THE IMPORTANCE OF USABILITY CRITERIA ON LEARNING MANAGEMENT SYSTEMS: LESSONS LEARNED

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Abstract: This paper points to the importance of guaranteeing usability in Learning Management Systems (LMS) in order to achieve success in performing learning tasks in this kind of environment. The paper presents the results from a case study in which learners had to perform several learning tasks on the TIDIA-Ae LMS. It is presented usability problems observed during the performance of the case study learning tasks, as well as the difficulties that learners faced with in some tasks due to those problems and the actions taken in order to make viable the execution of the learning activity tasks. By this paper, it is intended (i) to call LMS developers' attention to the importance of usability in the development of tools to support the learning process; (ii) to point to interactive problems which should be avoided in LMS systems and (iii) to show some problems which can appear during a learning activity execution supported by computer and possible ways to deal with them.

1 INTRODUCTION

Nowadays, people live in a world where information is very important and can define their professional success. Professional life is also more complex and competitive and, in order to keep updated and guarantee their position, people need to acquire new knowledge in a fast and effective way. For this purpose, the advances in the computational area has been used for supporting the learning process in an approach that combines Electronic Learning (e-learning) and Distance Learning (DL), so that flexibility and portability can be provided to it. Examples of using computational resources in the learning process are the production and distribution of learning content through the web.

In this context, several systems such as Moodle (2008), Blackboard and WebCT (2008), and TIDIA-Ae (2008), have been developed to manage the distribution of learning content. These systems are called LMSs (Learning Management System). This paper points out that the usability of this kind of systems is very important in order to reach success in the learning process. It is necessary to consider that, when the learning process happens via an e-learning approach, learners not only have to learn a new content but also have to learn how to use the LMS functionalities to perform the proposed tasks. So, the cognitive load demanded to learn the system cannot be ignored because if the effort to understand how to use the LMS itself is big, the learning process success can be compromised (Carvalho et al., 2008).

Usability can be defined as the set of all features which allow users to interact satisfactorily with a system in order to reach their goals with effectiveness, efficiency and use satisfaction. Effectiveness corresponds to the precision and completion with which users reach their specific goals; efficiency refers to the relation between precision and completion of the reached goals and the resources expended to achieve it; and the use satisfaction is related to the comfort and acceptance in using the system (Nielsen, 1993). It is noticed, therefore, the importance of assuring the usability in LMSs, because it is known that, the better the system usability is, the easier for users is to understand and to use it.

This paper discusses some usability problems which were found in TIDIA-Ae LMS (TIDIA, 2008), during the performance of a learning activity, i.e. a task that can promote the process of learning in students, stimulating them to think and work on a new concept or topic presented by a teacher. The results presented here were not obtained from the application of a usability evaluation method in the system; the results were collected by the observation of a practical experience. The paper is organized as follow: section 2 describes the issues which concern the system usability; section 3 presents a case study where professors and undergraduate students have performed a learning activity on the TIDIA-Ae

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LMS, explaining the problems and pointing to the solutions adopted in order to make viable the learning activity tasks execution; finally, section 4 presents the conclusions about the reflection of the usability problems in the learning activity execution and point to some future work remarks.

2 USABILITY ISSUES

According to Nielsen (1993), there are ten main issues which should be covered in a system so that a good usability level can be reached. They are: *(1)* learning facility; *(2)* use facility; *(3)* intuitive interface; *(4)* simple and natural dialog; *(5)* feedback to the user; *(6)* knowledge retention (remembering facility); *(7)* high speed task performance; *(8)* system prepared to avoid users' errors; *(9)* consistent error messages; and *(10)* subjective satisfaction.

A system with *learning facility* is the one which is easy to learn. It means that the system offers conditions for users to learn how to interact with it, independently of the users' level of knowledge and skill, as well as to get the maximum performance during the interaction (Dix et al., 2003; Nielsen, 1993). The interface predictability, synthesis capacity, familiarity, generality and consistence are some principles which support the learning facility (Dix et al., 2003). The predictability allows users to preview the effects of their actions based on past interactions with the system. The synthesis capacity allows the users to know the effects of past actions they performed so that they can go back to previous steps and keep oriented in the interaction. The familiarity consists in the possibility of users to apply the knowledge they get interacting with other computer applications, in the current interaction. The generality is related to users interacting with other computer applications in the same way they are interacting with a specific system. Finally the consistence refers to the standardization of the input and output mechanisms to reach similar goals.

