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Designing Learning Management System to Encourage E-Learning Sustainability

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Abstract

Many universities have been employing Learning Management System (LMS) in their educational programs for many years. However, sustaining the e-learning environment has become a great challenge for these institutes. Although there was much research conducted to study the success factors of a LMS, understanding the impact of user interface, navigation and usability designs, which may affect the user experience in virtual learning environment, is equally important. It is suggested that during the design stage the instructor should plan and structure the resources to assure interactions that assist in the transfer of skills and knowledge. In addition we can use tools such as email, chat rooms, and discussion boards to provide learners the opportunities to interact and add a new level of depth into their learning. It is also necessary to conduct a complete series of evaluations for testing the accuracy, effectiveness and clarity of the e-learning system. Therefore this research aims to evaluate the effectiveness and clarity of LMS design to encourage e-learning sustainability. We investigate the effectiveness of the LMS in assisting knowledge transfer and interactivity in the virtual learning environment, based on three areas: navigation design, user interface design and usability of the discussion board. An online questionnaire survey was conducted to collect data from students and instructors regarding their experiences with the LMS, and their satisfaction levels in these three areas, as well as to suggest areas of improvements.

Keywords: learning management system, navigation design, user interface design, usability, discussion board

Introduction to Learning Management System

Learning management system (LMS), which is also known as course-management system (CMS), is ubiquitous in the e-learning world especially for higher education institutions (HEIs). A LMS prepares a set of tools and framework that allows exchange of information and knowledge amongst instructors (teachers) and students via the Internet. Additionally, it makes the creation of online course content, the teaching, and the management of course content to be relatively easy for the instructors (Meerts, 2003; Trotter, 2008). Other facilities provided by the LMS may include enabling communication by using tools such as e-mail, real-time chats and asynchronous bulletin board, creating online assessments such as test and quiz, and displaying student grades, inter alia.

Initially there was resistance against the use of LMS by many HEIs due to its high price and the closed-proprietary system model. Nevertheless today many institutions are increasingly adopting LMS. For instance, in the United Kingdom alone, 95% of the institutions of higher education use LMS in 2005 compared to 86% of them in 2003 (Jenkins, Browne, & Walker, 2005). In Malaysia, 88% of the HEIs adopted LMS in 2004 versus 100% in the year 2011 (Abtar, Ahmed, Abas, & Asirvatham, 2005; Embi, 2011).The reasons for the increase in number of adoptions are mainly due to the tools becoming more robust and flexible and the increasing student demand for faculty use of LMS in the institutions (Meerts, 2003).

Since many universities are employing e-learning into their educational programs nowadays, the strategies of sustaining the e-learning environment has become a great challenge for these institutes to ponder (Embi, 2011). Although there are a lot of research conducted to study the success factors of a LMS, the system should also be evaluated on the aspects of HCI factors such as the effectiveness of interfaces and the quality of usability and interaction (Costabile, Marsico, Lanzilotti, Plantamura, & Roselli, 2005; Ssemugabi & de Villiers, 2007). This is important as complexity of the tools or the usability of the user interfaces should not be a hindrance to learning.

The Importance of Improving User Experience in LMS

Much research was conducted to study the challenges and success factors of e-learning in several HEIs in Malaysia, such as strategic planning and implementation, technology availability, governmental and institutional supports, and management factors that could increase the success of the LMS (Embi, 2011; Masrom, Zainon, & Rahiman, 2008; Maznah, 2004; Selim, 2005; Zainon, Masrom, & Rahiman, 2007). However, understanding the impact of user interface, navigation and usability designs of the LMS towards the success of e-learning, which may affect the user experience in virtual learning environment, is equally significant.

A user experience encompasses the behaviour, thoughts and feelings a person has when encountering a product over time. A good user experience balances elements such as usefulness, usability and desirability (Ssemugabi & de Villiers, 2007). Research in psychology and neuroscience reveals a tight connection between affect and cognition; Emotions (affect) guide social interactions, influence decisions and judgments, affect basic understanding, and can even control physical actions (Ssemugabi & de Villiers, 2007). It is also proven that there are perspectives on how cognitive processes are related to emotions (O'Regan, 2003). Kay & Loverock (2008) predicted the changes in emotions would be correlated with changes in use of computers. Increased happiness and decreased negative emotions should translate into more frequent use of computers. Therefore developing strategies to reduce negative emotions or to promote excitement may be important with respect to promoting use of computers (Kay & Loverock, 2008). Thus, it is important to take into consideration the emotional state of the users in e-learning environments in order to enhance learning performance.

