Evaluation of User Interface Design for Learning Management System (LMS): Investigating Student’s Eye Tracking Pattern and Experiences

Prasanna Ramakrisnan\textsuperscript{a*}, Azizah Jaafar\textsuperscript{b}, Farizah Hanis Abdul Razak\textsuperscript{a},
Dianacamelia Anak Ramba\textsuperscript{a}

\textsuperscript{a,c,d}Faculty of Computer and Mathematical Sciences (FSKM), Universiti Teknologi MARA Shah Alam, Selangor, Malaysia
\textsuperscript{b}Faculty of Information Science and Technology (FTSM), Universiti Kebangsaan Malaysia Bangi, Selangor, Malaysia

Abstract

E-learning is an innovation technology with the aim to provide a strategy to improve the quality of teaching and learning. The establishment of LMS is to improve the teaching and learning environments and to have better learning delivering through electronic device. The interface design of LMS plays an important role to deliver the learning process to both learners and educators. The usability of LMS is an important criterion for providing an effective and easy learning environment. Thus, this study aimed to evaluate user interface design of LMS by analyzing student’s eye tracking pattern through the gaze plot and heat map. The interface of LMS was divided into three area; top, left and content. Student’s area of interest was identified using the eye tracing pattern. Students eye movement was studied using Tobii Series Eye Tracker Model T60/T12 and ManGold software suite to capture their eye tracking pattern when using the LMS to complete their task. The analysis from the student’s eye tracking pattern indicated some interface design issues in LMS. Based on this finding, we discuss the user interface design guidelines applied in LMS and suggested some improvement for identified design issues.

Keywords: usability; user interface design; eye-tracking; e-learning

\* Corresponding author. E-mail address: prasanna@fskm.uitm.edu.my.
1. Introduction

E-learning is a combination form of online and offline learning. The term online learning is defined precisely as learning using a computer with a link to internet access (Duff 2004), while offline learning refers to learning which is not linked to internet access for example, CD-ROM, video and audio tape. Online learning is encompassing with a diversity learning access and teaching paradigms. The most familiar current online learning is learning management system (LMS) which is used widely at the local university to increase interaction between student and lecturer. The LMS is an information system that controlled by administrator and manage e-learning course and also keep track of students’ progress (Brown & Johnson 2007). LMS is a web-based technology which facilitates in planning, distribution and estimation of a particular learning process (Ayub et al. 2010). LMS offers possibilities for changing and developing new method in education as well as facilitating flexibility for institutions.

The LMS is accessible via the internet where lecturers could access the system to upload content and establish online collaboration with students. Students can also access the system from anywhere to download content and collaborate online. Therefore, the design interface of LMS is important as its play a vital role in user interface interaction. In the online environment, users will utilize the computer to access the content and interact with others online user and instructors. The LMS must be designed in an appropriate way so that users would not face any trouble when using it (Ayub et al. 2010). The problem in LMS design would decrease the user satisfaction when using the portal. Thus, a simple LMS user interface must be included for ease the interaction between users and systems (Ghoniemy & Fahmy 2010). The evaluation of user interface design for i-learn portal, LMS used in University Technology MARA (UiTM) was studied using eye-tracking technique. The eye tracking technique is employed to identify the current design issues concern on the design interface. An eye-tracking technique works to track the student’s eye movement pattern and their position on the screen. The student’s eyemovement pattern is recorded with Tobii Series Eye Tracker Model T60/T12 to obtain the information on student’s attention area in i-learn portal interfaces during accomplishing tasks. After student’s task completion, a post interview is conducted to identify student’s experience, using i-learn portal. An interview is needed because the eye-tracking alone does not provide any direct information on the student’s experience (Eger et al. 2007).

The concept of student’s experience is directly related with the usability of LMS. It is important to obtained information about student’s behavior and understands the way students navigate through learning LMS (Murieal Garreta-Domingo & Mor 2007). The student’s behavior provides useful information on usability and to system designers in order to identify the LMS design issues and which is the task that generates more failure and frustration. Hence data was collected from the eye tracking test and interview to analyze and identify the interface design guidelines that applied in LMS. Besides that some suggestion were also listed for improvement of identified design issues.