The *use facility* is directly related to the system flexibility. In order to present both learning facility and use facility the system must be able to adapt itself to the users' knowledge and skill level (Nielsen, 1993). Dix et al. (2003) defines flexibility as the system ability to adapt itself to the context of the interaction as well as to the users' preferences and needs, so that it can be used more efficiently. The dialog initiation, the multi-threading capacity, the switch facility among tasks and the system adaptability are some important issues related to the system flexibility. The dialog initiation refers to the interaction between the computer and the users which should represent a partnership between the two actors involved. It can be pre-emptory to the system or pre-emptory to the users (Dix et al., 2003). The multi-threading is the system ability to keep a plausible interaction with the user when more than a task is happening at the same time. The switch facility refers to the sharing of responsibility between the user and the system, i.e. a specific task being controlled either by the user or by the system. This means that the user can set up the system to perform a certain task or s/he can perform the task manually (Dix et al., 2003). The system adaptability concerns the changes in the user interface so that it fits to the users' level of knowledge (Nielsen, 1993).

The *interface intuitivism* is associated to the system commands necessary to the tasks performance and their memorization. The system commands which are necessary to perform a specific task should be clearly visible so that users do not need to memorize them. However, it might be pointed out the difference between the memorization necessity and the memorization possibility (Nielsen, 1993). While the first forces the user to memorize the system commands the second allows expert users to raise their task execution speed.

In reference to the *simple and natural dialog*, it is suggested using expressions and concepts which are known by the users. For instance, technical vocabulary from the computing area might be avoided. Furthermore, irrelevant information might be hidden from the users in order not to compete for the user's attention. According to Nielsen, it should be presented only the necessary information to the task performance (Nielsen, 1993).

The *feedback to the user* demands that the interface provides mechanisms to notify the users about the processing which is being performed and the time which is going to take in order to be concluded. It is necessary to provide mechanisms which allow the users assess whether the system behaviour is the expected and whether the processing is still happening. These mechanisms are extremely important for users to be always oriented in the task execution.

About *knowledge retention*, the interface should be designed so that users can remember how to perform their tasks in the system after a period without interacting with it. The user should be able to remember the system main command without the necessity to check instruction manuals. Moreover the system help might be always visible so that the users can use it when they need (Nielsen, 1993).

Concerning the *task execution speed*, the users expect that the system answers them fast and with precise information. The computer processing speed and the algorithms to increase the system

performance reflects directly on the system usability. If the users have to wait lots of time to get their task execution concluded, they get bored and the use satisfaction is compromised. Consequently, the system usability decreases (Dix et al., 2003).

The *system preparation to avoid users' errors* is related to the system robustness. The robustness is one of the more important principles for maintaining the system usability. It is related to the maintenance given to the users so that the task execution is successful. To be robust, a system should obey the observance, the recovery, the comprehensibility and the task conformity principles (Dix et al., 2003). The observance is related to the system feedback to the user, i.e. mechanisms that allow users to observe and assess the system behaviour, making users' intervention and error correction possible. The recovery consists in the ability of users to take corrective actions every time an error is recognized (Nielsen, 1993). The comprehensibility refers to the way the users understand their communication with the system (stability) and the conformity refers to the quality of the system support for users to perform their tasks.

Although the system must be designed to minimize users' errors, it is impossible to predict all different ways which users can interact with the system and the errors that they can make. Thus it is very important to design *consistent error messages* that explain to users which action has caused the error, where the error is located in the system and how it can be corrected. In this way, the users are always concerned about their actions and oriented to solve the problems which appear during the interaction, losing no time in correcting them.

Finally, the *subjective satisfaction* refers to how users feel in using the system. It is directly related to the system functionalities and the facility to use them. If the system does not have the desired functionalities the user will complain. In the same way, the user will not be satisfied if the system has all necessary tools for her/his task but they are very difficult to be managed (Nielsen, 1993).

