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User-Centered Design in a mobile learning course

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Abstract

Mobile learning (or M-learning) is a blend derived from mobile and e-learning presupposing the use of mobile technology to facilitate the learning process. The success of a "mobile course" is influenced by many factors, first of all the fact of being "in motion". To implement a course is essential to define the most appropriate course model to use. The aim of this paper

is to illustrate how a "mobile course model" has been designed and implemented using the User-Centered Design and participatory planning methodology. Four experimentations were carried out, in which 20 university students were involved, which have led to production of some "guidelines" to be followed for the construction of a mobile course. As today's students organize a course for tomorrow's students.

Keywords: Usability, Mobile learning, User–Centered Design, Participatory planning

1. Introduction

Mobile learning (or M-learning) is a blend derived from mobile and e-learning presupposing the use of mobile technology to facilitate the learning process. The aim of this paper is to illustrate how a "mobile course model" has been designed and implemented.

The methodology used is the User-Centered Design (UCD), implemented by techniques such as interviews, direct observation, focus groups, questionnaires (on-line and paper), card sorting, paper prototyping, wireframing, creation of scenarios and user profiles, testing on samples of users, usability testing.

Twenty university students, who have attended the "Human-Computer Interaction" course of the three-year degree in "Communication, languages and cultures" during the 2014-2015 academic year, were involved in a participatory planning realized through four experimentations.

The sample was divided into two groups. Each group consisted of ten subjects, who took turns in the design and testing phase.

The results of the experimentation have led to the creation of some "guidelines", which will be followed during the implementation of the mobile courses.

2. Materials and methods

User-Centered Design (UCD) is a working mode where designers - in every phase of the design process - pose the greatest attention to the "point of view" and the "needs" of end users. Is a process consisting of several activities and is based on the iteration of different analysis,

design and verification tools.

This concept (UCD) has been introduced for the first time by Donald Norman towards the middle of the 80' [1] [2] [3] [4]. He notes that manuals accompanying many products, often long bulky and incomprehensible, help not users in any way. He suggests that each artifact should be accompanied by a small booklet, which can be read very quickly and should be designed taking into account the knowledge of the world (user-owned). He offers four basic tips designers; in particular the design should (Norman 1988, p.188):

- make it easy to determine what actions are possible at any moment;
- make things visible, including the conceptual model of the system, the alternative actions, and the results of actions;
- make it easy to evaluate the current state of the system;
- follow natural mappings between intentions and the required actions; between actions and the resulting effect; and between the information that is visible and the interpretation of the system state.

These recommendations place the user at the "core" of the project.

International standard ISO 9241-210: 2010 "Ergonomics of human-system interaction - Part 210: Human-centered design for interactive systems" (including the previous version, ISO 13407: 1999 "Human-centered design processes for interactive systems") is the basis for many UCD methodologies. This process consists of different activities and is based on the iteration of different analysis, design and verification tools. The objective is to improve the design according to the feedback received by users [5].

Designing contents for mobile learning, is crucial to consider the usability principles of these tools: small screens, touch interaction, need for earphones to exploring the contents, inevitably lead to a specific design.

2.1 Mobile learning

According to Helen Crompton vision mobile learning is defined as "*... learning across multiple contexts, through social and content interactions, using personal electronic devices* ..." that is a blend deducted from mobile and e-learning and presumes the use of mobile technology to facilitate the learning process [6].

The practice of using technology to enhance the overall teaching and learning in higher education, has seen an exponential growth with the emergence of internet and the development of information technologies. This integration of technologies has significantly changed teaching strategies in our educational institutions and changed the way teachers "teach" and students "learn" [7].

Since learning can occur in very variable locations and conditions, the design of a multimedia system for mobile learning must consider several factors. During the design phase, are essential the choice of the mobile device to use and a careful analysis of the future system users, to identify in detail both the user scenarios and possible experiences arising from the use of the system. The user's attention should be directed towards the goal of learning and not simply focused on the use of the portable device. In designing adaptable teaching materials, must be taken into consideration both the user needs / preferences and the characteristics of the chosen mobile device. On this information the developer must choose the right technology to use before starting the implementation phase.