A study by Lazar et al shows that between a third and a half of the time on computer is spent on frustrating experiences. Amongst the reasons, web navigation appears to be the largest cause of users' frustrations. It also shows that novice users suffer even more frustration than experienced users, as they do not have a lot of computer experience (Lazar, Bessiere, Ceaparu, Robinson, & Shneiderman, 2003). Also, a website that is packed with many features is not necessary usable and effective (Jenkins, Browne, & Walker, 2005). When the users find a website unfriendly, confusing, overloaded with too much information, or they are unable to find the information they need, they will leave that site in frustration (Browne, Hewitt, Jenkins, & Walker, 2008) .

User experience can be improved with good design of the website. Selim proved that the instructional implementation of the information technology (IT) is also critical in bringing the success of e-learning, which includes network components (such as bandwidth, security, etc.), course management systems, and user interface (Selim, 2005). A badly designed and unpredictable user interface, which is inconsistent, deceptive and confusing, can increase user frustration (Granic & Glavinic, 2006; Guo, Qian, Guan, & Wang, 2010; Lakhan & Jhunjhunwala, 2008). Therefore, it is important to design an effective interface, so that it improves user experience. Johnson suggested that during the design stage the instructor should plan and structure the resources, to assure interactions that assist in the transfer of skills and knowledge. In addition we can use tools such as email, chat rooms, and discussion boards to provide learners the opportunities to interact and add a new level of depth to their learning. It is also necessary to conduct a complete series of evaluations for testing the accuracy, effectiveness and clarity of the e-learning system (Johnson, 2003).

Research Questions

This research evaluates the effectiveness and clarity of LMS designed to encourage e-learning sustainability. We investigate the effectiveness of the LMS to assure interactions that assists the transfer of knowledge in the virtual learning environment. In this research, we like to survey the following from LMS users (instructors and students):

1. To what extent are the users satisfied with its navigation design?
2. To what extent are the users satisfied with its user interface design?
3. To what extent are the users satisfied with the discussion board as a communication tool to encourage interactivity?
4. How the LMS should be designed to improve the navigation design, user-interface design and usability of the discussion board, to meet users' expectations?

It is important to note that satisfaction is correlated to emotion, and outcome satisfaction is positively related to user's enjoyment of the overall experience (Bee & Madrigal, 2012; Hülsheger, Alberts, Feinholdt, & Lang, 2012). In other words, if the overall experience using the system is positive, then the user's emotion towards the system is also positive (satisfaction).

Method

Participants and Procedure

This research uses questionnaire survey to collect users' opinions and satisfaction levels based on the 5-point Likert scales. Some qualitative data regarding feedback and suggestions to improve the designs are collected too. The survey is conducted at Tunku Abdul Rahman College, Malaysia. The institution adopts Blackboard Learn™ as the e-learning platform to allow blended learning. The data for this study are gathered by means of an online survey questionnaire, which was made available for a month. The respondents are instructed to answer five different sections regarding (1) their demographic background and experiences with the LMS, (2) their navigation experience, (3) their opinions on the user interface design, (4) their experiences with the discussion board, and (5) the areas of improvements to enhance learning/teaching.

Demographic and Background

The survey targeted all the instructors and students at different levels of studies (certificate, diploma and advanced diploma), who have experience with the LMS. A total of 626 responses were achieved within one month, however only 549 of them have experience with the e-learning system. Amongst these 549 experienced users, most of the responses were from students (87.80%) compared to instructors (lecturers and tutors) (12.20%). Respondents were majority male (55.92%) compared to female (44.08%). By age, respondents were grouped into 17 to 20 (75.59%), 21 to 25 (12.39%), 26 to 30 (1.82%), 31 to 40 (6.56%), 41 to 50 (2.00%), and above 50 (1.64%) years old. In terms of students' level, certificate student was represented by 0.21%, diploma student was represented by 94.61%, and advanced diploma student was represented by 5.19%. In terms of experience with the LMS, most of them have used the LMS for 1-2 years (61.34%), followed by those novices who have used it for less than a year (19.17%). Only 12.14% of them have used the LMS for 3-4 years and lastly 7.35% have used for more than 5 years. In terms of the satisfaction level, two percents of the users reported they are very satisfied, 28.42% of them are satisfied, 7.10% of them are not satisfied and 1.46% of them are not satisfied with the LMS at all. Majority of them (61.02%) are neither satisfied nor unsatisfied with the system. However based on the statistics, the satisfaction level is positively skewed (towards satisfaction).

