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my.Eskwela: Designing An Enterprise Learning Management System to Increase Social Network and Reduce Cognitive Load

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Abstract

A typical learning management system (LMS) provides a tool for teachers to upload and create links to resources, create online assessments and provide immediate evaluation to students. As much as it tries to be student centered, most LMS remains a tool for instruction rather than learning. In a learning generation that is bound by very high online social capital, connectedness to the family weakens. my.Eskwela (My School) redefines LMS to include a parent component to address the need for inclusive participation of parents in the teaching-learning process. Basis for re-design came from the low user acceptance of teachers in using similar system. The study premised that designing an environment that evokes a "feeling of socialness" through social widgets provides a perceived presence of a social environment that will increase usage of the system. In a majority of the focus group discussion, results showed a more positive evaluation of the system. Precisely, for perceived usefulness, perceived ease of use, perceived adoption and intent to use, it can be reasoned that the implementations for reducing the total effort to perform a task and the effect of implementing social interaction in the user-interface has high-impact.

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1. Introduction

Department of Education (DepEd) Learners Information System (LIS) is a School Information System that integrates nationwide public school learners data. LIS provides information to support critical decisions of stakeholders in the public education system. At the same time, LIS was also designed as a facility for administrative tasks of teachers, namely: to enroll students, upload the final grade point average, encode learners information and track students registration from one school to another [1]. The teachers to some degree meted with skepticism with the issuance of DepEd order (AO 25) that requires the adoption of the LIS. Specifically, teachers point out that the LIS is additional work because of delayed response time and occasional system breakdowns [2]. These unforeseen delays, therefore, require the teachers to stay up late at night waiting for LIS to be available again to comply with submission deadlines [3]. Available online videos that provide training materials on the use of the LIS, [4, 5, 6] also show how a task is accomplished by following a various set of steps which affect teachers cognitive load. Despite these hindrances, teachers need to comply with the use of the LIS because it forms part of the performance which translates into Performance-Based Bonus(PBB) [7]. DepEd response to this challenge is to advise teachers to persevere as the system undergoes several stages of fine-tuning [8].

The nationwide implementation of DepEd LIS faces the problems of computing infrastructure scal- ability and user adoption issues connected to its current design being teacher-centric. The system is not able to accommodate heavy usage demands because of the limited access to stable internet infrastructure. From a cognitive perspective, there is a certain threshold that the brain can tolerate concerning the delay of systems response to human-computer interaction(HCI) [9]. In most cases, LIS response time exceeds the user's delay threshold. One solution for the LIS computing infrastructure scalability is to add more comput- ing resources to its servers, but this may only justify the investment only during peak hours. An expensive investment for computing resources not optimally utilized by DepEd.

The goal therefore of this paper is to discuss how my.Eswkwela can address scalability and adoption such that the tool becomes a learning environment which reduces cognitive load and promotes a feeling of socialness and connectedness. Reducing cognitive load increases adoption. Increasing social connectedness through social widgets provides a community based learning environment that in effect promotes social presence among teacher, parents, and student [10, 11].

2. Literature Review

Learning Management Systems (LMS) are "web-based applications, running on a server and accessible with a web browser from any place with an Internet connection. LMS give educators tools to create online course websites, and provide access to learning materials" [12]. Moreover, beyond the confines of primary education, many enterprises have seen the potential of LMS to enhance human resource capacity. Enterprise LMS is tailor-fit to the organization needs for knowledge sharing and enhancement among others [13].

2.1. LMS Challenges

Currently, there are many available LMS ready to use. However, these tools face challenges in a chang- ing environment of users influenced by disruptive technologies like the social media and the enforced social connectivity. Often referred to as "silent" user requirement, failing to incorporate this user demand may move the LMS to obsolescence. For example, a study showed that Moodle is a platform that is pure LMS and may not be

suitable for today's educational settings [14]. Also, some LMS design only considers the teacher's system needs pointing to the role's influence for effective adoption [15, 16, 17].

With these challenges, there is a need to redesign LMS to embody social features towards attaining the goal of better performance and connectivity.

2.2. Human Computer Interaction

Out of the nine features needed for an enterprise LMS, user interface ranks the first [13]. The user interface does imply not only aesthetics but also performance in responding to user requests.

Human-Computer Interaction (HCI) is "a multidisciplinary field of study focusing on the design of computer technology and, in particular, the interaction between humans (the users) and computers" [18]. Further, HCI is social and emotional regardless of the interface goal [19]. With this, interactive products should avoid negative experiences as it can affect performance [20]. For example, a mere presence of an icon might influence task performance [21]. The challenge would then be on the design of interfaces for better interactions and continued use. Concerning websites, visual aesthetics can come from a socially rich widget that promotes the feeling of socialness among users [10].

