Usability Issues of e-Learning Systems: Case-Study for Moodle Learning Management System

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Abstract. Mobile devices have potential to be integrated into the classroom, because they contain unique characteristics such as: portability, social interactivity, context sensitivity, connectivity and individuality. Adoption of LMS by students is still on the low rate, mostly because of poor usability of existing eLearning systems. Usability issue is rising to the higher level on mobile platform, due to device limitations and also because of context of use. Our hypothesis was that it is wrong to take a mobile device as a surrogate for desktop or laptop PC. By accessing LMS on mobile devices using adaptive technologies, like Google proxy, we didn't acquire the satisfactory results. Possible solution to the problem could be development of rich client applications for today mobile devices that would improve usability. Results gathered in usability research conducted among students have confirmed that development of eLearning systems needs to have learner in the center of development process.

Keywords: Usability, User center design, mLearning, Moodle, Mobile devices.

1 Introduction

Education is organized process of knowledge, skills, values and beliefs transfer and prerequisite for any improvement at individual or social level. Due to technological advances new opportunities emerge to fulfill the process of education amongst the strongest representative is the computer, which with its abilities added a whole new dimension to the education process [1]. E-learning is an approach to facilitate and enhance learning through both computer and communications technology. This type of learning uses network that can be Internet, university network or corporate computer network.

E-learning is usually based on learning management systems LMS. LMS is software for different types of direct and indirect interaction between professors and students, and exchange of different type of electronic learning material. Most used systems are Blackboard, WebCT (commercial software) and Moodle (free open source software).

In order to truly integrate eLearning system into regular curriculum at University, mobile access to LMS has to be enabled. Mobile devices have potential to be integrated into the classroom, because they contain unique characteristics such as: portability, social interactivity, context sensitivity, connectivity and individuality. But

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student experience is not always good, and adoption of LMS by students is still on the low rate. This is mostly because of poor usability.

The prime assumption of this work is that poor usability of existing eLearning systems leads to poor adoption. Our second hypothesis is that it is wrong to take a mobile device as a surrogate for desktop or laptop PC. By just adopting existing LMS on mobile devices with adaptive technologies, like Google proxy, we do not acquire the satisfactory results. Usability can prove to be even lower compared to desktop application.

This paper is aimed at issues of LMS systems usability for desktop platform as well as mobile devices. Those issues are addressed to in section two of this paper. Existing research in this field is a focus of section three. As a competitive technology for our usability study we developed a prototype that we presented in section four. Above mentioned usability study as well as results are presented and discussed in section five. Conclusion is given at the end of the paper.

2 Usability Issue of e-Learning Systems

As a part of our teaching activities, our faculty is using Moodle LMS (Learning Management System) in order to support course activities. Professors are usually adding contents for a course, on a weekly basis. Students are provided with the ability to regularly inform on new events and gain new information on course via News section on our eLearning portal. Collaboration, as well as discussion is encouraged through forums. Quiz module is widely used for student self-examination during the semester, and also for student knowledge evaluation. In spite of the obvious upsides of this type of conducting course, students brought to our attention several issues of use. We are constantly receiving e-mails, with questions about finding some material, logging-in to the system or grade checking. Students often get frustrated with these problems which are providing the reasons for complaint.

On the other side, same problems occurred during our collaboration with Energoprojekt company that resulted in building a life-long eLearning system through utilization of Moodle LMS for knowledge verification [2, 3].

Several questions are raised from this experience: Is Moodle too complicated for novice users? Is there a usability problem with Moodle?

Also we cannot disregard the learning effect that can be achieved "*On the go*". Standard use of LMS systems simply by use of desktop computer does not fully involve the user and it cannot provide essential information at any time. One solution to that problem is provided by mobile technologies. By using adaptive technologies we can reformat the content to suite mobile devices. The problem is that by doing so we usually end up with confusing content due to limitations of such device.