Data collection

The research is conducted to investigate the effectiveness of the LMS to assist in interactions and transfer of knowledge. Three areas are investigated, which are navigation design, user interface design, and the usability of the discussion board. The data is collected from the 549 experienced users who have used the LMS in the past 2 years.

Navigation design refers to how the features of a website (e.g. hyperlinks, buttons, image buttons, etc.) are located and organized, to enable the user to navigate around the website easily. To measure the satisfaction of the users on the navigation design, we gathered the data as follows:
- The number of features they used and what are the commonly used features in the LMS
- The reasons for not using the features

- The users' satisfaction levels on the navigation design

User interface design refers to the graphical and visual design to facilitate interaction between a user and the system, so that the user can carry out his/her tasks. To measure the satisfaction of user interface design, we gathered the following data:
- To what extent they agree that (1) the layout design and choice of colours are consistent, (2) the textual hyperlinks are visible and easy to recognize, (3) they are always kept informed about their current navigations, (4) proper explanations of the actions and validations to be carried out are displayed clearly, (5) the LMS offers good use of term or image to help them understand what the purpose of a feature is, and (6) the pages are loaded with too many features.
- Their levels of satisfaction with the user interface design

Lastly, we assessed the usability of the discussion board. Usability refers to the ease to learn and use the functionality/features of a website. It also refers to how the user perceives the effectiveness (fit for purpose) and efficiency (work or time required to use) of the functions. In this section, the respondents are asked to answer the following:
- How often do they use the discussion board? If the respondents have not used the system in the past two years, then state the reasons of not using it
- To what extent they agree the functions are usable, such as (1) they are able to figure out how to use it immediately when they were new to the discussion board, (2) them can effectively follow the posts under the main topic and not to get off track, (3) they are allowed to know/see the posts they have already read and those they have not, (4) they always know how to start a new topic/thread for a new discussion, and (5) the subscription function that allows them to receive emails when somebody replies to their post efficiently
- Their levels of satisfaction with the discussion board

Results

Navigation Design

We group the types of features[1] in the Blackboard LMS into 5 categories, which are:

1. Communication tools - announcement, discussion board, discussion board management, file exchange, address book, internal email, messages, group pages, real-time chat, and whiteboard (10 types).
2. Productivity tools - calendar, My Grades, search, offline content, user manual/quick tutorials, survey/pool, Bookmarks/Scholar Bookmark/Scholar Stream (7 types).
3. Student-involvement tools - manage groups, home page/student portfolio, the Electric Blackboard, online test, and early warning system (5 types).
4. Course delivery tools[2] - test manager, Gradebook/Gradebook Views, course statistics/performance dashboard/student tracking, course management and Echo content (5 types).
5. Page content design tools[3] - manage course design, manage course menu, and create syllabus (3 types).

First we determine the commonly used features by examining whether or not the features are used by the majority of the users. The formula below is to determine how many users have used each individual features in the past two years:

$$UserFrequency, f_{i,k}(\%) = \frac{n_{i,k}}{N_k} \times 100$$

Where,
$n_{i,k}$ = Total number of users who use the feature i of category k
N_k = Total number of users who use any feature of category k

The unit step function, $H_{i,k}$ is used to define how common that the feature i of category k is used:

$$H_{i,k} = \begin{cases} 0, & f_{i,k} < 50\% \\ 1, & f_{i,k} \geq 50\% \end{cases}$$

Hence, if $H_{i,k} = 1$ then the feature is considered commonly used.

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[1] Some other features which are available in the LMS in general may be omitted in this research.
[2] Used by instructor only
[3] Used by instructor only

Overall, from the 30 types of features, only 8 types of tools achieve $H_{i,k}=1$. They are announcement (74.89%), discussion board (51.48%), My Grades (60.28%), survey (59.10%) online test (79.49%), course management (78.43%), course statistics (52.94%) and manage design (78.43%). Therefore, we could conclude that only 26.67% of the features available in the LMS are commonly used by majority of the users.