2.2.1. Context of User Interaction

Understanding the user encompasses the interactions provided for by the user interface because expe- rience cannot be guaranteed only afforded [22]. Gender, culture, and collective experiences are among those that influence the design of an interface. In a gender-stereotyped computer, the willingness among female participants are observed in a positive mood and not in a negative mood, while the male participants showed a different pattern of behavior [23]. Cultures also affect interface design, mainly because of the difference in backgrounds and perception. In a group of people, the emotional user experience is affected by self-confidence and such was derived from competence in computer interaction [24].

2.2.2. Media Equation Theory

Media Equation Theory asserts that people interact socially with computers, the same way they interact with real people [23, 25]. Research indicated that cues of language use and voice, among others, influence the individual perception of computers as social actors which has a strong association with satisfaction [10, 26]. A social presence can reinforce the feeling of socialness by conveying human contact, sociability, and sensitivity as a form of psychological connection [11].

2.2.3. Cognitive Load

Aside from promoting social presence, it is also essential to understand cognitive load which is the "mental effort necessary to understand and process the information being presented and to then formulate and carry out a response" [27]. Mental effort can be affected by merely remembering the number of task sequences needed to perform an interaction. Good HCI design suggests reducing the cognitive load by minimizing the sequences of steps in performing an interaction [28]. Moreover, along with cognitive load comes also the physical load which is the number of physical efforts (i.e., mouse click, keyboard typing) required to perform the tasks.

From cognitive load, system response also plays a critical role for it influences the user's system per- ception. System expected response can be derived from category. Typing and mouse-clicks are covered with instantaneous category and have the shortest expected response time of 100-200ms. The next category expects to acknowledge actions from the user with an expected response time of 0.5-1 second. The expected response may not be displayed immediately, but the system must show indication (a form of response) that it is processing the request. Continuous category requires a response time of 2-5 seconds to maintain the flow of interaction; otherwise, the communication is considered failure. The captive category makes the user wait for results in 7-10 seconds; otherwise, the user will abandon the task [27].

2.3. Technology Acceptance Model

After all considerable effort has been exerted to build the conceived software product, next step is to measure user's acceptance. For information system, Technology Acceptance Model (TAM) "posits that perceived usefulness and perceived ease of use determine an individual's intention to use a system with intention to use serving as a mediator of actual system use. Perceived usefulness is also seen as being directly impacted by perceived ease of use" [29].

3. User-Interface Design Process

The following section discusses how my.eskwela user interface came into being considering social pres- ence while addressing cognitive load [13].

3.1. What is my.eskwela?

my.eskwela is a platform that aims to bring together teachers, parents, and students to form a community who believes that real-time and active monitoring of student's learning can facilitate student success in performance. The first implementation was designed to be an extension of Mindanao State University-Iligan Institute of Technology's (MSU-IIT) Student Information System (SIS), e.SMS [30].

The promising results of my.eskwela V1.0 encouraged the use of application within DepEd schools because of public school difficulties in maintaining and accessing student records. Designing a system to address the problem can be done by understanding the user needs of a DepEd public school. In this respect, a Memorandum of Agreement(MOA) was signed on the 9th of October 2015 between MSU-IIT and DepEd public school represented by Tambo Central School (TCS), Iligan City. The MOA stipulated the cooperation between two schools which involves the development of my.eskwela for DepEd or my.eskwela version 2.0 that like its predecessor includes the teachers, parents, and students.

my.eskwela 2.0 is a client-server architecture that implements a RESTful API for data access [31]. The RESTful API was on a separate server from the server of the user interface(UI) using OpenShift RedHat 2.0 free Platform-as-a-Service (PaaS). The choice of using the cloud is by the fact that DepEd school's budget is constrained to the acquisition of new physical server.

3.2. Incremental Model Design Process

An incremental model design process is a method of developing software that follows the cycle of design, implement, and test until the completion of the product. During planning, a study is also made to understand the existing DepEd LIS and the cognitive load requirement for each featured interaction within the system. After examining DepEd LIS, an implementation of the same feature was done in my.eskwela, specifically integrating socialness.