2. Literature Review

2.1 Usability Testing

The usability testing is a technique which widely used to identify the quality of a certain area in web site design. The purpose of conducting usability testing is to make sure the students can do the purposed tasks in LMS with efficiently, effectively and satisfactory. Usability testing is a method which can be used in discovering problems regarding the user interface of the LMS by students (Nakamichi et al. 2006). The usability evaluation of LMS can be studied through the user testing (Nielsen 2003). There are three components, which encompass in conducting the user testing. There are participating students who have an experience as a user; asking students to perform representative task with the design; and observing the students.
There are several methods to conduct the usability testing such as heuristic evaluation, cognitive walkthrough, and task analysis (Razeghi 2010). Each of the methods has one or more technique embedded into it. Table 1 includes the description of some important methods and techniques of usability testing.

Table 1. Usability Testing Methods and Techniques

<table>
<thead>
<tr>
<th>Usability Testing</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heuristic evaluation</td>
<td>Experts evaluate a product based on some accepted principles</td>
</tr>
<tr>
<td>Cognitive walkthrough</td>
<td>Experts walkthrough the phases and actions necessary to accomplish a task and gather potential issues</td>
</tr>
<tr>
<td>Pluralistic walkthrough</td>
<td>Experts walkthrough the actions which needed to accomplish a task as a group asking themselves a set of questions</td>
</tr>
<tr>
<td>Task analysis</td>
<td>Is a learning process about the product by observing user in action</td>
</tr>
<tr>
<td>Interviews</td>
<td>Enquiry user verbally after completing a task</td>
</tr>
<tr>
<td>Questionnaires</td>
<td>Ask user to write down their ideas in answering question about the test</td>
</tr>
<tr>
<td>Thinking Aloud</td>
<td>Ask user to say aloud what they thought when completing a task</td>
</tr>
<tr>
<td>Restrospective think aloud</td>
<td>Ask user on what they thought after completing a task</td>
</tr>
<tr>
<td>Direct observation</td>
<td>Observe user’s behaviours when complete a task.</td>
</tr>
<tr>
<td>Video recorded observation</td>
<td>Video record the user’s behaviours while completing a task</td>
</tr>
<tr>
<td>Screen logging observation</td>
<td>Record the user’s interaction with interface via logging software application</td>
</tr>
<tr>
<td>Focus group</td>
<td>Record a moderated discussion among potential users of a product</td>
</tr>
<tr>
<td>Eye tracking</td>
<td>Capture user’s point of gaze while completing a task</td>
</tr>
</tbody>
</table>

Source: (Razeghi, 2010)

2.2 Eye Tracking

Eye tracking is a method used to measure a person’s point of gaze, which focuses on what a person looking at and find out the eye spot. The function of eye tracking is to record a person’s eye movements while performing a task provides information about the nature, sequence and timing of the cognitive operation that takes place (de Kock et al. 2009). The hardware that is used to capture the eye movement is called an eye-tracker. The data collected from an eye-tracker will be analyzed using an eye tracking software.

The eye movement can be studied through the fixation and saccade to monitor the complexity of an interface. Fixation is the moment where the eyes moderately static, normally lasting between a quarter to a half of a second (Manhartsberger & Zellhofer 2005). The most information from the eye is made accessible during a fixation and it target is to recognize the fixated object. Saccade is rapid movement between fixations to another spot. it typically occurs 3 to 4 times every second (Ehmke & Wilson 2007). Data that collected on fixations and saccades from an eye-tracker will be visualized in an eye tracking software as gaze plot and heat map. Gaze plot is used to exhibit the fixation and saccades, while heat map explains the focusing duration on the screen by using color representation.
3. Method And Techniques Used

An empirical study was conducted to gather data from the eye tracking technique for the evaluation of user interface of LMS and an interview for identifying the student’s experience using LMS. The study on student’s experiences can give better understanding on the usability of LMS (McCarthy & Wright 2004).