Secondly, a question is given to the respondents to find out the reasons for not using the above features in the past 2 years. Based on the 368 responses, the main reasons are they actually do not know the functions of the features (they do not know what are the features for) (44.29%) and they are not aware of the features (39.95%), followed by they think they do not need the features or the features are not useful (34.51%). Only 11.96% of them commented that the features are not easy to use, and only 2.93% noted some features listed in the questionnaire are not available in their institution. Other reasons that they provided include emergence of other social networking platform (such as *Facebook*), relying on other classmates to retrieve the materials, slow loading time, lack of time to explore other features, less attractive interface, and restriction of certain feature .

Regarding the satisfaction level, 37.16% of them are either very satisfied or satisfied with the navigation design. Only 11.48% are unsatisfied or not satisfied at all. Majority of the respondents (51.37%) are either neutral or have difficulty to judge their satisfaction level.

User Interface Design

Majority of the respondents agree that the LMS layout design and choice of colours are consistent (60.77%), and the textual hyperlinks provided are visible and easy to recognize (57.66%). Only 42.15% of them agree that the LMS always keep them informed about the current navigation, 40.88% of them think the system always display proper explanations of their actions, and 33.58% of them agree that the system offers good use of terms to help them to understand the purpose of the feature. Lastly, although majority of the users neither agree nor disagree (or having difficulty to judge) that the pages are loaded with too many features (55.01%), however 36.79% of them do agree with that. Only 8.20% of the users do not think the pages are too packed. Lastly, 42.34% of them are satisfied with the user interface design, and 12.77% do not agree. Most of them (44.89%) have difficulty in judging whether they are satisfied or unsatisfied with the user interface design.

Usability of the LMS Discussion Board

About thirty percents of the users (30.78%) have not used the discussion board in the past two years. From the remaining respondents of 380 users, majority of them only use the discussion board for 1 to 4 times in a semester (58.68%). Only 22.89% of them are truly active, where they use it more than 10 times in a semester. The major group of users comes from students (72.61%), while for the instructors - only less than half of them (43.94%) are using the discussion board in the past two years. For those who never use the discussion board in the past two years, the main reason is they think they do not need to use it (58.58%), and the second reason is due to majority of the students (37.88%) do not know the purpose of the discussion board. Other reason includes they prefer to use other social networking platform, such as *Facebook* for discussions. Besides, since there are no responses most of the time, they therefore lose interest to use the LMS discussion board.

On the flip side, based on those respondents who have used the discussion board, majority of them could not judge whether they agree or disagree that the functions are usable. Only 32.88% of them were able to figure out how to use it immediately when they were new to the discussion board, 33.15% of them agree that the system can effectively allow them to follow the posts under the main topic and not to get off track. Less than 40% (37.74%) of them agree that the current design of the discussion board allows them to read all the posts/replies easily, 43.13% of them agree that the discussion board enables them to know/see the posts they have already read and those they haven't, and 29.65% of them think they always know how to start a new topic/thread for a new discussion. Lastly only 26.68% agree that the subscription function is efficient and user-friendly. Regarding the level of satisfaction, 56.33% of them are neither satisfied nor unsatisfied with the discussion board. Only 34.5% of them think they are truly satisfied with the system. However, less than 10% (9.17%) of them are actually not satisfied with the system.

Discussions

Improvements on the Navigation Design

From the results, it is shown that even there are many features made available to the users, however only 26.67% of them are commonly used. The main reason for not using those features is the users actually do not

know what the features are for, and not many of them agree that the system offers good use of terms to help them to understand the purpose of the feature. According to Tidwell (2011), it is important to ensure the system offering terms that allow the users to scan and pick whatever they think possible rapidly (Tidwell, 2011).

The second reason for users not using the features is they are actually not aware of them. It is proven that displaying many features on a page doesn't necessarily increase the user awareness. When there are too many links for user to view, they need to take time to choose the desired destination. Some suggestions given by the respondents include making the user interface simple and not to include so many functions/features, only make those important or frequently used features to be easily assessed, and show only the courses that the user are enrolled in and remove those irrelevant links from the home page.

