

Evaluation of a Learning Analytics Tool for LMS

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Abstract- We have developed several tools to allow instructors analyzing students' interactions in a Course Management System. In this paper we describe a Systematic Usability Evaluation made to test the usability of one of these tools, based on cookies. The evaluations were based on task analysis and follow-up studies. In addition to regular observation and questionnaires, 3D video was used to provide the evaluator with more information about interactions. The use of this technology helped us in identifying functions and features that need to be improved.

Keywords- Learning Analytics; Usability Evaluation; E-learning; LMS; Teaching and Learning Process Enhancement

I. INTRODUCTION

Most Course Management Systems (CMS) lack versatile tracking functions, as shown in different studies [1, 2]. Sometimes, they provide information but it is not as accurate as teachers' demand, for instance, to use them to predict and prevent from possible students' dropping off or failings.

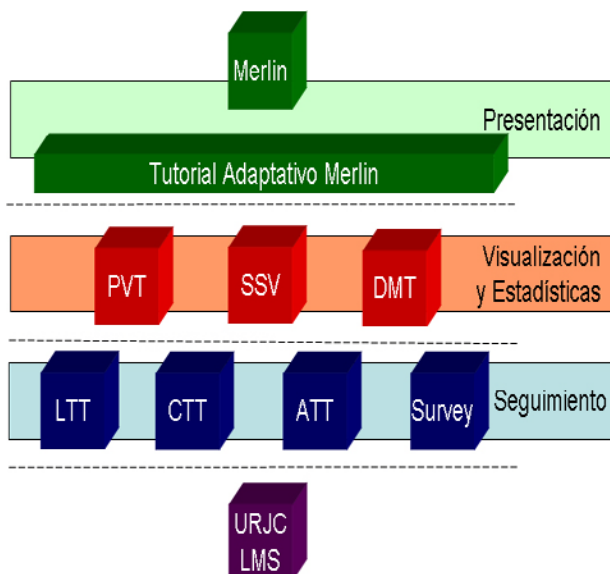


Fig. 1 Learning analytics systems to enhance CMS at the university

We have been working on building better tools for analysing students' interactions with a CMS at our university [3]. They are based on four different approaches, namely: log analysis, cookies analysis, records of interactions of the identified students by login name and surveys. Fig. 1 shows the structure of the tracking system which is divided into four parts. Firstly, the web log analysis tool analyses log server files. It shows information to the user (i.e. the teacher), based on the assumption that accesses are impersonal, since the log files do not storage login data. Secondly, a Cookies Tracking Tool (CTT) allows us to storage the user accesses based on the use of cookies. Thirdly, a more subjective approach based on surveys has been developed. Finally, an ad-hoc Tracking Tool (ATT) that records all the user accesses identified by their login name is being developed.

In this paper we focus on the CTT, a cookies-based analysis tool. The application collects data about users' interactions with the CMS and stores them in a data base. Afterwards, the tool allows teachers to display information about students' accesses in different graphical and tabular formats.

The user interface of the CTT is shown in Figure 2. Notice that there are four different areas of the tool interface, depending on the data the user wants to obtain and are identified in the figure with a number. Number 1, "statistics by visits' number" area allows the teacher to obtain the number of accesses to a subject page or to a part of it grouped by different criteria and visualized in different chart or table formats. Number 2, the "most frequently followed paths" area offers a tree visualization of the sequence of clicks or accesses to pages that the user has followed most frequently. Number 3, the "number of visits per page" area displays all of the system pages ranked according to the number of accesses they had. Finally, number 4, the "user's statistics by" area offers several features of the computing and connection resources of students that the user/teacher can wish to consult. The information requested from the four areas can be constraint to ranks of data in the upper area of the tool, identified by number 5. Finally, complementary functionality regarding maintenance of users of the application, interactive help, summary of accesses to the CMS, disconnection, etc. can be selected in the left-hand side menu.



Fig. 2 Learning analytics tool main interface

This application was plugged-in to our CMS and has been collecting data for five months about accesses of students to web sites of different courses. We offered the tool to some teachers, who reported us problems on understanding all of the features of the tool. Consequently, we developed a Systematic

Usability Evaluation (SUE) to enhance it. Our ultimate goal is to improve the tool interface before making it available to teachers for their dairy teaching activity. Of course, they had no previous experience in the use of the system.