This lead us to our research hypothesis: Moodle LMS has usability issues, which represents major disadvantage of this LMS, and makes positive aspects of eLearning systems less effective; Usability issues are rising to the higher level on mobile platform; It is wrong to take a mobile device as a surrogate for desktop or laptop PC.

3 Existing Research in the Field

Multimodal interaction is part of everyday human discourse: We speak, move, gesture, and shift our gaze in an effective flow of communication [4]. While multimodal interaction research focuses on adding more natural human communication channels into HCI, accessibility research is looking for substitute ways of communication when some of these channels, due to various restrictions, are of limited bandwidth [5]. During our research we addressed general issues of multimodal HCI and universal accessibility by proposing generic frameworks [4, 5]. A specific area of our research is dedicated to usability issues of e-Learning systems and mobile devices.

There is a huge bibliography on adaptive and context aware applications [6]. In particular, lots of papers that have been written on this issue in the context of mobile computing: adaptation to limited device capabilities, network bandwidth, location, QoS and user preferences (among others) have been already deeply studied. However, research area targeting access to Moodle via mobile devices is not adequately addressed to, only few solutions for mobile access to Moodle content was proposed [7,8,9,10], and few researches were conducted concerning usability of Moodle via mobile devices.[11,12] On the other hand, the usability issues for mobile devices were a common subject among many researches, which shows the effectiveness of experimental method applied in our usability research [13]. Also there were several projects not specifically targeting Moodle, but offering solutions for social interaction via mobile devices [14, 15, 16, 17] as well as custom made m-learning solutions [18,19,20,21].

Most of the researches rely on adaptive technologies in providing access to eLearning systems e.g. Mobile browsers. However, this approach has few drawbacks:

Limited screen size: Standard Moodle pages are designed for access from standard desktop PC, with large screens, but mobile devices have very limited screen size. Mobile browser wrap content in order to show it in whole, and we lose initial page layout. Browsing through standard web pages by use of mobile browsers is at a low level.

Limited input methods: Input on standard web pages strongly relies on keyboard usage, but mobile devices usually lack one.

Limited network bandwidth: Each web page is actually bunch of HTML code, and each page load and reload actually sends request to the web server and receives the whole HTML code for requested page. Network overhead can be pretty big, when we open standard web pages via mobile device.

4 Rich Client Prototype

In order to test our hypothesis we decided on comparing standard approach to Moodle LMS via desktop computers against mobile solutions. Since usability of LMS systems is subject of test, we also required a comparison technology for adaptive mobile solution. For that purpose we decided to develop a rich client application for PocketPC, and a Web service as standard middleware interface between Moodle database and a client application. System architecture is shown below (Fig. 1).

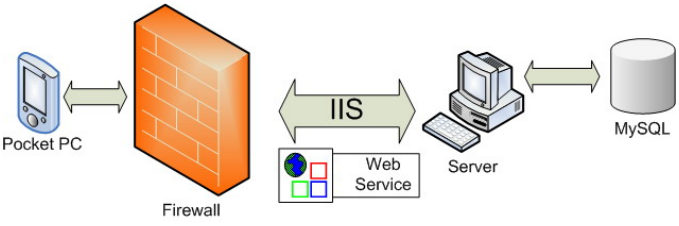

Fig. 1. Mobile Moodle architecture

Since Moodle was developed using PHP/MySQL platform, we have chosen to develop a Web Service as more universal data source to access Moodle from different kinds of devices and platforms. Because Web Service implements standard interface described by WSDL, accessible via SOAP based on XML it's very well suited as a universal data source, much better than just MySQL database. It also supports additional features such as using a firewall for extensive security without additional reconfiguring. In our architecture, Web Service is very important, in order to develop clients and support broad range of mobile devices (PDAs, mobile phones, smart phones, etc.).

Rich client application could be a better solution than standard or WAP Moodle pages, because it targets main drawbacks (listed in previous section) of these solutions. However there are downsides to using rich client (fat client) where most significant is *forking* (Certain changes to Moodle will require updates of client as well as server).