Aspects on which to focus are: user analysis (users have a central role in the learning process, so user analysis is obviously a fundamental element), usability (an interface can be described as usable when it is easy for a beginner to learn how to use the application, fast acting for a more expert user, provides efficacious support to the user's working needs and is pleasant to use), designing a usable interface (designing the interface and presenting the information to the user according to the previous analyses), implementation of the application [8].

Mobile learning presumes the use of mobile internet technology to facilitate the learning process; learning whose characteristics are "Anytime" and "Anywhere". As a result, numerous Mobile learning portals have been developed to gain the advantages of it. Some authors have begun experimentations proposing usability guidelines in designing Mobile learning portals to achieve efficiency, effectiveness and satisfaction of learning. Usability Guidelines Framework which is based on three categories of usability: user analysis, interaction and Mobile learning interface design [9].

2.2 Related work

In the Australian program "Anytime and Anywhere Learning", the use of laptops in school and university environments has elicited greater motivation and interest in lessons and

improved learning and teaching styles [10].

The growth and rapid evolution of wireless technology, the lower costs of mobile technology (mobile devices, the cost of connection over cellular networks etc), the technology development that has transformed the modern mobile devices in real computer with specific applications for the web, convinced many researchers and educationalists to move from web-based and e-learning to mobile learning, which promising easy and convenient ways of learning. M-learning can create new opportunities for anytime and anywhere learning paradigm [11].

Since the distinguishing feature of mobile learning is mobility, this word is seen as the point at which mobile computing and e-learning intersect to produce a learning experience to live in every place and at all times. Anytime, anywhere computing can lead to paths of access to information and learning experiences accessible and portable [12].

In recent times, there has been an increase in the number of universities committed to the research related to the MOOC (Massive Open Online Course) platform. In the United States, 2012 was called the year of the MOOC. In Europe, this phenomenon is just spreading out while in the US nearly twenty to fifty MOOCs start every month [13]. The E-Learning Lab of Shanghai Jiao Tong University developed a mobile MOOC platform, We-Cast (was put on-line in 2011 and the iOS/Android client has been put into use since 2012). The platform integrates screen sharing and synchronous recording, layered transmission of real-time multimedia video streaming and many other proprietary technologies invented by the E-Learning Lab. So far, WeCast platform has a total of 520 on-line courses and has been visited 675.587 times (307.357 times on iOS devices and 368.230 times on Android devices) [14].

In 2002, a university at south of Brazil called Unisinos has proposed a new pedagogical approach to undergraduate courses. This approach is called “Undergraduate Course of Reference” (nicknamed GRefe). Currently, there are four GRefes. These courses are organized in “Learning Programs” and “Learning Projects” and include the use of mobile and ubiquitous computing technology to support and improve learning [15].

In 2014, at the Grinnell College, the researchers propose a new model – a different approach involving student-faculty collaboration for the development of the course rather than follow an instructor-dictated development process. Basing development on course goals and

objectives, a faculty member works with a development team of undergraduate students to structure course content, prepare materials (e.g., readings, laboratory exercises, problem sets, projects) and test each element of the course. The instructor tabulated topics from the traditional course, reviewed ACM curricular guidelines and provided experience with lab-based teaching. Students brought their recent learning experiences taking computer science courses, identified themes and applications that could excite students and shared their experiences concerning potential obstacles they had with learning various topics. The instructor and students identified groups of topics and activities that seemed to fit together naturally. Over time, brainstorming sessions helped identify an overall structure for the new course [16].

3. Case study: Materials and Methods

Using the User-Centered Design methodology, 20 university students were involved in a participatory planning whose objective was the design and implementation of a "mobile course model".