The paper describes the SUE Inspection we performed in our CTT. Section 2 describes the three parts of the SUE inspection. In the third and fourth sections, we describe the participants and the tasks they had to fulfil and an idea of the results they got. Section 5 contains results obtained from the three parts of the SUE. Finally, we summarize our conclusions.

II. A SYSTEMATIC USABILITY EVALUATION

There are many possible ways of combining the various usability methods [3] but it is highly recommended not to rely on a single one to the exclusion of others.

Thus, we have carried out the SUE inspection by a combination of three usability methods, namely: observation, questionnaires, and interviews.

The first method consists in the observation of the user as he/she works in the 10 different tasks the participants develop within the system. This method was improved by the use of video recording by using three cameras placed close to the user. The use of three video records allows the evaluator to obtain important usability information. The first one was focusing on his/her face, which gave the evaluator the impressions the different activities caused on his gestures or facial movements. The second camera was focusing on his/her computer screen, which allowed the evaluator to check what was exactly doing or trying to do a user in any moment of the SUE Inspection. This allowed observing particular interactions or substantial usability information. Finally, a third camera records the user environment, providing a view of the user interacting with the system, the mouse, visibility of the screen and general ergonomics the interface allows the user. All of this information provides important feedback to the evaluator about legibility, size, and user friendly characteristics of the application. Three snapshots of the three cameras are shown in Figure 3.

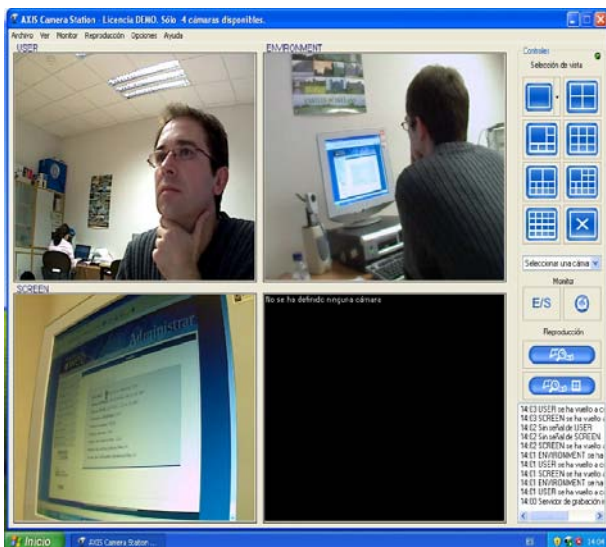


Fig. 3 One moment of the evaluation with the three cameras: user, environment, and the screen

The aim of the second method, fulfilling a usability questionnaire based on a set of heuristics, was to obtain more objective information about users' evaluations.

Finally, the third method was an interview with users, where any lacks, dysfunctions, or extra functionality required was exposed as well as positive information about the usability he/she has felt.

III. PARTICIPANTS

Regarding the context of the evaluating tool, we found that users' experience in using this type of tools is fairly advanced and similar.

We chose as evaluators teachers from different courses of Computer Science Engineering at the Universidad Rey Juan Carlos. They use a CMS as a platform to deliver courses material to their students. Thus, the information students retrieve is directly related to teaching pace in a given course. These evaluators have experience in using the CMS, but they have not used before the CTT whose usability we evaluated.

As it is explained in [3], having a single evaluator enables us to find only 35% of the usability problems. However, since different evaluators tend to find different problems, it is possible to achieve substantially better performance by aggregating the results of several evaluators. The best rank is obtained by using five to ten evaluators. Thus, assuming Nielsen's 75% threshold in 5 evaluators and the same percentage for 7 evaluators using different techniques [5], we have used a total of 7 evaluators.

IV. FULFILLING THE TASKS ON THE CTT

In order to evaluate the cookies tool, we took into account the four dimensions that we found to be important as explained in [6], which are:

- *Presentation*: all aspects bound to visualization of functions and elements of the cookies tool.
- *Hypermediality*: aspects related to the way the user goes from one page to another, considering issues of quantity of memory required to fulfil the tasks and so on. Easiness of use.
- *Application proactivity*: user's errors must be highlighted by the tool, allowing the user to "learn by doing" and by making errors.
- *User's activity*: the user may need to perform unplanned activities.