The second reason above can also be caused by poor organization of menu options, poor grouping of categories, and unexpected navigation behaviour (e.g. broken link) (Kalbach, 2007). For instance, an inconsistent design includes using two different visual styles for textual hyperlinks, and it is unpredictable as the user could not recognize the hyperlinks easily. It is also very confusing if there are two totally different features given similar names (e.g. Gradebook and Gradebook View), or two same features or given different names (e.g. Unit Documents and Course Documents), therefore the user could not predict the differences between the two. Some students also commented that they encountered some unusable functions (empty links), e.g. when they click the "Assignment" link, but the page returned is empty. To improve, some of the respondents suggested rearranging the outline and the layout of the interface to provide clearer sections/grouping, to remove the empty link from the main menu, to provide a better search engine to aid navigation, and provide shortcuts to avoid the need to have too many clicks to reach a particular function.

Lastly, the third reason for not using the features is due to the users thinking they do not need the features. Some students explained that they have not been given any briefing regarding the LMS when they were new, and therefore they are not aware of the other functions. To increase user awareness of the functions, it is important to provide briefing/training to the users especially novices. However, providing training to a large number of students can be costly. Therefore, a good navigation design could help to increase user awareness, by offering tooltips or help to explain the functions of the features. Besides, user manual or tutorial could be helpful too.

Improvements on the User Interface Design

Although most users agree that the LMS layout design and choice of colours are consistent, however many of them commented that the design is outdated and less interesting. They are not attracted by the user interface design, and therefore feel bored with it. Only minority of the users disregards that the user interface is full of features, and many of them think that the interface may appear overwhelming to the users.

The first step in designing a good interface is to understand what jobs that the users are trying to accomplish. User interface design is not about putting the information and laying it out nicely, but the real objective lies in solving the right problem for the users (Tidwell, 2011). Hence, designing an interface that allows them to scan and pick whatever they think possible rapidly could improve the user experience.

The suggestions provided by the respondents to improve the user interface design include designing a simpler user interface, enlarging the font size so that it is readable by all groups of users, providing clear description/instruction wherever necessary, replacing text with appropriate graphics and icons, providing messages any time or in between the process to keep users informed of the status, enabling flexibility to the users to allow them to modify the interface design, always have a "Help" option to inform the users on what to do next , and providing options for the users to view all the links in one page rather than making them to click many times (e.g. site map).

Improvements on the LMS Discussion Board

It clearly shows that not many users of the LMS are keen to use its discussion board, especially the instructors. The main reason is they think do not have the need to use it. Furthermore, there is a vicious cycle which the unresponsiveness of the students (or instructors) leads to another that aggravates the problem. Therefore the instructor (or student) may not want to continue to use the discussion board due to unresponsiveness of the others, unless they force the students to respond. In addition, the emergence of other social network platform such as *Facebook*, which appears to be more attractive and usable, makes the students stay away from the LMS discussion board. A respondent also commented that there are many steps involved to post a forum. For instance, to allow group discussion, the students need to be grouped first by the instructor beforehand, and the

steps to enable grouping are tedious. Most of the users find the discussion board is less attractive and it is limited if compared to other forum site such as *vBulletin*. To improve the usability of the discussion board, some suggestions given include enabling discussion between all students and instructors in the college (currently it is limited to only those who are enrolled in the course), add more functionality and flexibility such as allowing the users to form group for their own group discussion, enabling the users to save the comment / reply as draft, provide tutorial or user manual to explain the steps, and keep the design up-to-date and as attractive as the current social-networking site.

Conclusion

Navigation design is not just about creating a way to provide access to information, but it is how it should provide access to the users. It should be designed to show users where they are on the site and helps to orient them. Putting a lot of information or features into a page does not necessarily increase user awareness. The research shows that although the LMS has a lot of features to offer, but only less than 30% of them are commonly used. Good use of terms helps users to understand the purpose of the features, and attractive design of user interface will increase user's interest to continue to use the system. User interface design is not about laying out the information nicely, but the real objective is to help the users to complete their tasks easily. A badly designed interface will lead to a low usability of a function and low satisfaction of the users, regardless how good the function is. Well-designed system helps users to achieve their goals, increase their positive affect such as job satisfaction, and decrease their negative emotions such as frustration. This research also shows that although discussion board is provided as a platform that assists in the transfer of knowledge through user interactions, however when there is no proper plan by the instructor and active involvement of users (which can be caused by unusable functionality), this platform will not be effective. Developing a system with good navigation, user interface and usability design is strongly believed to enhance user experience. Good user experience improves user's positive emotional response in virtual learning environment, and it is one of the essential success factors in the e-learning system.

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