Xxxx, 2012) areas. The proposed model allowing the teaching-learning process takes place on several platforms, offering content tailored to each platform, in the appropriate context and using only open source software.

The model ensures that a student has the necessary conditions to access the contents (text, picture / video, audio) at a given time and with a controlled cost. Information is stored at the end of the learning activity. This information will allow knowing, on one hand, the moment, location and the activity time duration, and on the other end, the student knowledge assessment.

In order to provide a positive learning experience the Learning Management System (LMS) must be effectively integrated with other specialized systems typically found in an educational environment.

The BML-CO (Xxxx, 2010) uses two types of tools: the Learning Management System Moodle with integration of MLE-Moodle (Mobile Learning Engine – MOODLE) and separately three specific

tools according to the course, one for the Algorithms and Programming (Xxxx, 2010), other for Computer Networks (Xxxx, 2011) and other for Requirement Engineering (Xxxx, 2012).

4 COURSE OVERVIEW

The Requirements Engineering course was designed following the ACM/AIS guidelines and the Bloom taxonomy referential. It runs for 15 weeks (one semester) and consists of two hours of theoretical/practice lectures to discuss theory and 2 hours of practice (lab sessions), where students put in practice the theory they have learnt.

The main goal of the course is that students use the Requirements Engineering in their future work as designer in the development of software systems. So, it is expected that a student, at the end of the course, be able to (1) Select and use techniques in requirements engineering process according to the problem to be solved; (2) Evaluate and use different techniques for prioritizing requirements according to the problem to be solved; (3) Use a requirements management tool; (4) Recognize technical developments in the area.

In order to meet the proposed goals the programmatic contents are:

1. Overview and Challenges of Requirements Engineering
2. Basic Concepts of the Requirements Engineering
3. The Requirements Engineering Process
4. Requirements Engineering – Process
   - Elicitation
   - Analysis, Negotiation and Prioritization
   - Modeling and Specification
   - Documentation
   - Validation
5. Requirements Management - Use of a management requirements tool
6. Future Directions and discussion

The theoretical/practice lectures use the expositive method, intending, however, the active participation of students through direct interpellation between teacher and students and vice versa.

In laboratory lectures students solve case studies that approximate them to the real-world situations. In parallel the students develop a group project whose goal is to acquire knowledge "Known to do" in a collaborative environment and simulation.

In lectures the concepts, techniques and tools fundamental of the Requirements Engineering are discussed in order to provide students with a solid foundation that allows them to operate under the current systems and accompany technical developments in the area.

It is intended that each concept, technique or tool presented/discussed in lectures, be put into practice by resolution of Case Studies and a Project which are solved in and out of lectures. The lectures take place in the context of collaborative work, where the ability to group works will be developed.

5 RESEARCH IN PROGRESS

5.1 Context

The study intends to add a tool to the model presented in section 3, that allow to support the teaching/learning process in a RE course. RE is a set of activities concerned with identifying and communicating the purpose of a software system, and the contexts in which it will be used. Hence, RE acts as the bridge between the real-world needs of users, customers, and other constituencies affected by a software system (stakeholders), and the capabilities and opportunities afforded by software technologies (Kaur & Singh, 2010). Identify requirements in RE is an arduous task for a student in an initial phase of his studies. We have identified Mobile Google Docs (MGD) (Google, 2011) as a good system to learn and experience this topic. The MGD is a free Web-based word processor, spreadsheet, presentation and form editor whose data storage service is provided by Google. MGD serves as a collaborative tool for editing documents so that they can be shared, opened, and edited by multiple users at the same time.

5.2 Proposed approach

We will follow the set of techniques proposed in (Gutwin, & Greenberg 2002). These techniques, allows us to be aware of the other user's cursor position and whether they have selected a text fragment or not, that text will represent a catalogue of requirements. Thus, when a remote user is writing other users can observe it in real-time. Additionally, if the user selects some text, it is highlighted by marking it with the user's color. In this context, we propose three steps on the "elicitation" task: (1) requirements identification, (2) writing requirements, and (3) discussion.

Step 1 - Requirements identification

Our requirement "elicitation technique" demands identifying requirements following steps:

1. Reading the text document that presents the Case Study which is available in MGD;
2. Identify business processes (Davenport & Short, 1999)and mark them with blue color – The main business process lead to Functional Requirements;
3. Identify the information that a business process needs to manage and support it and mark it with yellow color – this information must lead to Functional Requirements;
4. Identify the business rules (Hay & Anderson, 2000). and mark them with green color;
5. Identify the non-functional requirements and mark them with red color.