Fig. 2. News module (list and detail) and activity module (list of activities between chosen dates)

Brief comparison between existing solutions and prototype application by selected criteria is given in the table below.

Table 1. Comparison of HTML,WAP and rich client Moodle access

	HTML/WML Moodle	Rich client Moodle
Limited screen size	HTML controls, one page model – harder to use	Better component layout – easier to use
Limited input methods	each user action require response from the server, over the network – slower and less productive	Richer user controls gives more options for user interaction – faster and more productive
Limited network bandwidth	has network overhead, complete page is reloaded for each data change	small network overhead, only new/modified data exchanged

Brief comparison showed competitive advantages of customized smart client application over HTML/WML based solution. Based on that we proceeded with usability study, which includes examination of different usability aspects such as: stability, response and feedback, consistency, control and screen design.

5 Usability

Usability often refers as the question of how well users can use system functionality [22]. Usability is not one-dimensional property of user interface. It's associated with five attributes: learnability, efficiency, memorability, errors and satisfaction. In order to measure usability we conducted a Think aloud study [22] amongst University students.

The goal of the study was to determine the usability of Moodle LMS system. We attempted to determine the quality of our PDA application prototype in comparison to other available technologies for using Moodle via mobile devices and also to compare the results to standard desktop approach using web browser. As the alternative technology we have chosen the *Google Proxy* for mobile devices that provides the service of reformatting the requested content to be more suitable for mobile devices. We used *Google Proxy* for mobile phone and PDA as well.

Our research was conducted on one Desktop PC, two PDA devices and two mobile phones. First PDA was *HP Ipaq rx3715,* with our rich client prototype. Second was *Dell Axim X30*, that subjects used for performing tasks on *Google Proxy* reformatted content. Both devices had *Pocket PC 2003* for an operating system. Finally, our mobile phone devices were *Nokia,* model *N80* with Symbian OS 9.1 and slider numerical keyboard, as well as *QTEK*, model *9100*, with Windows Mobile 5, touch screen and slider QWERTY keyboard.

Students first performed a predefined set of tasks on a desktop computer using web browser. Then they performed the same predefined set of tasks firstly on PDA using our custom PDA Application, following on PDA using internet browser through Google Proxy, and at the end on mobile device using internet browser through Google Proxy. The tasks were done in a predefined order. First they had to log in. Then they were expected to check for news and then read them. Next came checking for the

upcoming activities and informing on them. Following, they needed to send a message to other participant as well as check for their own messages. Finally they were required to check their grades on different courses.

After the participants performed a set of tasks on different platforms, they were asked to fill out a questionnaire. Questionnaire included a few demographic questions about respondents and their computer skills. Then followed questions about subjective satisfaction on every platform and questions that required them to rate the platforms and to explain their rating. Questions about subjective satisfaction were presented using seven points semantic differential rating scale from positive impression to negative impression (for example 1 = complicated 7= simple).

Subjects in our research were undergraduate senior year students from different departments at University of Belgrade Faculty of organizational sciences. Research was conducted in a laboratory conditions. A total of 12 students participated in a study and all of them completed the end survey. Respondents were 8 men and 4 women. All respondents were experienced users of computer, PDA and mobile phone. The mean knowledge about CMS systems was 4.92, on the seven point scale, where 1 = no knowledge about CMS systems, and 7 = sufficient knowledge about CMS systems. On the scale ranging from 1 = little experience with e-learning to 7 = experienced user of e-learning systems, our participants mean was 4.58, with no answer under 3.

Students performed the tasks while sitting down. They were documented by two cameras, one aimed directly at their face to reveal facial expressions during the session and another aimed covering actions on the mobile device. Also a microphone placed on the subject recorded commentary and voice. During the session the subjects were encouraged to think out loud, by asking them questions such as: „*What are your thoughts now?*“, and „*Can you state your imppressions about performing this action?*“.