In our SUE Inspection we placed a set of ten tasks the user had to perform, as shown in Table 1. Reading left to right, the columns contain the task number, the task description, the way the query should be placed in the system by the user (i.e. its user interface), and finally, the query results. These tasks can be grouped in five groups. The first group includes tasks 1, 2, and 4, and deals with mundane tasks, such as creating and maintaining users into the system and consulting the online help. The second group is task 3 by itself, which offers a visual representation of the most commonly followed paths into the system composed of a given number of mouse clicks. The third group contains tasks 5 to 7, and permits the user to query about the number of visits to different subject pages in a selected time period. Information is grouped by different criteria and can be visualized in different graphical formats, including both chart and table representations. The fourth group consists in the task 8, which offers a visual representation of the number of visits per page. To conclude, the last group is formed by tasks 9 and 10, which show users' statistics grouped by different selection criteria and for a certain period of time.

TABLE I
ACTIVITIES CARRIED OUT BY THE PARTICIPANTS ON THE SUE INSPECTION

	Task Description	Interface	Result
1	Access to the summary of visits the Tool provides as well as the online help		
2	Create a new user (teacher) in the system that would interact		
3	Consult the most common links followed by the user for 3 mouse clicks		
4	Change the password of a user		
5	Consult the statistics to a specific subject page in specific graphical and table format during November '06		
6	Consult the statistics in the day before to a subject page with another graphical representation		
7	Consults last week visits to a specific subject page with a pie chart and no table		
8	Consult number of visits per page during the month before		
9	Consult for a rank of data the origin of the visits		
10	Obtain for the current year the screen resolution used by the users		

All of the participants fulfilled satisfactorily all the tasks of the experiment, with little or no help at all, and in an average time of 36 minutes. Consequently, we think that the first usability inspection has resulted satisfactory; but let's check the rest of the results!

V. RESULTS

As some researches have shown [7], there are many task-specific and windows manipulation problems shown while observing the user or by interviewing him or her after performing tasks execution that would be missed by heuristics evaluation. This is the reason why the method of observation of the user as his/her work has resulted so effective.

We explained here the results obtained by the different methods used.

A. Observation

As a result of observing users, as they worked with the system, we noticed some drawbacks that need to be improved, as well as some advantages that they enjoyed very much. Such features are summarized in Table 2. Although the precise symptom may not be illustrated, the reader can link the symptom to task number in Table 2.

TABLE II USABILITY ERRORS IDENTIFIED BY THE OBSERVATION TESTING

Symptom	User Problem	F	HS	Cause
Re-entering of data when sending another query (task 5-10)	Data reselected should stay when the user goes backwards	6	High	OS functionality is not part of the user model
Difficulty in finding the page that needs to be tracked (task 5-7)	Site pages are not ordered alphabetically	5	Med	Requirements specification did not include this feature
Difficulty in finding the page that needs to be tracked (task 5-7)	Necessity of creation of another search window for a specific page into the tool	4		The amount of web pages being tracked is very large
User does not realize at first glance which part of the tool is using (task 5-10)	The user forgets to mark the check box indicating in which part is working	5		The part of the tool that is being used should be highlighted automatically
User does not see the global summary of access at first sight (task 1)	User does not realize that the screen contains the summary of accesses	3		The summary of accesses title should be highlighted or colors changed
User cannot see the name of the small pie pieces in the pie chart graph (task 9)	The labels of the pie graph step one over the others when they are too little so the user cannot read them	3	Med	Pie graphs must be rethought and rebuilt to avoid this malfunction
There are parts of the tool that not permit to select another type of	User wants to change the layout of the information using another type of graph	2		The best graph was selected at the requirements analysis step

