Model for mobile, collaborative and multimedia e-learning environment

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ABSTRACT: *Integration of mobile devices in the multimedia delivery systems provides the users with access to multimedia content outside the classroom (workplace). In order to provide users with multimedia content that is suitable for their mobile devices and according to their needs, we use the mobile cloud (mCloud) computing environment as paradigm that is ideal to overcome these problems. In this paper, we propose a model for mobile, collaborative and creative multimedia learning in Mobile Cloud (mCloud) environment which goes beyond the existing solutions and provides personalized delivery of multimedia learning content. Our empirical results confirm that the increased possibilities for the exchange of ideas among the students and teachers within the Mobile Cloud (mCloud) and/or Social Networks (SN) lead to more creative work of the students (mobile learners) confirming the efficiency and usability of the proposed model.*

Keywords: Mobile learning, multimedia, collaboration, interaction, creativity.

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1. Introduction

In this paper we propose a model for mobile, collaborative and creative multimedia e-learning based on Mobile Cloud (mCloud) and Social Networks (SN) which goes beyond the existing solutions and provides personalized delivery of multimedia learning content.

Mobile learning systems provide easy portability, real-time learning, autonomy, interaction and collaboration in the process of m-learning [1]. However, the existing mobile learning systems, which are based on traditional teaching and assessment principles, provide the same learning content to every student [2]. The introduction of the interactive mobile live video learning system in a cloud computing environment is a step forward [3]. Another innovative technology for mobile learning systems is based on the Web 2.0 browsers, which allows teachers to author their own mobile learning environment and opens the opportunity for participation and collaboration anywhere, anytime [4].

Web-based collaborative work and virtual interactive classrooms have been used in order to inspire creativity in e-learning [5]. On the other hand, online social networking (SN), foster multi-disciplinary collaboration by providing a platform for researchers from diverse backgrounds to find one another and cooperate on issues of common interests. The authors in [7] provide a innovative student- centric platform for performing laboratory experiments based on collaboration in a creative and personalized way.

In our approach, we provide a system based on high interaction among the students organized in groups. The system stimulates social group collaboration and group creativity among the students by using the advantages of the mobile Cloud (mCloud). The instructor is just a moderator and advisor on the group level, while the students, supported by the mCloud and by using SN, are searching the learning multimedia content in high interactive, collaborative and creative way. In Section 2, we give the related work. In Section 3, we present the model for such a system, while our empirical results for the graduate students in Computer science and engineering at our University are given in the Section 4. The last Section 5 concludes the paper and gives our future research directions.

2. Related Work

There are several creativity models based on the processes of divergent and convergent thought [9], [10], [11], [12], [13]. Divergent thinking involves generating vast numbers of disparate ideas. However, creative solutions have been described in cognitive psychology as those that are both original and relevant. Convergent thinking deals with the latter by analyzing ideas for relevancy and feasibility, discarding anything impractical. Creative conversation occurs through collaboration and relationships between an individual and other human beings [9]. Working in groups allows individuals easy collaboration among team members to produce more ideas, share different perspectives and re-interpret each others' ideas, [8].

On the other side, groupware is defined as multi-user software that is designed to help team members to coordinate and track joint projects [14]. According to [8] groupware tools do little to improve the creativity of group ideas except to provide more efficient ideas exchange. In [16], the students in Biomedical Engineering develop own projects by searching for additional knowledge in a creative way. The students at the University of Aveiro (Portugal) developed their creativity and competence by working on minute paper, eBook writing etc. They also participated in brainstorming sessions followed by concise written reports. It is especially important to analyze the feedback from the group development of experimental short scientific project, [17].

Recently, the creative thinking and creative problem solving were studied as entrepreneurial mindset [15]. The participants of the workshop presented new ideas for the creation of a business for a product or service. The feedback from the participants concerning the business creation process was very positive.

3. Model For Mobile, Collaborative And Multimedia E-Learning

Delivery of multimedia content is highly dynamic and the innovative mobile technologies that are introduced can bring increased capabilities. When new media content is offered by the teacher than the users preferences are changing overtime, making a feedback loop. In order to have an efficient learning system, that will increase Quality of Learning (QoL), it is necessary continuously to adopt the feedback from the students in order to apply appropriate learning techniques that will increase their knowledge. This feedback loop in our proposed model for multimedia learning should provide collaboration between the participants using the social network interaction.

The model for mobile, collaborative and multimedia e-learning is presented on Figure 1. As can be seen from the model, the mobile cloud computing environment offers to mobile learners to use heterogeneous types of connections to Internet, such as WiFi, GPRS, LTE etc.

The architecture considers the influence of the social network groups of interest, and together they support the group support formation process. The mobile learner is connected to the system for m-learning using his mobile device. The cloud broker is responsible for authenticating the user to the m-learning system and then for processing the user requests for multimedia content. After receiving the user request the mobile cloud is responsible to process the request through a series of three services.