During the task completion we measured efficiency of use by measuring number of clicks/taps and the times necessary to complete the task. Besides efficiency we measured errors by number and type (simple and catastrophic), and subjective satisfaction.

First table (Table 2.) provides the results of measuring the amount of click/tap actions to complete the given operation with results of measured amount of data transfer in Kb per operation. Operations are processed for each device/technology. The results provided indicate that PDA Application has the lowest amount of click/tap actions comparing to other technologies. The only exception is *Read Activities.* The reason for that is poorly developed input control for specifying the date interval for searching the activities. It does not provide the ability of choosing the date from calendar but requires manual input. Another indicative that this is a good place of improving the interface came from our test subject that commented on this feature as inadequate during our *Think aloud* study. Some of these comments were: “*The date input is too complicated!”* or *“It is too difficult to enter the date, and I am repeatedly making a mistake!”*.

The given data for data transfer clearly states the obvious advantage for PDA Application comparing to other technologies. Interaction between PDA Application and a Web Service provides impressive amount of savings in data transfer due to the ability to return only the data relevant for the given operation.

Table 2. Click or Tap numbers/ Measured data transfer (Kb)

	Desktop		PDA Application		PDA Browser		Mobile Browser	
	No	Kb	No	Kb	No	Kb	No	Kb
Login	15	166	15	1	16	37	24	37
Read News	2	17	1	4	7	13	12	13
Read Activities	2	30	22	1.5	9	16	12	16
Send Message	17	7	16	1	22	9	29	9
Receive Message	2	6	1	2	5	7	8	7
Check Grades	3	5	1	1.5	6	4	9	4

Second table (Table 3.) is a summary of results acquired by measuring time efficiency of each operation executed by our test subjects. The data shown in table are average times per operation for given devices/technologies. Revision of data leads us to a conclusion that PDA Application is more time efficient than other two mobile technologies for each operation performed. Interesting fact is that it also proven to be more efficient than standard Desktop use of Moodle except in two cases *Login* and *Read Activities.* Average time for *Read Activities* can be explained by poor method of date input mentioned earlier while the reason of longer lasting *Login* operation could be blamed on lack of keyboard on PDAs part. Also several of our test subjects positively commented on ease of use of PDA Application as opposed of Desktop internet browser. Some of these comments were: *"It is a bit confusing to navigate to the wanted section, and it is hard to immediately find a way to perform the given operation",* this regarding the Desktop internet browser, and also *"It is much simpler to find my way around on this than on Desktop",* regarding the PDA Application. The results and subject comments lead us to a conclusion that Moodle is not intuitive and user friendly. It is obvious that our subjects had difficulty in performing even the easiest of tasks using this technology.

Table 3. Average user time per operation (second), for each of devices

Time (second)	Desktop	PDA Application	PDA Browser	Mobile Browser
Login	27.8	34.7	39	54.3
Read News	58.2	23.2	80.6	87.4
Read Activities	82.6	98.5	121.5	139.9
Send Message	74.8	39	181.6	209
Receive Message	55	27	65.9	57.2
Check Grades	45	18.8	59.6	65.6

In order to graphically present the corresponding data we provided the chart (Fig. 3). Average time per operation, for our rich client prototype is shown with red vertical bar.

As we described subjective satisfaction was measured by seven point's semantic differential rating scale. Questions included in measurement were: System is pleasant to use; Interface is complete; Interface is simple for use; System is fast for use; System is cooperative in completing the tasks. Results are shown on the chart (Fig. 4).