Step 2 – Writing requirements

Concluded the requirements identification task it is expected that the students writing in natural language (Pohl, 2010) using the Mobile Google Forms (MGF) the requirements taking into consideration that a requirement should satisfy the flowing features (Wiegers, 1999), (IEEE, 1998): (1) Correct; (2) Feasible; (3) Necessary; (4) Prioritized; (5) Unambiguous; and (6) Verifiable.

Step 3 - Discussion

When students submit the catalogue of requirements, teacher analyse that and then in a collaborative way discuss the proposed solution with students.

During these tasks, we propose that students use the MGD which shows the list of participants that are editing simultaneously the same document. By using this list, users can communicate with each other by using a chat.

This technique expressing information about authorship/about the past are used to make available to the users the history of changes carried out. They have been implemented by MGD by using a revision history. It allows the system to keep track of all the changes made by the users to the different types of documents being edited. In addition, if the change made is a deletion, then the text will be also in strikethrough style. In this context we intend to use the system capabilities to identify and write requirements in a collaborative way. In the next section we present a propose case study where students must identify/write functional and non-functional requirements and business rules.

5.3 Case Study

In order to operationalize the approach, students will be required to be held in Mobile and collaborative context, identifying and writing requirements for the case study below. In the selection of the case study theme, we tried that it was familiar to the students for an easier understanding of the system and the business environment.

Video club system – *VideoClub*

".... Customers renting movies. A customer can be a holder client or one of their dependents. When a person does his registration in the *VideoClub* as a holder costumer is given to him the possibility of indicate up to three dependents that will be responsible. For the *VideoClub*, is critical to identify exactly who rented a movie, if the holder or one of your dependents. However, for purposes of control, the *VideoClub* want more information about the holder of that on their dependents. About a holder wishes to know the name, email, address, phone the residence, workplace, mobile phone, taxpayer identification number and date of birth. Only persons over eighteen years of age may be a hold. Of a dependent are required only name, email, date of birth and relationship to you. Both holder and dependents have a registration number, which is unique per customer ....."

Step 1 - Requirements identification

".... **Customers renting movies**. A customer can be a holder client or one of their dependents. When a person does his registration in the *VideoClub* as a holder costumer is given to him the possibility of indicate up to three dependents that will be responsible. For the *VideoClub*, is critical to identify exactly who rented a movie, if the holder or one of your dependents. However, for purposes of control, the *VideoClub* want more information about the holder of that on their dependents. About a holder wishes to know the name, email, address, phone the residence, workplace, mobile phone, taxpayer identification number and date of birth. Only persons over eighteen years of age may be a hold. Of a dependent are required only name, email, date of birth and relationship to you. Both holder and dependents have a registration number, which is unique per customer ....."

Step 2 - Writing requirements

Functional Requirements

ID	RF01
Description	The system shall allow the registration of a rental, **recording the customer and the items rented, the date and amount of the rent and expected return date of each item**
Priority	High

*Not included in the presented text

ID	RF11
Description	The system shall allow controlling/managing customer - holder and dependents.
Priority	High

Business Rule

ID	BR04
Description	There are two types of customers: 1. holder 2. dependent
Priority	High

ID	BR05
Description	A holder might have 0 to 3 dependents
Priority	High

ID	BR06
Description	Only persons of full age may be customers holding
Priority	High

ID	BR07
Description	The customer number is generated automatically by the system
Priority	High

5.4 Evaluation process of proposed approach

For the process of evaluation to be conducted in a proper order, is asked to the students to use heterogeneous mobile devices with a variety of operating systems and different browsers.

The evaluation process of the students has two stages, the initial response to a questionnaire on experiences of teaching and learning in the use of various types of teaching-learning methodologies and a second phase at the end of the course delivered. Students must be registered in advance and receive an initial explanation of how the whole process will be conducted.

To respond to the evaluation questionnaires (initial and final) module ministered, students are asked to answer using Google Forms. With this tool we can get the results of the questionnaires immediately.

The questionnaires will consist of questions divided into 20 categories in order to reduce potential polarization. For each question, students will respond through a Likert scale. The definition of the number of categories to be used in the Likert scale is according to Alexander et. al (2003) "*indicates four categories be better than a five-category scale*," so the four categories used are: 0 - nothing important, 1 - unimportant, 2 - important and 3 - very important. In the last part of the questionnaire is presented an open question giving students the opportunity to express their views by the introduction of comments.

The comparison of these results will be conducted between the results of the questionnaires that students will have to answer concerning the use of this model, with final results obtained where the education provided uses other teaching-learning process.

In this evaluation process will also be involved teachers in order to understand what degree of fulfillment found in monitoring the progress of learning and that way, positive or negative, the new process influence the results obtained

6 FINAL CONSIDERATIONS

In this paper it is proposed the use of the MGD system into the developed BML-CO (Xxxx, 2010) model in a RE course context.