3.1 Participant

Five participants are chosen from two different faculties, which is from Faculty of Business Management and Faculty of Computer Science and Mathematics. Each participant required to complete given tasks without unlimited time.

3.2 User Task

For this study the i-learn portal, LMS used in University Technology MARA was used to conduct the user interface design evaluation. The participants are students of UiTM. Students were given four (4) tasks to be completed with LMS. There are as follows.
Task 1: Assess to i-learn portal account.
Task 2: Download a lecture note from one of the registered courses.
Task 3: Upload the selected note to i-learn portal account.
Task 4: Send the selected note to one of the course members.

The above task includes student’s interaction such as accessing, downloading, uploading and sending. Those interactions are important to evaluate an LMS because they are the basic interactions that need to be included in any LMS.

3.3 Eye Tracking

The eye-tracking technique was used to collect data from student’s eye movements to measure their performance towards LMS. Tobii Series Eye Tracker Model T60/T12 was used to record the user performance for task 1 to 4. Calibration is the first process in eye-tracking technique to track the position of eye movements. This process is important to ensure the gaze vector and gaze fixation position of students is on the host of computer screen (Bates et al. 2005). In this study, the eye tracker device needs to be calibrated for each student before conducting the test. After the calibration process, students will proceed to completion of given tasks. During completing the tasks, the student eye movements and action. Will be recorded. Once the task was completed, we obtain data on student’s eye movement in a form of visualization and video recording. The visualization type used to interpret the data is the gaze plot and heat map.

The gaze plot indicated where a student’s attention. Gaze plot provides information on fixation and saccade. The circles in gaze plot suggest student’s attention area in a page. Gaze plot circle specify the duration of a fixation. Larger circle represents longer fixation. Long fixation can be interpreted as the user is interest or, either the user is confusion on the subject or on the interface design. The lines that connect circles indicate the saccade path. The lines show the student’s eye movement in i-learn portal interface. Heat map is another method used to visualize the data collected from student’s eye movement. The heat map shows the hotspot area of student’s attention. The hotspots are the areas which most viewed by the students and this area is shown in red (Navalpakkam et al. 2011). Both gaze plot and heat map is used to provide better understanding on student’s attention area. To further support experience on interface design, we can study student’s attention spending when entering the selected pages on the i-learn portal. The i-learn portal layout is divided into three parts or variables to detect the area of attention spending. There are top, left and content. These three variables are used to analysis the area of interest (AOI) and
area of attention spent by each participant. The AOI analysis allows to define areas within a page and to compare eye tracking data for those areas such as the fixation count and the fixation duration by eye tracking data on each page. The chosen of layout areas are based on the portal layout interfaces itself (see Figure 1) and the data analysis of eye movements is based on the area to help investigate the students’ attention spending on each interface design of portal.

![Fig. 1. The three areas used for the analysis of the eye movement data](image)

3.4 Interview

An interview was conducted once the student’s completed all the 4 tasks given to them. The interview was to identify student’s perception and experience using the LMS.

4. Finding and Discussion

4.1 Analysis of Eye Tracking Patterns

The following section discusses the eye tracking results and suggests design guidelines for identified user interface design issues.

4.1.1 Task 1: Assess to i-learn portal account

All participants have completely finished this task without any assistant from the test administrator. However, student 1 had taken long time during this task before this student can move to the selected course page. All the students stated no problem with this task.

**Eye tracking patterns analysis:** Only gaze plot of student 1 indicated fixation on entire area of i-learn portal home interface (see Figure 2). But the focus of the attention was still at content area, which was indicated with the red colored area in heat map (see Figure 3). The rest of four students gaze plot revealed more attention was given at the content area which menu for course selection is available.