All these issues might be considered during the system development in order to reach its acceptability. This is because the users look for tools that fit to their necessities, i.e. which support the execution of their tasks and that do not bring problems during their execution. Low usability reflects on the system usefulness negatively (Dix et al., 2003; Nielsen, 1993). Therefore, using a system with low usability in e-learning can compromise the execution of the learning tasks and, instead of supporting the learning process, it can make it unsuccessful, as it is discussed in the following.

3 LEARNING ACTIVITY ON TIDIA-AE LMS – A CASE STUDY

The FAPESP TIDIA-Ae Project (2008) aims at research and development in DL supported by high speed networks. The project goals include the specification, design and implementation of several DL tools based on flexible and cheap solutions. The project LMS is currently under development. In its first phase, it was developed a set of DL tools for the LMS and it was played several learning activities on it in order to perform a proof of concept (TIDIA, 2008). One of the learning activities played on the environment was the learning activity "Guaranteeing the continuity of home caring a sick person", which was planned by professors from the Nursing Department of the Federal University of São Carlos in the context of a case study whose main goal was to illustrate the possible usages for common sense knowledge to support learning activity planning (Carvalho et al., 2007; Carvalho et al., 2008).

In the learning activity planning it was used the OMCS-Br (Brazilian Open Mind Common Sense) project knowledgebase (Anacleto et al., 2008). The common sense knowledge was used to call the learners' attention to the way which the population talks about requirements to be a caregiver or about procedures which might be taken while home caring a sick person. It was presented points to the learners which they should emphasize during the orientation and the community common vocabulary which should be used by the future professionals in the orientation process.

The learning activity was planned according to a framework to prepare DL learning activities supported by computers (Neris et al., 2007) and, as it is defined in the framework, each learning activity task was related to a computational tool, which would be used to perform it. In the same way, as it is proposed in the framework, each tool which would be used for performing the activities was tested before the learning activity starting. In the test, the LMS tools could be used without any problems. Nonetheless, the user who tested the tools, the learning activity monitor, had previous knowledge in computing and it is possible that his computing background knowledge helped him not to feel difficulties in using the system, differently from the nursing learners as it is reported in the following.

It is worth mentioning that the results presented in this paper are not from a usability evaluation such as heuristic evaluation or user tests (Nielsen, 1993). The results were empirically obtained in the case study where learners had basic background in

informatics, i.e. were accustomed to use just computer office tools such as text and spreadsheet editors and web tools such as chats, forums and e-mail clients. Table 1 lists the tools which presented interaction problems during the first learning activity tasks.

Table 1: TIDIA-Ae LMS tools not used in the learning activity execution because of usability problems.

TIDIA-Ae LMS Tool	Usability issues not attended
Chat	1. simple and natural dialog 2. feedback to the user 3. system prepared to avoid users' error 4. consistent error message 5. users' satisfaction
Hypertext	1. use facility 2. intuitive interface 3. simple and natural dialog 4. users' satisfaction
Portfolio	1. learning facility 2. intuitive interface 3. users' satisfaction

The first learning activity task was to explore the TIDIA-Ae LMS tools which were going to be used during the learning activity. As this activity was guided by a monitor, it was decided to use the tool *Chat* available in the LMS to conduct the task whose purpose was to discuss the tools features and possible difficulties to use them. Although the task was quite simple, it could not be performed properly because several learners had problems to open the *Chat*. The problem was occasioned due the LMS used an applet without digital signature to make the tool available to users. This made a warning security message to be presented to the learners, who did not take the expected action to launch the tool. Figure 1 presents the warning security message presented to the learners when they tried to initialize the TIDIA-Ae *Chat* tool.

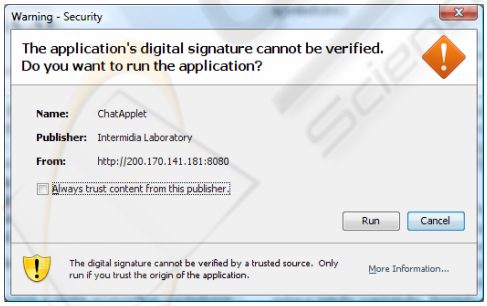

Figure 1: Warning security message presented when the tool *Chat* is launched.