The first service is estimating the user learning preference using the information from different social network groups of interest. The user profiles provided in collaboration with the data from SNs are analysed in specific context according to the request from the mobile learner.

The next service is adapting the multimedia content according to the context-aware conditions of the mobile learner.

In the last step, the service of transcoding the multimedia content is performed in order to be compatible for the user's mobile device. The authoring multimedia service will complete the learning content that should be delivered to the mobile learner. Multimedia content adaptation server located in the mobile cloud will provide delivery of the adapted multimedia content to the leaner.

The adaptation of the multimedia content is explained in details in many previous papers of our research group.

All of the requests from user's mobile devices and heavy-duty processing tasks will be executed in the mCloud and the response is appropriate multimedia learning content. The main role of mobile cloud computing is to offload and to reduce the workload of mobile devices by exploiting the remote multimedia processing resources in the mCloud. The multimedia content is sent to the content adaptation engine and delivered to the mobile device.

In order to increase the quality of delivering of multimedia content, current systems try to improve the network parameters such as delay, jitter, packet loss, which are definitely important parameters to be considered using the Quality of Service (QoS). However, they are mainly measuring the accuracy of networked data delivery that is not sufficient to describing the actual experience of the user. Quality of Experience (QoE) metrics gives overall acceptability of an application or service, as perceived subjectively by the end-user and represents multidimensional subjective concept that is not easy to evaluate [18]. The relationship between QoE and QoS is non-trivial. It is a real research challenge to investigate and analyze what additional factors are influencing the user's perception of quality for delivery of multimedia content in cloud computing environment. The research presented in this paper is the first step in this direction.

Findings in [19] show that online social networking, foster multi-disciplinary collaborations by providing a platform for researchers from diverse backgrounds to find one another and cooperate on issues of common interests. The proposed learning environment in [7] provides a motivating and innovative student- centric platform for performing laboratory experiments by using a type of monitoring system via simulation. It not only conveys knowledge and skills to students but also develops their creativity, collaboration and personality. In our approach, we provide a system with a high interaction, social group collaboration (for increased attention of self-created groups of students) and group creativity among the students by using the advantages of the mobile Cloud (mCloud).

Initially, after the creation of the groups of students by themselves (for increased attention), the instructor is responsible for set-up the learning topics on the group level with some basic content and some introductory suggestions. After this initial step, the instructor is just a supervisor on the group level.

Then, the students are searching the learning multimedia content in high interactive, collaborative and creative way. The students communicate via Web in different ways: forum, chatting, exchange of messages and content etc.

The instructor is just an organizer and advisor on the group level, while the students, supported by the Web, mCloud and/or SNs are searching the learning multimedia content in high interactive, collaborative and creative way. This model provides rich interaction, collaborative and creative capabilities allowing students to access a vast knowledge base of logical interconnected segments related to a particular subject and, at the same time, the instructor can monitor the student's group learning progress and suggests or advises the groups accordingly. It is especially important to monitor the group of students in the process of developing an idea for research and how this idea is further used among the student as a basis for collaborative and interactive design and implementation resulting in first draft of the research paper.

The proposed model offers improvement in the quality of education, interactive and creative experience as well as collaboration among learners and teachers. To the best of our knowledge such a system is still not described in the literature. In Figure 1, we give only a general framework of the model for such a system, while our empirical results for the graduate students in Computer science and engineering at our University are given in the Section 4, "Empirical results".