**Design issues:** The student 1 accesses the home page of i-learn portal for the first time for the student encounter the design. Learn ability student 1 was moderately fast. Student 1 spends some time in exploring the home page of i-learn portal before proceeding to the content area.
**User interface design guidelines:** The students should be able to learn easily and timely the features provided in LMS (Štuikys et al. 2006). The home page interface should be simple and memorable design and guide the students directly to the content area where the menu for course selection is available. The simple and memorable design can help users to easy accessing the interface.

The i-learn portal has a learnability characteristic. New user of the portal was able to learn quickly the interface before proceeding to the content area. The important content area was highlighted to the students by displaying the course menu in a table with different background color. Besides that, all the important announcements that need to be given to the students were posted just above of the course menu. This is a good area to place the important announcements because every student will be focusing to course menu area at LMS home page once they log in.

4.1.2 Task 2: Download a lecture note from one of the registered course

Students were able to complete task 2 even though some of the students had several problems. Most of the students had difficulty to understand the navigation tools on the left area of course page. This causes the students to spend longer time for understanding the function of course navigation (myTool).

**Eye tracking pattern analysis:** The larger gaze plots identified much occur between left area and the content area for all participants. The fixation counts revealed more at content area and left area (see Table 2). This indicated the participant eye movements much focus at center and left area. Student 2 and 3 never logged in to i-learn portal for some time. The fixation counts on left area for these students indicated slightly higher than the rest of the students. But Student 1 is first time user of i-learn portal, so this student spend more time understanding the tools available on left area first. Once understood, this student was able to do the given task. This supported by higher fixation count for student 1 at left area and lower fixation counts at the content area.

**Design Issues:** When the infrequent user, the student logged in to portal, they could not remember the ways to access the content in the portal. However, they were able to quickly move to the content menu.
Table 2. The Fixation Count for the Three Identified Area of Interest

<table>
<thead>
<tr>
<th></th>
<th>Top</th>
<th>Left</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 1</td>
<td>0</td>
<td>165</td>
<td>13</td>
</tr>
<tr>
<td>Student 2</td>
<td>0</td>
<td>11</td>
<td>30</td>
</tr>
<tr>
<td>Student 3</td>
<td>0</td>
<td>1</td>
<td>22</td>
</tr>
<tr>
<td>Student 4</td>
<td>11</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>Student 5</td>
<td>6</td>
<td>1</td>
<td>32</td>
</tr>
</tbody>
</table>

User Interface Design Guidelines: The LMS interface should help the students or lecturers from remembering the information while using the system (Mandel 1997). One of the criteria used in LMS to minimize memory load was information display of current location of students. Most of the student use LMS to download notes (Muhammad et al. 2011). The i-learn portal was design in such a way that once the student selected the course at home page, they are able to see all the folders containing the course content for the selected course at the content area. Besides that, one more features that can be included is the shortcut. The mnemonic and accelerator keys (e.g. keyboard shortcuts) can be included as a shortcut for commonly used function in LMS.

4.1.3 Task 3: Upload the selected note to i-learn portal account

Students needed longer period of time to complete this task. The feature of the i-learn portal used to upload a file is myDrawer. The myDrawer is online storage that is available for all the students. There are two myDrawer available in the i-learn portal. The students had uncertainty in choosing between the two myDrawer that led to four of the students used myDrawer that is available under myTools and one used group myDrawer.

Eye tracking result: All students able to complete this task successfully. Most of the students’ fixation and saccade path was at adding the file title and file browsing (see Figure 4 to Figure 8). Nevertheless, fixation and saccade paths for student 5 illustrated eye movements were around the left and content area (see Figure 8). Student 5 had uncertainty in choosing between the two myDrawer. Thus student 5 had a larger fixation circles around the myDrawer and Group link at left area.

Design Issues: Students were unable to differentiate the use of two myDrawer. The label name used for both the myDrawer does not distinguish them.