In order to launch the tool the learners should have clicked on the button "Run". However, some of them thought that the message box was a pop-up and clicked on the button "Close" (X) or in the button *Cancel* when the box was presented. In this point it can be considered that the usability issues *simple and natural dialog* and *system prepared to avoid users' errors* was not attended. Concerning the first issue previously mentioned, the message was presented in English which was not the learners' native language and it was used terms such as "digital signature" and "ChatApplet" which were not part of the learners' vocabulary, according to what could be verified by the analysis of the questions which were sent by the learners to the learning activity monitor.

Besides the learners who closed the digital signature warning message box, others could not launch the tool because of protection systems which were installed in their computers and which did not allow the warning message box to be presented to the learners. This situation showed also the absence of the issue *feedback to the user*, since it was not presented any message warning the learners that the message box was blocked.

In relation to the *feedback to the user*, another system behaviour points that it does not works properly. Figure 2 shows the interface that is presented to learners, after the warning message box previously mentioned being shown, even if the learner clicks on the button "*Close*" or "Cancel" or if the box is not presented to her/him due to pop-up blockers.

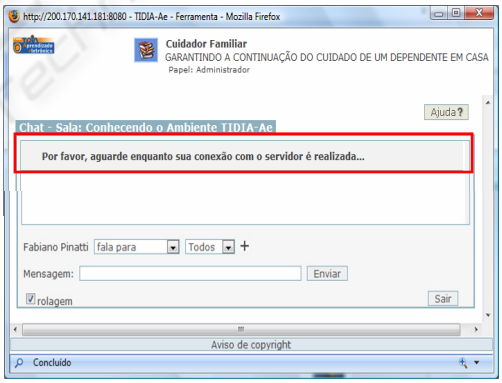

Figure 2: Incorrect feedback to the users.

The message inside the red box says "Please, wait while the connection is established with the server…". This message is not true if the user does not click in the warning message box button "Run", since the applet is the responsible for trying the connection. Hence, if the applet is not run, there is no attempt to contact the server in order to start the communication among the chat participants. In this case, it should be presented a message notifying the user that the connection could not be established because the applet was not activated and explaining to the user what s/he should do in order to get the tool running properly. Thus, it can be considered

that the system also does not provide *consistent error message* to the user.

Because of the wrong feedback message previously described some learners who were performing the first learning activity task and who had not clicked on the button "Run" kept waiting more than five minutes for system response. As some of them were in contact with each other, they asked to one of the learners who had successfully entered in the TIDIA-Ae *Chat* to notify the monitor of the problems.

As more than 70% of the learners were experiencing problems to enter into the *Chat*, the monitor tried to conduct a chat section using an instant messenger external to the LMS in order to try to solve their problems. The section was not successful because the learners were so disappointed with the problems they were facing and full of doubts that they asked lots of question at the same time in such a way that the monitor could not answer all questions in a suitable time. This was one of the main lessons learned in the case study: do not try to solve a general problem by trying to discuss it distantly with everyone who is experiencing it at the same time. It is very difficult to control everyone's anxiety so that a good communication can be reached. The solution proposed by the monitor was to send a tutorial explaining how to use each tool which was going to be adopted during the learning activity tasks so that the learners could perform some sample tasks by themselves in order to learn how to use the tools and report their difficulties by e-mail so that the monitor could better help them. As a consequence of this experience, the majority of learners complained about the tool, demonstrating that the tool did not provide *subjective satisfaction*.

By executing the tutorial activities, the learners found problems in other tools, which were reported by e-mail. After that, the *Chat* and two other tools of the TIDIA-Ae LMS, the *Hypertext* and the *Portfolio* mentioned in Table 1, were substituted by other tools that learners felt comfortable to interact with. This decision was taken because the problems in those tools were impeding some learners to perform the learning tasks and compromising the overall performance of the learning activity.