A preliminary part of the activity, but crucial to the course design, was aimed to the analysis of the models, used by major universities present in iTunesU platform. Has been chosen to use the ranking compiled by Jiao Tong University in Shanghai in 2014, the Academic Ranking of World Universities (ARWU) [17], which assesses the main tertiary education institutions.

This list, along with the QS World University Rankings [18] and the Times Higher Education World University Rankings [19], is considered as one of the most important and most frequently used tools in the world. Despite some criticism in academic circles, is still considered a list drawn up in accordance with clear and objective criteria.

Based on this ranking, the models of the top 15 universities in the world listed on iTunesU have been analyzed.

From this analysis, a total heterogeneity in the solutions used has emerged: from the point of view of timing (the video length ranged from 15 to 90 minutes), from the point of view of the shots, from the point of view of camera techniques (from fixed camera to the moving camera), from the point of view of subject movement (the only teacher, the teacher who alternates with slide, the teacher writes on the blackboard, the teacher who uses a laser pointer to highlight

the projection screen concepts, the teacher that uses a specific software).

The objective of the experimentations described below, was to engage students in a participatory planning to define - through iterative refining of the developed prototype modules - mobile model course: how today's students organize a course for students of tomorrow.

It was decided to take a really existing education - provided in the classic mode of classroom lectures - and use as a basis for the design. The "Human-Computer Interaction" course of the three-year degree in "Communication, languages and cultures" was chosen: the lecturer shared and supported the idea of multimedia learning, students appreciated his exhibition and dialectical skill, the topic of course very well conciliated with the experimentations.

3.1. First Experimentation

Participants: were involved in the experimentation 20 students (11 males and 9 females), aged between 21 and 25, who attended the course “Human–Computer Interaction” of the triennial degree in “Communication, languages and cultures” during the academic year 2014–2015.

Objectives: involve the users in a participatory planning, in order to define the standards of the course, the graphics to use, the type of content, the duration of the clip.

Procedure: Students participated in a focus group in which it was shown – the Mobile learning, the User–Centered approach, the importance of participatory planning, the aim of the experimentation. So began the discussion (in order to bring out the expectations of the users, the type of content included in the platform, the format to be used – considering also between different graphics options).

After the focus group students were interviewed (so that each of them could freely express their design ideas) and filled out a mixed questionnaire. The first part (socio–identifyng) contained open-ended questions (Last Name, First Name, Age, Place of birth, etc.). The second (technological) contained closed questions type YES / NO (Knowledge of e-learning platforms, Knowledge of iTunesU – the platform used by the University of Siena, etc.). The third part (teaching) included questions on graduated scale 1-5 (Interest for the course, Understanding of contents, etc.). The fourth part (design) contained a single open question (How would you design the course of Mobile Human-Computer Interaction?).

Results: 100% of users knew iTunes, 93% knew iTunesU, 67% knew iTunesU Siena (our platform), 93% showed a strong interest in the course, 87% reported a good understanding of

the topics. The sample of users, therefore, was highly motivated to work and the course chosen was deemed accessible thanks to the clarity of lecturer.

The open question was undoubtedly the most interesting (how today's students would organize a course for tomorrow's students). 100% of the subjects responded that a service like this can not follow the classic mode of lectures (such as timing, duration, illustrated content), 87% considered useful to provide – also – a written documentation (slide), 93% believed that each content should be limited in time (preferably the same for all).

Conclusion: by the feedback received was developed the model which will then be implemented.

- course will be modular (this will allow lecturer to add, edit and remove modules in the future);
- each module will contain only a specific topic;
- each module will have a maximum length of 10 minutes;
- for each module will be made available audio, video and PDF content;
- for each course will be produced an initial video of “Welcome” (explaining the contents of the collection), a video of “Getting started” (outlining the learning environment and the modules that will be contained), a series of videos related to “Tests in progress” (to check directly to the student's level of learning).

3.2. Second Experimentation

Participants: were involved in the experimentation the same 20 students who attended the course in the year 2014 – 2015. The sample was divided into two groups, each group was asked to perform a specific task.