3.2.1. Understanding DepEd LIS

There are many features available in DepEd LIS. In this study, enrollment using Learner's Reference Number (LRN), learner's profile and grade encoding were the only features considered since these features have corresponding features in my.eskwela. As a note, DepEd LIS also provides batch enrolment where teachers select from a list of students for inclusion in their section. However, it is not considered here because my.eskwela is designed to be a real-time system that encodes LRN during student enrollment.

YouTube videos were uploaded as manual on how to operate the LIS [4, 5, 6]. The instructional videos give insight into the steps a teacher needed to accomplish to perform an interaction. The observed cognitive load for performing tasks showed that enrollment, learner's profile and encoding of grades features require a cognitive load of 10, 4 and 6 steps respectively.

Clicking the buttons prevents the user from doing any other task by blocking the screen with loading messages. Also, one of the loading messages reads, "Loading content... Reload webpage if loading took more than a minute".

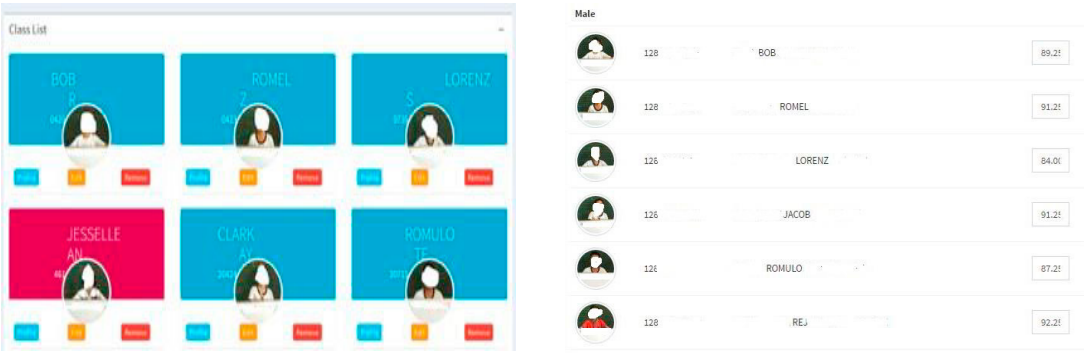
From this observation, it is clear that the system is captive. Considering the physical load by looking at the total number of steps classifies the system as complex.

The videos also showed the kind of interface DepEd LIS used in its implementation. From looking at the videos, DepEd LIS uses the textual presentation of data set in text boxes, labels, and tables.

3.2.2. Designing the my.eskwela Interface

One of the goals of re-designing my.eskwela interface is to promote a feeling of socialness by using socially rich widgets provided by AdminLTE version 2.3.0. To further promote social connection in these widgets, a picture of the students and teachers were displayed. Figures 1a and 1b shows the representation of class list and grade entry using the widgets with pictures. The widgets do not only represent a textual data, but it also personifies the data the way people look at profiles of social media like Facebook. More than the text, it reminds the viewer that they are interacting with the data of the real person. A connection not established when looking only at a pure textual data.

Concerning response time, my.eskwela is designed to be non-blocking to ensure users can perform other tasks after clicking the submit button. Further, for enrollment, view profile and grade encoding, the required number of tasks to perform the interactions are 3, 5, and 2 respectively. From this, classification of my.eskwela interface is continuous. If the teacher does not want to change the pre-computed grade from the system, encoding of grades can be ignored.



(a) Class List (b) Grade Entry

Fig. 1: Socialness in two Sample Forms

3.2.3. Training and Participatory Discussion

After the interface design, interaction features needed to access data were made available with RESTful API that exposes resources needed to operate on student records. The resulting system was then presented to the TCS teachers as part of training, after which participatory discussion was conducted for them to suggest improvements to the system. As a side note, the teachers of TCS are computer literate and have experience interacting to DepEd LIS as this is mandatory. Others also brought their mobile devices (cell phones and tablets) during the training which posed no problem with my.eskwela because the UI is already responsive. TCS principal encouraged all Teacher's participation in the training as part of the agreement.

Each training session began with an orientation, followed by a workshop where they encoded student detail, view/edit profile and enroll student. Encoding of grades were not done but discussed.

my.eskwela's sustainability model was also presented to the teachers using monetary contribution for payments of cloud infrastructure and other incidental expenses.

The hands-on training and participatory discussions were done separately for Grade 1 up to Grade 5 teachers in computer laboratory inside TCS. Teachers requests for feature inclusion during each session and was implemented and experienced by the teachers of the next training session.

