Usability Evaluation of an Educational Management System affecting the User – Satisfaction among Tertiary Students in an Undergraduate Engineering Program in the Philippines

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Abstract

Learning Management System (LMS) is an accommodating technology to instructors wherein lessons, quizzes, and other usable features in teaching can be conducted online. There is an LMS used in an engineering institution which won many awards for continuous improvement for the past few years. Yet, students are having difficulties in using the system which can affect their academic performances. In order to certify that there is a problem regarding the usability of the system, an initial data gathering of SUS Questionnaire was conducted to the 100 participating students. The said LMS requires improvement based on the SUS score of 51.75 which is below the marginal average scale of 68. On the other hand, the data of SUS Questionnaire, QUIS, checklist of tasks, and SEQ gathered from 425 students were used for Structural Equation Modelling (SEM) – path analysis to determine the factors affecting the usability of the LMS. The results are the following: (1) effectiveness – usability, (2) screen – usability, (3) task level – usability, (4) terminology – usability, (5) learning – usability, (6) system capabilities – usability, and (7) efficiency – effectiveness. Hence, this research modifies the user interface to increase the usability, and user satisfaction of the said LMS.

Keywords
learning management system, usability, user satisfaction, structural equation modelling

1. Introduction

Usability refers to users who can effectively utilize a tool or system to accomplish a particular assignment with fulfillment and simplicity (International Organization for Standardization, 1998). On the other hand, learning management system (LMS) is one of the expanding trends nowadays which involve the utilization of technology in teaching providing a platform of learning environment by facilitating activities, sharing of educational resources, and recording of learning assessments using web or servers. The ease of use and greater satisfaction of the users with the tools and features included in the LMS delivers better human computer collaboration (Thuseethan, Achchuthan, & Kuhanesan, 2014). Usability can enhance the learning background for students (Tselios, Avouris, & Komis, 2008) and as well as in improving one's academic performance. An LMS secures the learning experience more firms for students to increase the participation of students and facilitates educators a personalized learning system.

The center of this study is a usability evaluation of an LMS used in an engineering institution in the Philippines. Based on the computed mean of System Usability Scale (SUS) questionnaire of the 100 participating students result to 51.75 which is below the 68 marginal average scale, thus requires improvement. The main cause of the low SUS score observed by the researchers are (1) difficulties in remembering names and use of commands, (2) unclear help messages on screen, (3) not designed for all level of users, and (4) difficult to learn to operate the system. Moreover, this research paper aims to improve the usability and user satisfaction of a learning management system through modifying the user interface from the gathered information of concepts and works of ergonomics.

2. Review of Related Literatures and Studies

Learning Management System (LMS) is a necessary implementation in all universities worldwide (Adzharuddin & Ling, 2013). A study conducted by Hammed and Cullen (2008) at the Harvard Business School that blended learning approach makes students to learn five times as much material at one – third the cost of a classroom – only approach. On the other hand, a study conducted in the Philippines by Dimasuay and Pabro (2009) about the awareness of the students on the LMS used in their university. There were students failed the course because of not participating on the said LMS. In the same manner, the utilization of the said LMS by the professors is currently low. The researchers encouraged the professors to have more trainings to incorporate LMS in their teaching. Hence, modifying the user interface of LMS can increase the user satisfaction and at the same time can ease the use of the system to its users.