Objectives: involve the users in a participatory planning, in order to define the most appropriate video format for the course, produce a prototype module, perform a test on a sample of users.

For each group, the procedure used and the results obtained will be presented. Students of the first group participated in the design phase. Students in the second group participated in the testing phase.

Procedure: the first group participated in a second focus group which aimed to define the

video format best suited for the course (considering a mobile use). At the end of the focus groups were carried out the interviews; each student was able to freely express their design ideas.

Results: the feedback obtained with the first group showed that the mere presence of lecturer in the video was not enough, but that this must be accompanied by slides relating to the discussion. A first prototype module (entitled "Human-Computer interaction") was implemented, in which alternated still images to moving images (figure 1); the lecturer explains and alternating to slide following a fairly regular intervals.

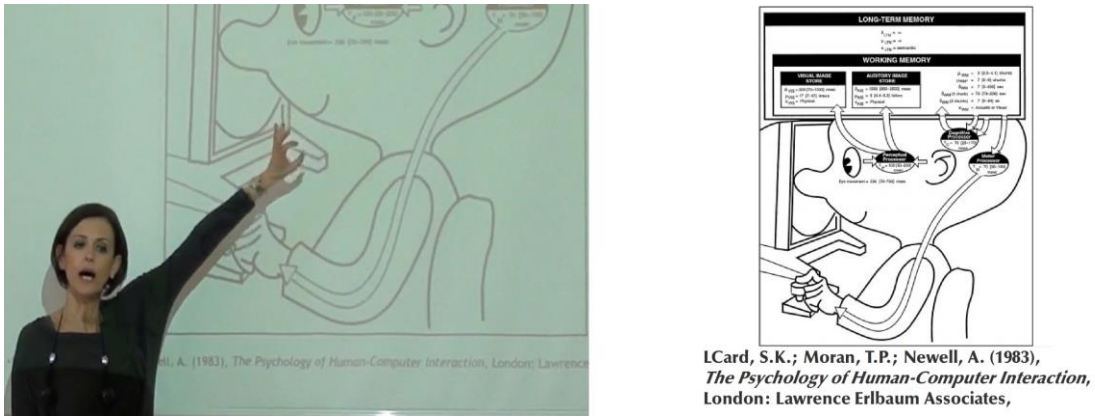

figure 1 – First prototypal module (source: University of Siena)

Procedure: students of the second group have interacted with the prototypal module product previously, using a mobile device (tablet). The task was carried out in a laboratory in order to videotape the interaction; students had to speak loudly to record questions and criticality. After the test students filled out a mixed questionnaire. The first part (socio–identifyng) contained the same open–ended questions (Last Name, First Name, Age, place of birth). The second (evaluative) contained both closed questions of type YES / NO (The video format corresponding to your expectations?) and open–ended questions (What difficulties have you encountered?, How would you improve the format?).

Results (analysis of video recordings): 60% of the subjects interrupts the vision, came back to the point where the slide is displayed, read the concepts expressed again and then continued the vision; 53% of subjects discontinued the vision at the exact moment when appeared the slide containing the "key concepts" presented by the lecturer (read them thoroughly and then starts again).

Results (analysis of questionnaires): 67% of the subjects found difficulty in following the exposure of lecturer, 53% expressed the need to have "paper slide" as a form of support while

watching the video (for example on the desk), 40% showed some difficulty in identifying the key concept explained by the lecturer (for example when – in class – the lecturer indicates with his finger on the projection screen a specific concept), 60% expressed the need to have a viewing time of the slide greater than that provided (since each student has their own learning times, is difficult to optimize the viewing time).

The critical issues emerged, highlighted the need to re-design the video format.

3.3. Third Experimentation

A second prototype module (entitled "The four approaches to design") was created, in which they appear – simultaneously and permanently – the slides (on the right, to reinforce the concept shown) and the lecturer who explains (on the left, in a smaller panel). Also, when the lecturer explains a specific concept contained in the slide, some "highlights" were used to attract the student's attention on that specific point (figure 2).