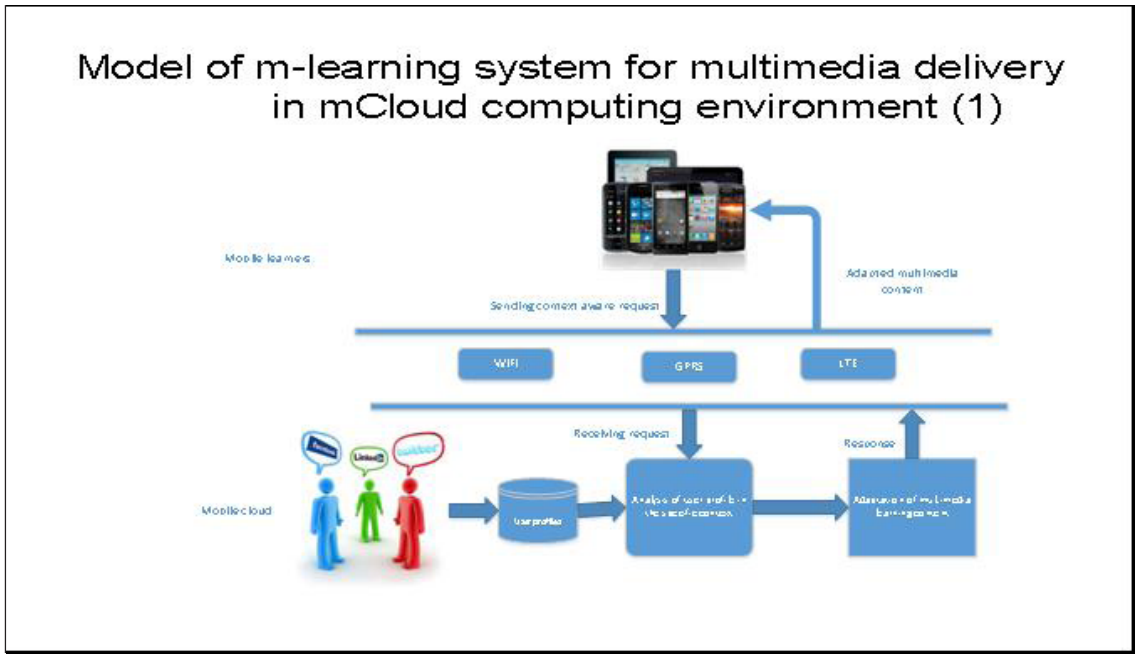

Figure 1. Model for mobile, collaborative and multimedia learning

4. Empirical Results

On Table 1 we presented some empirical results for the students on the master study in Computer Science for the Management Information System (MIS) course. As can be seen from the Table 1, the analysis is done for five years. Students were divided in groups working on different research projects. In 2011, the student didn't use mCloud or SN (only the usual usage of Web was evident). In 2012, mCloud was available for the students and as a result, three papers and one potential paper were prepared. In 2013, they used mCloud or SN resulting in three papers, two potential paper and one idea. Finally, in 2014 and 2015 the students could use mCloud and CN resulting in more potential papers and especially more ideas about the research work.

The number of papers, potential number of papers and research ideas is increased as a result of increased possibilities for exchange of ideas among the students and teachers within the mCloud and/or Social Nets (SN) or both.

The most usual student's projects were defined by the students themselves in consultation with the advisor (instructor). They proposed a problem from the companies were they were employed. After some basic knowledge within the MIS course, they had to analyze and design the solution by using Unified Modelling Language (UML). During the analysis, in the process of creating the use case model, they collaborated via Web, mCloud (Cl) or SCn by using their mobile devices (smart phones, tablets etc.) in order to find all necessary use cases, to propose new scenarios and/or to modify some existing scenarios. It is obvious that each group had specific interests according to the problem that was analyzed.

In the second phase, the design of the problem was performed by crating UML diagrams. According to the problem they have to decide which diagrams are the most appropriate for designing the problem (sequence, state or collaborative). Almost all of them used activity and deployment diagrams. During this process they exchanged information between themselves via SNs, but also they have searched some existing solutions on the Web, mCloud. It was usually necessary to find original solution and in some cases to modify and improve some existing solutions.

In the third and last phase, the group of students, on the basis of the UML deployment diagram implemented the solution (as prototype) by using preferred programming languages, databases and all necessary hardware and software components. In the case when all three phases are finished successfully, the research paper was almost done. Of course, they had to provide some experimental evidence and to compare their solution with some other relevant solutions.

However, as can be seen from the Table 1, some groups were not able to finish successfully all three phases, so we classified these works as "potential papers" or just ideas.

The increased quality of creative learning compared to traditional learning (lectures and exams) is evident. Working in groups on joint problem was also very productive, especially in the first two phases. Discussing the results and comparing with other solutions could be done only after the third phase (implementation of prototype). In this phase the students within the groups found very helpful to discuss together with the instructor the possible advantage of their solution.

Year (MIS-II cycle)	No. of students	No. of groups/projects	Average no. of students per group/No. of students per group using Web/CI and/or social nets(SN)	Total no. of research papers/potential papers/ideas
2011	32	10	3/1, no mCloud, no SN	1
2012	31	8	4/1 with mCloud, no SN	3+1
2013	30	6	5/2 with mCloud or SN	3+2+1
2014,2015	30	5	6/3 with mCloud and SN	3+3+4

Table 1. Empirical results for students in MIS

5. Conclusion

In this paper, we propose a model for mobile, collaborative and creative multimedia e-learning in Mobile Cloud (mCloud) environment which goes beyond the existing solutions and provides personalized delivery of multimedia learning content. From the empirical results, it is obvious that the increased possibilities for the exchange of ideas among the students and teachers within the mCloud and/or SN lead to more creative work of the students (mobile learners) confirming the efficiency and usability of the proposed model. In our future work, we plan to provide an extensive analysis of the attention process within the groups created by the student themselves. We expect an increased quality of creative learning compared to traditional non student centric learning. The increased attention and creative process within the group (supported by the usage of mCloud and/or CNs for content retrieval and communication) should be the crucial factor for this increased efficiency of learning.

In addition, we will especially focus on the quality of creative learning (QoL) by applying the adapted quality of experience (QoE) metrics for the proposed model.

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