There are different usability models used to indicate the influencers to the usability of the system such as Eason Model, Shackel Mdel, Nielsen Model, ISO 9241 – 11, and QUIM Model (Aziz, Kamaludin, & Sulaiman, 2013). Kenneth Eason proposed and published a model called Eason Model wherein there are three aspects: task, user, and system. Task has two attributes: frequency, and openness, user has three attributes: knowledge, motivation, and discretion, and system has three attributes: ease of learning, ease of use, and task match. Shackel Model was developed by Brian Shackel wherein there are four attributes namely: effectiveness, learnability, flexibility, and attitude. Another model is established by Jakob Nielsen wherein the main model is system acceptability and usability as part of the usefulness. Another attribute that shares to the main model are utility, practical acceptability, usefulness, and social acceptability. Easy to learn or learnability, efficient to use or efficiency, easy to remember or memorability, few errors and subjectively pleasing or satisfaction are covered by usability. There is also an international standard for guidance on usability based on process oriented called ISO 9241 - 11 wherein Nielsen and Schneiderman were among the committee members in the development. ISO 9241 - 11 has 3 attributes namely: effectiveness, efficiency and satisfaction. Another model consists of ten factors, effectiveness, efficiency, learnability, satisfaction, trustfulness accessibility, usefulness, productivity, safety, universality, and usefulness called Quality in Use Integrated Measurement (QUIM). The common factors of these models are effectiveness, efficiency, and satisfaction. Hence, these factors will be used in the study.

Checklist of tasks is a list of tasks created by the researchers wherein respondents will do the tasks and time their selves. **Task Level** is determined by answering the Single Ease Question (SEQ) after doing the task. SEQ measuring whether the respondents are perceived to the task as difficult or easy. Additionally, **Efficiency** is when application or system allows the user to complete the time with justifiable amount of time (Belson & Ho, 2012). It can be measure by utilizing time – based efficiency or overall relative efficiency (Misfud, 2015).

$$Time - base\ efficiency = \frac{\sum_{j=1}^{R}\sum_{i=1}^{N}\frac{n_{ij}}{t_{ij}}}{NR}$$

$$Overall\ relative\ efficiency = \frac{\sum_{j=1}^{R}\sum_{i=1}^{N}(n_{ij})(t_{ij})}{\sum_{j=1}^{R}\sum_{i=1}^{N}(t_{ij})}$$

Where:
N = total number of tasks
R = total number of users
n_{ij}= result of the task of the user; 0 for failed and 1 for accomplished task
t_{ij}= time consumed of the user to accomplish the task

Effectiveness is when users achieved specified tasks with accuracy and completeness (Greene, Kelsey, & Franklin, 2016). It can be measure by utilizing the completion rate efficiency (Misfud, 2015).

$$Effectiveness = \frac{Number\ of\ tasks\ completed}{Total\ number\ of\ tasks} x\ 100$$

Satisfaction is the impression of the users towards the use of system (Greene et al., 2016). Satisfaction can be measure by Questionnaire for User Interaction Satisfaction with five categories: (1) overall reaction to the software, (2) screen, (3) terminology and system information, (4) learning, and (5) system capabilities is used.

According to Khine (2013), Structural Equation Modelling (SEM) is a confirmatory method to data analysis by ruling out the relationship between variables and also equipped of modelling multivariate relations, and evaluating direct and indirect impacts of factors under investigation. One of the type of models in SEM is Path Analytic (PA) models. PA models are considered in terms of observed variables. In spite of the face that they concentrate only on observed variables, they form a vital part of the historical advancement of SEM and utilize the same fundamental procedure of model testing and fitting as other SEM models.

The figure shown below is the concept formed from the review of related literature and studies to use in SEM. Efficiency, effectiveness, and satisfaction are under usability. On the other hand, task level, reaction to the software, screen, terminology, learning, and system capabilities are under the satisfaction.