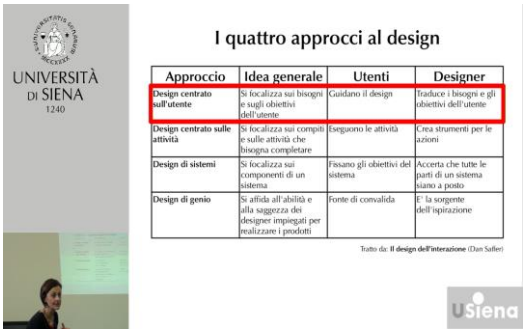

figure 2 – Seconf prototypal module (source: University of Siena)

Participants: were involved in the experimentation the same 20 students who attended the course in the year 2014 – 2015. The sample was divided into two groups, each group was asked to perform a specific task.

Objectives: involve the users in a participatory planning, in order to evaluate the solution found with the second prototype module.

Procedure: students in the first group have viewed "video content", while students in the second group listened "audio content". The task was carried out in a laboratory in order to videotape the interaction; students had to speak loudly to record questions and criticality. After the test students filled out a mixed questionnaire. The first part (socio–identifyng) contained the same open–ended questions (Last Name, First Name, Age, place of birth). The second (evaluative) contained both closed questions of type YES / NO (The video format corresponding to your expectations?) and open–ended questions (What difficulties have you

encountered?, How would you improve the format?).

Results (analysis of video recordings): 93% of the students was able to follow (without interruption) the lecturer during the explanation (the use of content was more fluid and continuous), only 7% discontinued the video while vision.

Results (analysis of questionnaires): 87% of students considered “easy to understand” the contents (also in virtue of the clarity of the lecturer), 100% were able to identify the key concepts explained by the lecturer (thanks the use of the highlights), 87% considered that the video format proposed meets their expectations, 93% considered very useful the use of concept maps (to be set immediately for the concept that a little later would have been exposed by the lecturer) , none of the students expressed the need to have slide in support, 93% expressed a very high degree of personal satisfaction in the use of the instrument (the User eXperience).

4. Results and discussions

The results of the testing phase are certainly encouraging. But we must make some considerations.

The first aspect to be considered is “the technological aspect”. Sometimes while watching – the video was blocked – or “jiggled” (as is commonly said). This is an important aspect, although it has nothing to do with the proposed model because it is related to the connection speed of the devices. The problem can be easily solved by downloading content on their mobile device. New technologies need bandwidth, fast lines, fiber optic. If we do not invest in this area, given the almost inadequate and critical infrastructure in our country, instead of living a phase of development could further increase the digital divide.

A second aspect to be considered is “the type of content” be made available to students. We can ask whether is useful or not produce an audio content identical to the video content. I personally think so. Obviously a video content, characterized by the presence of the lecturer and the slide, is more performing but needs more attention from the student. An audio content is less demanding on human resources (trivially - the visual component is not used) so it can be used more profitably in all those situations in which the external environment reduces attention. The observation made by a student is significant: “I will use video content to study and audio content to review the lesson”.

This aspect allows us to reflect on another point. Obviously learning in a mobility context is totally different from learning classical, in the comfort of own place of study (at home, at the library, etc.). Many are the factors that influence its success, the crowded environments, the background noise, the fact of being "on the move". However, this can be an advantage because it leads us to make the best use "dead time" of the day: the time spent on the bus or train, the wait in the square or at the station. So it is essential to understand which is the model suitable to achieve. To do this it is vital to involve end users (in our case the students) in its design (User-Centered Design).

The last aspect to be considered is the following: the proposed model can be exported in its entirety for all the teachings? Hard to say, probably certain scientific teachings have different needs compared to literary teachings or the teachings in the medical field. It should therefore produce prototype modules for some lessons (sample) occurred in each area in which is divided the educational offer of the University.

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