graph (task 8-10)	and can not do it.			
Queries of most common links followed by a number of clicks is too slow (task 3)	User gets bored waiting for the query to show its results	2	Med	The big amount of data the query needs must be calculated in batch process at night
Query of most common links can not be selected by a range of data (task 3)	User has to ask the query for the whole time period (this is why it is getting so slow)	2		Requirements did not include the selection of specific dates
All the pages are shown in the query by number of users (task 9-10)	There is no possibility to select a single page in the query, so it shows them all	2		Requirements did not include the selection of a single page
There is too much information in the statistics interface (task 5-10)	User get lost because the screen is full of information, he wants a 'selection statistics menu'	2	Med	It was thought to be most useful this way
Data selection is not filled by the user in a query (task 5-10)	User forgets to enter a data or mark a period	1	Low	Time period box is on the top. It can be changed
Names in the page subject to be tracked are not understood (task 5-7)	The names are shortened down because they are too long	1	Low	Little labels should appear when positioning there the mouse
The pie graph does not show the 'name' of the day (task 7)	User has to guess with a calendar which week day it is	1	Low	We did not thought it was important, but it is
User can mark several parts of the tool, but only one result is displayed each time (task 5-10)	The user marks different general parts of the tool (which are separated with lines, but does not realized of it)	1	Med	The system should not allow the user to mark data in more than one part
Can not view scrollable window contents (task 5-7)	The scroll bar arrows move too fast	1	Med	It is a standard feature that probably can be changed
All the information can be seen by all authenticated users (task 5-10)	Each user can see his/her subject tracking information as well as others'	1	Med	It was thought more useful this way in the requirement phase
The user does not see a message with his name once into the tool (task 1-10)	User likes to know he is the one that is using the tool. The session must be personalized with a 'Welcome <i>your name</i> ' message	1	Low	It was not thought important at the beginning. Easy to implement in the next version

B. Questionnaires

Immediately after fulfilling all the tasks, the user had to answer a questionnaire. The questions and results are shown in Table 3. The analysis of these results gives us a general impression of their first feelings about the tool. The rest of the methods complement information gathered here.

TABLE III RESULTS OF THE QUESTIONNAIRE

Questions	1	2	3	4	5
	no		yes		
1. Does the system provide the precise information for you to do the tasks?			2	5	
2. Do you consider the system easy to use?		1	2	4	
3. If you would have to analyse the CMS activity would you use this tool?			1	5	1
4. If you would have to analyse the activity of any other kind of web site, would you use this tool?			1	4	2
5. Would it be easy for you to get to be an expert in this tool?				3	4
6. When you do a task, do you exactly know which the following task you should do is?		1	2	4	
7. Is easy to change from one task to another without loosing yourself?		1	1	2	3
8. Have you easily find the exact link to complete the required tasks?		2	1	3	1
9. Have you felt comfortable using this tool?	1		4		2

TABLE IV RESULTS OF THE INTERVIEW

Commentary	Freq
Very good. I like it. Very intuitive. Well done. Very nice. Easy to use	7
Good statistics. Good Information. Good graphics	3
Very interesting most followed paths visualization	1
Very good time data selection interface	1
Information about country of origin, screen resolution and browser very useful	1
Very good it offers also table information easy to download	1
Very good the four type of graph	1

It is important to emphasize that it was the very first time the users used the cookies tool. On one hand, we wanted users who did not have experience about both the functionality it provides and how to use it. Thus, we could get the very first impression they had about the tool usability. On the other hand, having tested the tool with no previous experience from the users delays obtaining results about the tool aims. Although in

question number 5, the percentage 4 out of the 7 users have said that they find very easy to be an expertise in using this tool (marked 5 on the scale), which means that the usability test has been passed fairly well, even though there might be some commentaries being made during the interview afterwards to the user.

C. Interviews

In the interview with the user afterwards, commentaries were fairly positive, see Table 4:

VI. CONCLUSIONS

We are really satisfied with the SUE Inspection carried out. It provided us very useful information that it is not easy to gather for different reasons. Firstly, it is hard for the participant in an experiment to write things down (it is very time consuming). Secondly, the participant is not usually willing to offer all his/her impressions. Therefore, observation in the usability laboratory produced all of this information without much effort from the participant, simply by observing him/her by the evaluator as many times as needed.

In addition, information gathered by questionnaires is good but not as detailed as that obtained from observation of the user. Finally, the interview reveals impressions about the tool as a whole that also are useful to complete the SUE Inspection.

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