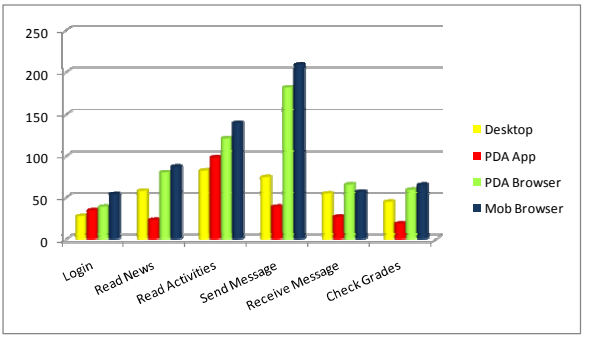

Fig. 3. Average user time per operation (seconds), for each of devices

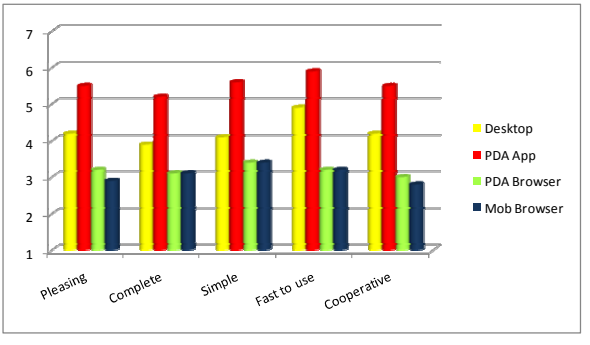

Fig. 4. Results describing subjective satisfaction for each platform

Rankin results were similar as results from satisfaction measurement. Almost all respondents (9 of them) said that the most preferred platform is PDA application. Second preferred was desktop, third PDA browser and forth Mobile browser. Some comments about PDA platform were *"PDA application is very easy for use, and almost all poor implementations from desktop are corrected."* or *"PDA application is almost perfect!"* or *"Definitely, PDA application is my the most preferred solution"*.

During the test there were no catastrophic errors, but there were few occurrences of simple errors such as accidental closing of mobile browser (two times) and one network error during the call to a Web service. The test resumed after the second try.

In spite of the positive results acquired by this research we noticed a few downsides to this type of testing. Primarily, the order of conduct implied the ability of our test subjects to accommodate to the LMS's way of use. Since they performed the same set of tasks by use of Desktop, PDA Application, PDA browser and mobile browser respectively they were in position to learn how to perform the same tasks on mobile devices with adaptive technologies. Even so, the results clearly stated that PDA browser and mobile browser were by far the most complicated tools in order to complete the given tasks. Limited resources provided us with another difficulty during our session. The lack of instruments forced us to form a queue, which caused the

need of additionally motivating our subjects. This is also a reason why the optimal amount of test subject was only 12.

Due to mobility of technology tested here, we cannot ignore the effect of using eLearning system *"On the go"* which is probably the strongest argument for this type of technology. Next step in our research will be to conduct a study in real life situation, away from office or classroom, and to consider the usability in such circumstances. Also we should consider the learning effect achieved this way.

6 Conclusion

During our experience in working with LMS's we came to a conclusion that users have a problem accommodating to them. Another question that occurred was inability of such systems to adequately provide their services via mobile devices. For that purpose we conducted a usability study that targeted user's ability to accommodate to specific LMS. As an alternative to mobile adaptive technologies for access to specific LMS we developed a rich client prototype for mobile device. Our usability study included this technology as an alternative.

The results and subject comments gathered during our study lead us to a conclusion that Moodle is not intuitive and user friendly. It stated as obvious that our subjects had difficulty in performing even the easiest of tasks using desktop technology. Adaptive technologies for accessing Moodle via mobile devices gave even lower results, and proved as inadequate. Our rich client prototype proved as more time efficient than other two mobile technologies for each operation performed. Interesting fact is that our prototype even preceded desktop approach and was favored by most of the subjects. Further development may include implementation of other popular Moodle modules (like blog, wikis, quiz, hot potatoes quiz, lessons, assignments...). However, we should carefully weight benefits before deciding to implement support for other Moodle modules in rich client application, because of mobile device limitations (e.g. screen size, memory, keyboard). Not all of them are well suited to be used from mobile device.

As a continuation of our research we will focus on usability of LMS systems in real life situation, during the class and also away from office or classroom, by use of mobile devices.

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