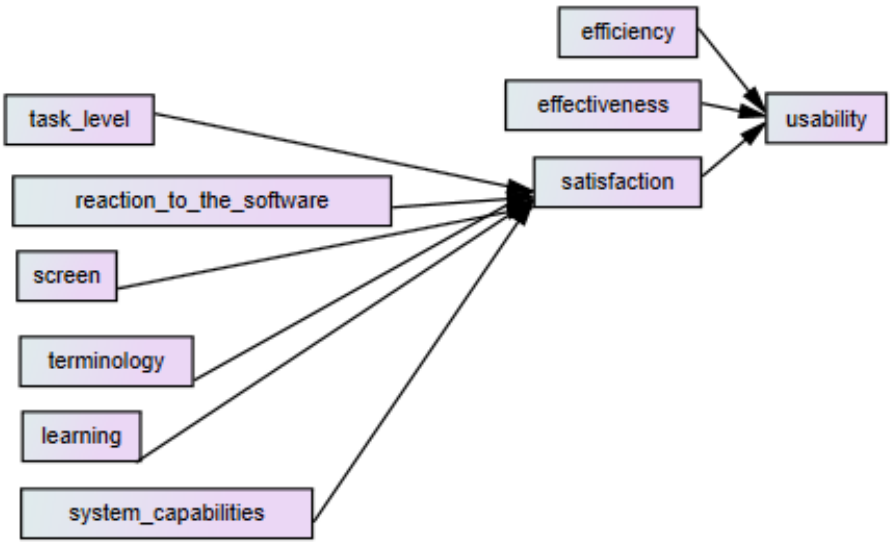


Figure 1. Conceptual Framework

3. Methodology

In order to perceive the problem in usability of the LMS, an initial survey of SUS Questionnaires to 100 students who already used a certain learning management system. Then, the conceptual framework was conceptualized by gathering some related literature and studies in relation to the factors affecting usability and the tools to measure it. To evaluate the influencer of the observed problem, necessary data is needed thus, Cochran's Formula was used to determine the sample size of the target respondents. The sample size arrived at 425 respondents. The data gathered from SUS and QUIS will be used for normality test utilizing Minitab 17 Statistical Software. On the other hand, the data computed from SUS, QUIS, checklist of tasks and SEQ will be used for correlation and path analysis utilizing Minitab 17 Statistical Software, IBM SPSS Statistics 23, and IBM SPSS Amos 23. After determining the factors affecting the usability of the LMS, a user interface modification will be recommended.