User Interface Design Guidelines: Navigational controls used in LMS allow the students control the interface (Mandel 1997). It is important for the student’s to use controls to interact with LMS. The design of navigational control (e.g. Types, color, visibility and label name) used for interacting with LMS user interface need to be clear. It is recommended using only one myDrawer or using different labeling such as courseStorage and groupStorage to distinguish between the myDrawer.
4.1.4 Task 4: Send the selected note to one of the course member

The entire students completed this task successfully

Eye tracking result: The eye tracking result had shown that all students focused at content area. From the gaze plot, it can be described that entire students concentrated at the title field, send check box, user selection, select file and browse through file field. Furthermore, the saccade path occurrence was a lot at the content area compare to other areas. Due to the function of sending is in the same page of uploading as file (task 3), there was not any new design issue detected for task 4. Hence user interface design guideline for this task was not proposed.
4.2 Analysis of Interview Data

Student’s experience and user behavior feedback on i-learn portal interface design is obtained from the interview data. Based on the finding the students provided a combination positive and negative experience using the i-learn portal. The result shows that all students participated in the testing were not satisfied with the design of controls used in the i-learn portal.

The i-learn portal was designed for assisting the teaching and learning process online. Lecturers usually upload all the course-related files in i-learn portal and any students registered for the course can download those files from any location. Therefore, these students do not need to wait anymore for the lecturer to provide the teaching material through handouts in the classroom. This could be a reason why students indicated downloading files related to course is really helpful for them and they enjoy having the availability of course content in i-learn portal.

Another important feature in i-learn portal is the availability of a forum. Students and lecturers are able to interact with each other at any time at any place for a discussion. Student’s interaction with the lecturer and other students taking the course is not limited to only classroom time with the availability of forum. The result discovered that students do enjoy having forum features in i-learn portal. The summary of student’s experience using i-learn portal is presented in Table 3.

Table 3. Student’s Feedback on Their Experience using i-Learn Portal

<table>
<thead>
<tr>
<th>Student’s Experience</th>
<th>Student’s Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfying</td>
<td>All five students are not satisfied with control design for i-learn portal user interface.</td>
</tr>
<tr>
<td>Enjoyable</td>
<td>Availability of course contents and forum in i-learn indicated enjoyment for the students.</td>
</tr>
<tr>
<td>Helpful</td>
<td>Feature of downloading files from course content was found helpful by the students.</td>
</tr>
</tbody>
</table>

Student’s feedback on the satisfaction of i-learn portal was negative to the control design. Student’s negative feedbacks are crucial in order to improve the design interface to be more interactive, usable and affordance. The negative feedbacks identified from the student’s feedbacks together with the proposed solution are stated in Table 4.
Table 4. The issues identified from the students about i-learn portal user interface design

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Identified Issues</th>
<th>Proposed Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Label</td>
<td>The word used for myDrawer was not well described. It was difficult for the student to understand and the word used confused them.</td>
<td>Change the use of “myDrawer” term to another appropriate term which familiar with all the students.</td>
</tr>
<tr>
<td>Color</td>
<td>The color combination did not attract the students. Most noticeable inappropriate color combination was stated at top menu. Both the background and text color for the top menu is dark.</td>
<td>Top menu color need to be changed as it is not visible to users. Proposed to use reverse color technique for top menu. Use dark background with lighter font color or vice versa.</td>
</tr>
<tr>
<td>Font</td>
<td>The font size for myTools is very small. Thus the visibility of the font is not clear for students with vision problem.</td>
<td>Proposed to use larger font size to increase the font visibility at myTools.</td>
</tr>
</tbody>
</table>

5. Conclusion

The design of the portal is important as its plays a vital role in student - interface interaction. This is because students in an online environment will use the computer to access into the content and interact with other students and lecturers. Therefore, the interface design must be designed in a comfortable way so that users would not face any difficulties while using it. From the finding, the i-learn portal had both positive and negative design issues. We proposed solution for the identified negative design issues. From this study it is hoped that the designer of i-learn portal can improve the portal interface based on the identified design issues to improve student’s satisfaction.

6. References


Razeghi, R. 2010. Usability of Eye Tracking as a User Research Technique in Geo-information Processing and Dissemination.