The proposed approach was in consideration the Bloom taxonomy and the main goals of the course. Specifically it addresses two educational objectives, Understanding and Apply.

The proposed solution takes into account costs, by using open source software, and the learning context. We aim to increase the scope of the BML-CO model, not only to the RE teaching, but to others courses in the IS area.

REFERENCES

Alexandre, J., Andrade, D., Vasconcelos, A., Araújo, A. & Batista, M. (2003). Análise do número de categorias da escala de Likert aplicada à gestão pela qualidade total através da teoria da resposta ao item. XXIII Encontro Nac. de Eng. de Produção. Ouro Preto, MG, Brasil.

Armbrust, I., Fox, M., Griffith, A., Joseph, R., Katz, A. D., Konwinski, R., Lee, A., Patterson, G., Rabkin, D., Stoica, A. & Zaharia, M. (2010). A view of cloud computing. Commun. ACM. Vol 53. 50–58

Bonham, S. (2011). Whole class laboratories with Google Docs. Physics Teacher, 49(1), 22-23.

Cheong, C., Bruno, V. & Cheong, F. (2012) Designing a Mobile-app-based Collaborative Learning System. Journal of Information Technology Education: Innovations in Practice. Volume 11. 97-119

Claburn, T. (2010). Google Apps available to New York schools. Information Week. Retrieved from http://www.informationweek.com

Davenport, T. & Short, J. (1999), The New Industrial Engineering: Information Technology And Business Process Redesign. Sloan Management Review. 31(4).11-27.

Denton, D. W. (2012). Enhancing Instruction through Constructivism, Cooperative Learning, and Cloud Computing. TechTrends. 56(4), 34-41 - (Denton, 2012)

Google (2011). Google Docs. [Online], Available: http://docs.google.com

Gutwin, C. & Greenberg, S, (2002). A Descriptive Framework of Workspace Awareness for Real-Time Groupware. Computer Supported Cooperative Work, Vol. 11, 411-446.

Hay, D., & Anderson, K. (2000). Defining Business Rules - What Are They Really? the Business Rules Group.

IEEE (1998) IEEE Guide to software requirements specifications, ANSI/IEEE Standard 830-1998, Institute of Electrical and Electronics Engineers, New York, USA.

Kaur, R. & Singh, T, (2010). Analysis and Need of Requirements Engineering, International Journal of Computer Applications, 7(14), 27-32.

Khaddge, F., Lenham, E. &, Zhou, W. (2009). A Mobile Learning Model for Universities: Re-Blending the Current Learning Environement", iJIM. 3(1).

Krathwohl, D. R. (2002). A revision of Bloom's taxonomy: An overview. Theory into Practice, 41(4), 212-218.

Xxxx. (2011). M-English – Podcast: a Tool for Mobile Devices. Handbook of Research on Mobility and Computing: Evolving Technologies and Ubiquitous Impacts, Hershey: Information Science Reference. 250-266.

Xxxx. (2010). Proposta de um modelo Blended Mobile Learning orientado ao contexto. IEEE-RITA. Edición Especial. 5(4). 132-137.

Xxxx. (2011). Modelo Blended Mobile Learning orientado ao contexto aplicado ao ensino de redes de computadores. In Proceedings of CISTI'2011 (6ª Conferência Ibérica de Sistemas e Tecnologias de Informação). June 15 – 18.Chaves, Portugal

Xxxx. (2012). Work In Progress: A Blended Mobile Learning Context Oriented Model Applied To An Information Systems Undergraduate Degree Curriculum. Frontiers in Education Conference, October 12 - 15, Rapid City, South Dakota, USA

NIST. (2010). NIST Cloud Computing Program. Retrieved from http://www.nist.gov/itl/cloud/index.cfm

Pohl, K (2010) Requirements Engineering: Fundamentals, Principles, and Techniques, Springer; 1st Edition, Springer, USA.

Quinn, C. (2011). Mobile Learning: Landscape and Trends", Retrieved from https://commons.lbl.gov/download/attachments/77828943/mobile2011report-f2.pdf

Schrock, K. (2012). Google Tools to support Bloom's Revised Taxonomy. Retrieved from http://kathyschrock.net/googleblooms/

Schubert, L., Jeffery, K. & Neidecker-Lutz, B. (2012). A Roadmap for Advanced Cloud Technologies under H2020. Comissão Europeia. Retrieved from http://cordis.europa.eu/fp7/ict/ssai/docs/cloud-expert-group/roadmap-dec2012-vfinal.pdf

Wiegers, K. (1999) Writing Quality Requirements, *Software Development, May*

Wood, M. (2011). Collaborative lab reports with Google Docs. Physics Teacher, 49(3), 158-159.