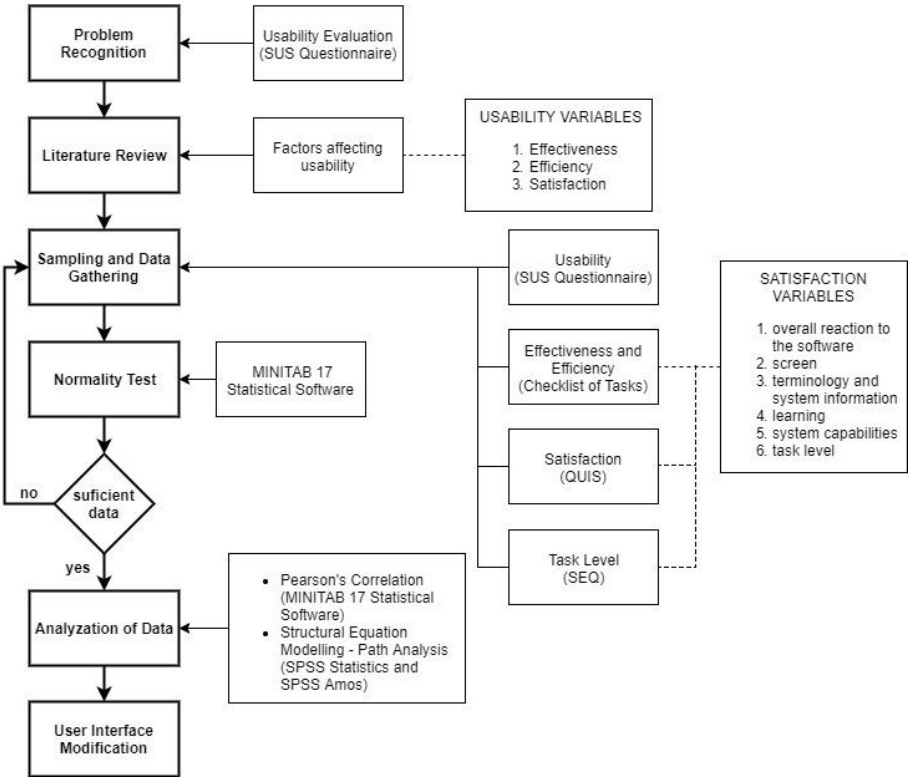


Figure 2. Methodology

4. Results

The questionnaires were distributed to five engineering programs: 60 Engineering 1, 190 Engineering 2, 55 Engineering 3, 48 Engineering 4, and 72 Engineering 5. Engineering 2 students contribute the greatest number of respondents on the study since most of the professors in that department used the said LMS.

The Figure 3 demonstrates the overall average responses of 425 students on each category in QUIS ranging from 0 to 9. The average students' response to the five categories were above midpoint of 5 which means that the students found to be quite satisfied to the current learning management system. Yet, screen has the lowest average score among the five categories.

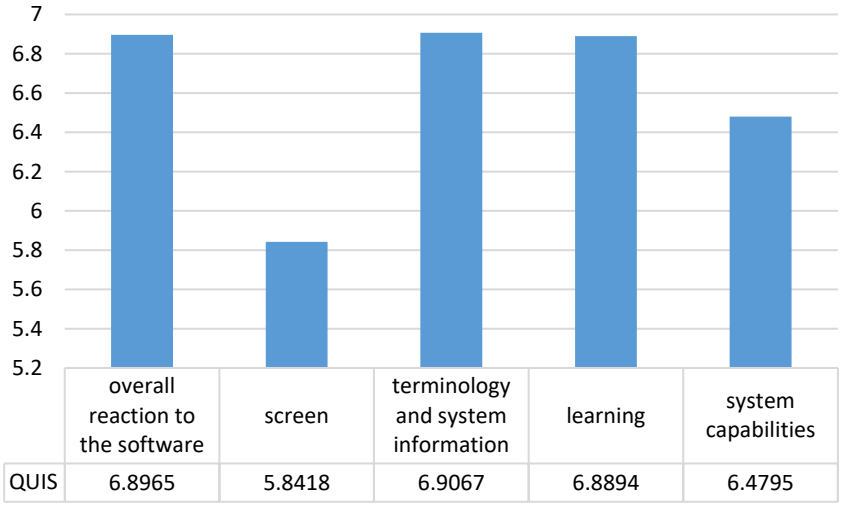
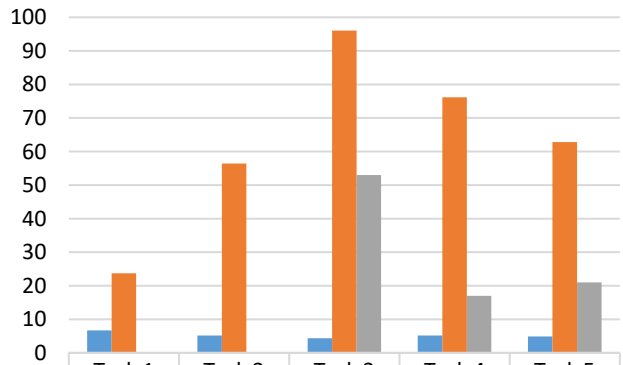


Figure 3. Average score of each category in QUIS

On the other hand, Figure 4 exhibits the overall average responses of 425 respondents on SEQ ranging from 1 to 7. The average students' response to tasks 1, 2, and 4 were above the average score of 4.8 – 5.1 which means that the students found the task easy. Task 5 was between the average score which means that the students found the task quite easy. While, task 3 was below the average score which means that the students found task not easy. The Figure 4 also demonstrates the average time of students finishing or aborting the task and the frequency of students failed to accomplish the tasks.