Some problems with the tool *Hypertext* reported by the learners pointed to the absence of the usability issues *use facility, intuitive interface, simple and natural dialog* and *users' satisfaction.*

About the use facility, the tool *Hypertext* was developed using some technologies which do not work properly at the browser Internet Explorer ©. Because of that, several learners could not perform simple tasks using the tool. One of the problems reported by the learners who were using Internet Explorer© was the absence of the edition tool bar in the page edition area. Without this tool bar it was possible only to add text to a page. It was not possible to format the document, to add tables, to add pictures, to add hyperlinks and so on, i.e. it was not possible to create a real hypertext. The tool does not offer the flexibility of being used properly in different browsers, which makes the learner unsatisfied with it. Furthermore several students contacted the learning activity monitor because they had not understood how to perform some tasks, pointing to the use of specific terms from the computational area; the interface did not provide a simple and natural dialog. Learners have also pointed to the tool unconformity with the way the learners considered natural to interact with it, i.e. the tool interface was not intuitive.

It was tried to persuade the learners to use the browser Mozilla Firefox© where the tool would work properly. However, some learners were resistant to install and to use it. Some learners justified that they were using computers in the university department where Firefox was not installed and where they had access to the computer through a limited account, which did not allow them to install any software. Others justified that they were used to using Internet Explorer and they would like to continue using it because they already knew where they could find what they needed. This showed the importance of a system to be prepared to run in different platforms and to fit to the users' needs. If the users do not feel comfortable with a system or if the system does not provide the features they expected, they will look for another one. This was another lesson which could be learned in the case study. As the tool *Hypertext* was discarded, the learning tasks which supposed the collaborative construction of documents were modified to activities in which the learners should discuss their ideas in specific forums, reach an agreement on them and choose a representative who was responsible for synthesize the group's idea.

The tool *Portfolio* has been also criticized because of its folder structures and the difficulties which the learners faced to upload and download documents. In this way, it was decided to use the tool *E-mail*, which provided a suitable interaction, to exchange information and documents of learners' interest. The tool available to explore the disposed learning content was also criticized because it did not have a navigation tool bar. Thus, while exploring a hyper document, the learners were not able to go back to a previous page if there was no link "back" in the page which they were exploring. However, as the users could interact with the learning contend

reasonably, the tool was not discarded in the learning activity.

4 CONCLUSIONS AND FUTURE WORKS

This paper presented and discussed various usability problems observed in TIDIA-Ae LMS tools during the performance of a case study using that LMS. It was shown that the absence of usability issues in an application can lead users to give up using it and adopting another application which provides a consistent and satisfactory interaction. It was also presented the actions taken during the case study execution in order to make viable the learning activity task execution.

Although this paper focused on a specific experience, it presented real situations which can occur in LMSs which lack the same usability issues and reflect negatively on the learning activity performance. It was shown the importance of usability in e-learning systems, since an activity could be not performed because of interactive problems. As it was mentioned before, if the usability of the system used to support the learning process is low, the learner will have to expend a bigger cognitive load to learn how to interact with it and, consequently, will have less time to dedicate to perform the learning tasks, which can compromise the learning process. However, as it could be noticed in this paper and according to Ardito et al. (2004), some developers still put usability in second plan.

By this paper, it is expected to call e-learning system developers' attention to the fact that usability must be approached since the beginning of the system development in order to build a useful product which can really support the learning process. In addition to that, it is pointed some usability problems identified in TIDIA-Ae LMS so that developers can design their products in order not to present the same problems. Furthermore, by reporting solutions adopted to make viable the learning activities task execution, such as to suspend a task, to provide a tutorial with the purpose of teaching the learner to interact with the LMS tools or to choose other tools to execute a task, it is intended to provide guidelines to people who are intending to execute a distance learning activity supported by computers so that they can deal with possible problems with which they will face.

As the usability issues pointed in the TIDIA-Ae LMS was empirically identified during the execution of the case study, it is proposed, as future work, the performance of usability tests involving all the TIDIA-Ae LMS tools as well as the tools of other LMSs mentioned in this paper, e.g. Moodle (2008), Blackboard and WebCT (2008). Performed the tests, it is intended to conduct a comparative study so that the main usability problems in LMS tools can be identified, classified and registered in a document which can be used as reference by developers of this kind of systems.

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