3.2.4. Evaluate

After the training, a technology acceptance survey was conducted by adopting the modified Mobile Services Acceptance Model (MSAM) survey questionnaire from my.eskwela version 1 [30, 32]. MSAM is based on TAM with the motivation for user acceptance of mobile applications. The survey questionnaire has sections of perceived usefulness, perceived ease of use, trust, and perceived adoption. Perceived usefulness tries to measure user's perception of the technology's impact on work efficiency. Perceived ease of use tries to measure the system's influence concerning the design intuitiveness in carrying the tasks and the respon- siveness in delivering results. Trust is a construct that describes the user's belief on the system's capability to protect the interaction against unexpected security breaches. Perceived adoption tries to measure the level of user acceptance as the system becomes part of doing a task on a daily basis. Each section contains set of questions that aim to measure user's evaluation of the system using a Likert scale.

4. Results and Discussions

The following sections discuss the findings on the cognitive load and the effect of evoking a feeling of socialness in my.eskwela interface.

4.1. Survey Results

There was a total of 67 teachers who participated in the training workshop. All the participants are licensed teachers, 63 are female, age ranges from 29 to 58 years old. All of them are at least a Bache- lor's degree holder. Moreover, thirty-two teachers pursued higher education from Master up to the Doctoral level. The educational attainment of the participants is a sign that they are maintaining a culture of excel- lence which affects their confidence in trying out alternatives that have the potential to improve the current situation [24].

Using Slovin's formula with a confidence level of 70%, the sample population needed for the system evaluation were ten teachers as a focus group.

4.1.1. User Acceptance

Figure 2 shows that majority of the focus group positively evaluated the different system's point of evaluation. For perceived usefulness, perceived easy to use, perceived adoption and intent to use results, the implementations for reducing cognitive load and the effect of implementing socialness in the user-interface has an impact to the majority. The survey results affirms that indeed visual aesthetics influences perceived usability[33].

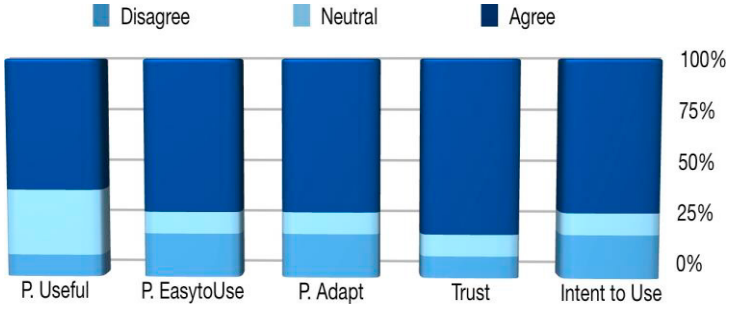


Fig. 2: Survey Results

The neutral and disagreeing group may be those that worry about the monetary obligation required with my.eskwela for sustainability. Further, even though not required by the survey instrument, a group member wrote its concern on the non-adoptability because of the monetary obligation.

Trust was perceived by the respondents because security mechanisms were discussed during the training workshop [34].

Though my.eskwela is not yet fully adopted by any of the schools, the perceived usefulness and the desire to adopt the system motivated some members to campaign for the use the system in different venues like research symposium and trainer‘s training forum. This motivation can be considered an effect of the new design of the LMS focusing on use social widgets to create an environment that promotes connected learning.

Because of these exposures, my.eskwela received a recommendation from the Division Superintendent for widespread adoption within member schools.

Infrastructure wise, since my.eskwela was deployed in the cloud, the occasional system breaks due to the lack of computing resources during high-demand can never happen. Thus, reducing the Internet related concerns that also lead to cognitive load [35].

5. Conclusion

Adopting socialness in interface design may have influenced system perception translated into user’s promotional efforts. These actions are the manifestation of afforded good user experience.

This phenomenon is the extent to which the users manifest media equation theory[25].

On the other hand, carefully examining the physical load in computer interaction, avoiding a captive system and complicated system design reduces too much cognitive and physical load which affect the user’s productivity. Also, using the cloud as the infrastructure to deploy applications can increase the user’s satis- faction for resource elasticity avoids unexpected system breakdown [35].

As a final note, the separation of concerns through RESTful API implementation, responsive web de- sign, tailor-fitting of functionalities, and the deployment to the cloud are just the characteristics that made my.eskwela an enterprise solution. However, more efforts need to be done in relation to certification, re- porting and analytics, single sign-on, personalization and localization [13]. More importantly, designing an enterprise learning management system for the current generation of students requires features that increase social network thereby creating a social learning environment. As my.eskwela is continuously improved, is an example of an enterprise LMS where in learning environment is student centric and includes capability of both teachers and parents to learn with the child.

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