	Task 1	Task 2	Task 3	Task 4	Task 5
SEQ	6.7177	5.1882	4.3718	5.1553	4.88
Time	23.7203	56.4214	96.0475	76.1672	62.8285
Frequency of failed the task	0	0	53	17	21

Figure 4. Average score of each task in Checklist of Tasks

Furthermore, these summaries of data could help the researchers determine which part of the said LMS needed to give recommendation in order to increase the usability of the system at the same time increase the satisfaction of its users.

4.1 Normality Test

The probability plot determines whether the data gathered is in normal distribution or not. In an Anderson - Darling, normal distribution follows a p – value of greater than 0.05. The data below shows that the p – value of the QUIS (0.747) is greater than 0.05 at 425 samples. Hence, the distribution of the data is normal.

Table 1. Minitab Result – Probability Plot of QUIS

	N	Mean	Standard Deviation	AD	P – Value
Mean	425	6.664	0.7703	0.747	0.052

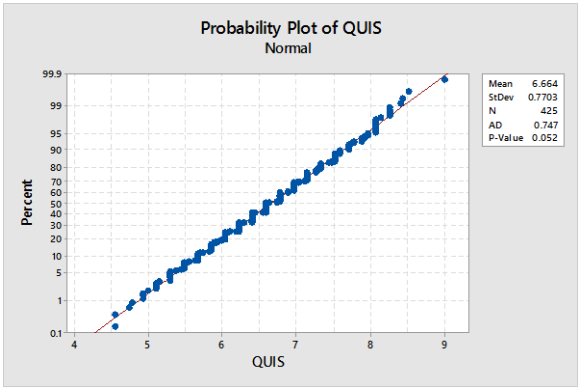


Figure 5. Probability Plot Graph of QUIS

The table below shows that the p – value of SUS Engineering 1 (0.401), SUS Engineering 2 (0.745), SUS Engineering 3 (0.625), SUS Engineering 4 (0.459) and SUS Engineering 5 (0.619) are greater than 0.05. Hence, the distribution of the data is normal at 425 samples.

Table 2. Minitab Result – Normality Test QUIS

Engineering	**1**	**2**	**3**	**4**	**5**
Mean	62.46	63.97	67.05	64.01	63.30
Standard Deviation	8.266	12.41	9.218	12.10	11.04
N	60	190	55	48	72
AD	0.401	0.745	0.625	0.459	0.619
P- Value	0.351	0.051	0.098	0.252	0.103

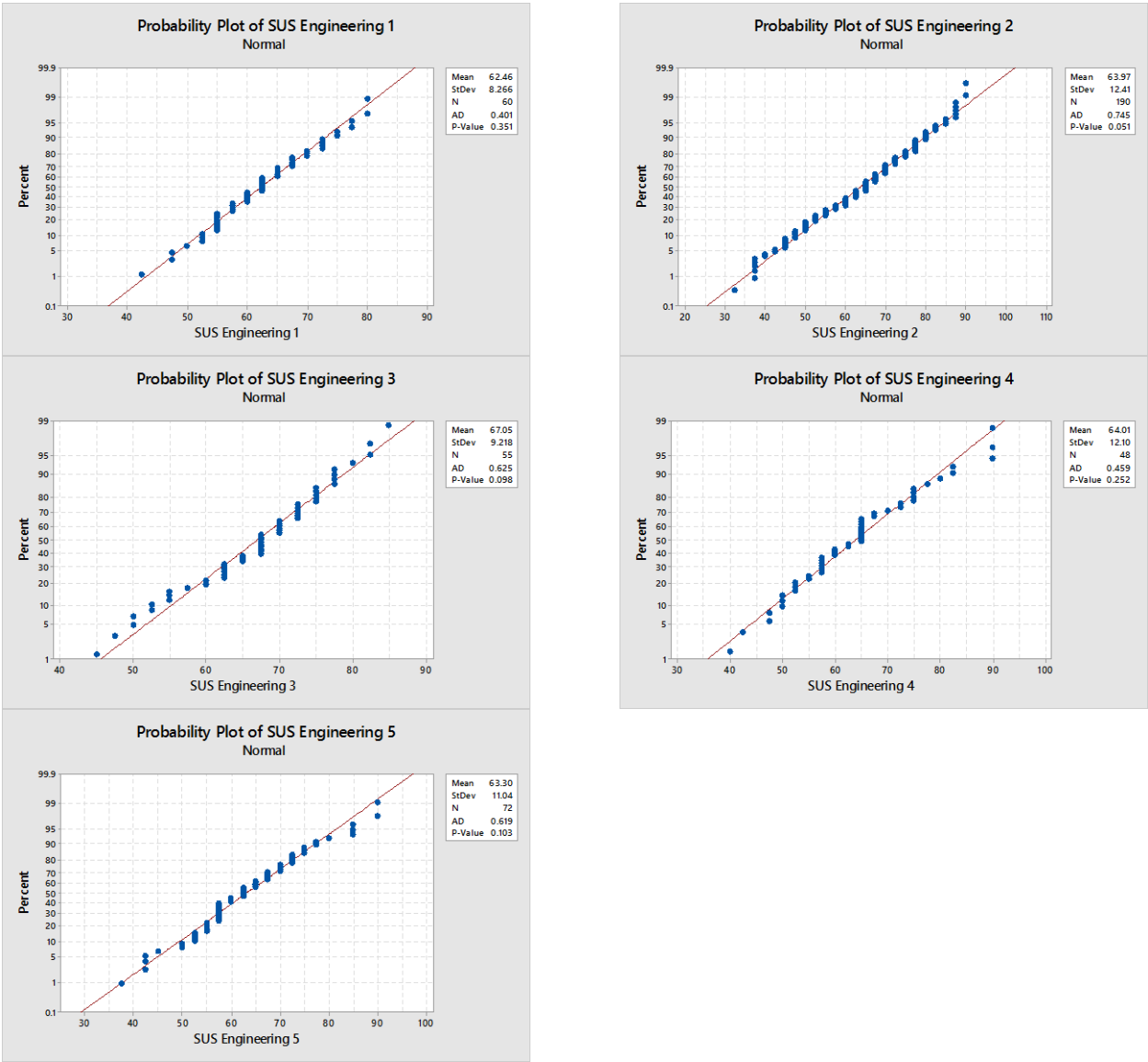


Figure 6. Probability Plot Graph of SUS Engineering 1, SUS Engineering 2, SUS Engineering 3, SUS Engineering 4, and SUS Engineering 5

4.2 Pearson's Correlation

The relationship exists between effectiveness - usability is positive moderate correlation. Task level - usability is positive high correlation. Meanwhile, screen - usability, terminology - usability, learning – usability, system capabilities – usability, and effectiveness - efficiency are having positive very high correlation. It means that the dependent factors will greatly affect the independent factor positively if there will be changes on the satisfaction, effectiveness, and efficiency of the users.

4.3 Structural Equation Modelling Analysis

In a path analysis, modification indices and model fit are important to satisfy initially before interpreting the output data. The table below shows the model fit of baseline comparisons and RMSEA of the path analysis diagram below. The value of RMSEA about 0.05 or less means a close fit of the model. NFI values above 0.95 are good. On the other hand, RFI, IFI, TLI, and CFI values close to 1 means a very good fit. Since all the values are satisfied, the path analysis diagram made was good.

Table 3. Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	1.000	.995	1.000	.998	1.000
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Table 4. RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.033	.000	.094	.589
Independence model	.795	.783	.806	.000

The figure below shows the good path analysis diagram wherein the values of RMSEA, NFI, RFI, IFI, TLI, and CFI were satisfied.

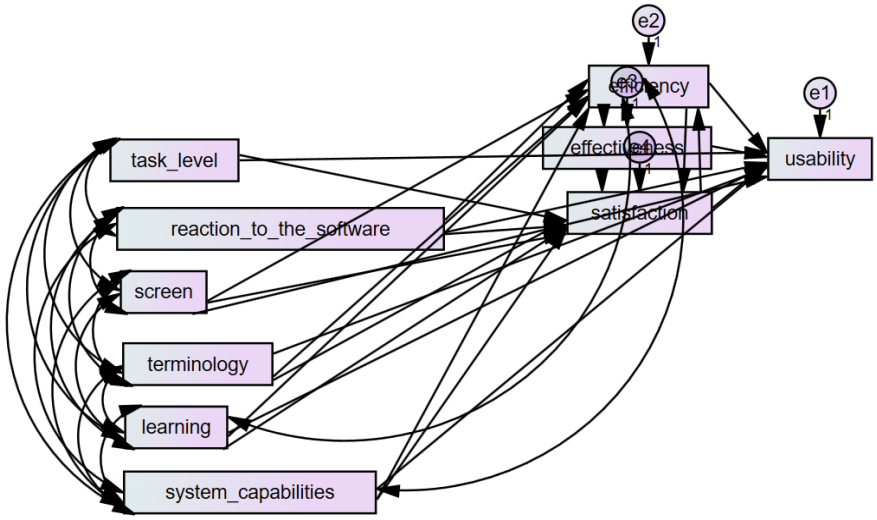


Figure 7. Path Analysis Diagram

The table below shows the regression weights provided by the SPSS Amos. In the column P, if the value of the parameter is less than 0.05 then it is significant. (1) effectiveness – usability, (2) screen – usability, (3) task level – usability, (4) terminology – usability, (5) learning – usability, (6) system capabilities – usability, and (7) efficiency – effectiveness are the significant factors affecting usability.

Table 5. Regression Weights with p – value less than 0.05

			Estimate	**S.E.**	**C.R.**	**P**
Usability	<---	effectiveness	-16.498	5.302	-3.111	.002
Usability	<---	task_level	3.160	.244	12.974	***
Usability	<---	Screen	-11.504	4.094	-2.810	.005
Usability	<---	Terminology	-17.387	4.858	-3.579	***
Usability	<---	Learning	21.765	3.979	5.470	***
Usability	<---	system_capabilities	13.274	3.033	4.376	***
Effectiveness	<---	Efficiency	.724	.024	30.072	***

The table below shows the estimate of squared multiple correlations in which the effectiveness, and usability acquired positive values of 0.749, and 0.897 means that the data fits on the trend and having a small variation on the responses. Meanwhile, satisfaction, and efficiency attained negative values of -39.241, and -884.518 which means that the responses did not follow a trend of data.

Table 6. Squared Multiple Correlations

	Estimate
Satisfaction	-39.241
Effectiveness	0.749
Efficiency	-884.518
Usability	0.897

5. Recommendations

The following significant factors: (1) effectiveness – usability, (2) screen – usability, (3) task level – usability, (4) terminology – usability, (5) learning – usability, (6) system capabilities – usability, and (7) efficiency – effectiveness are needed to be address to increase the usability, and user satisfaction of the LMS. Hence, the researchers recommend the following:

Table 7. Summary of Recommendations

PAGE	PRESENT	PROPOSED	PROBLEM/S ADDRESS
Sign in page error	The message error is too long. "Error: The email address and password combination you entered cannot be recognized or does not exist. Please try again."	The message error is now "Incorrect email address or password. Please try again."	There will be no information overload. Users can now understand the message error clearly.
Course Home page	The menu on the course home page as follows: Materials, Updates, Grades, Attendance, and Members.	The menu on the course home page as follows: Discussion, Materials, Grades, Attendance, and Members.	The users can now post directly to the course home page without exploring the side menus.
Calendar page	Upcoming events, homework, and activities were displayed.	Upcoming events, homework, and activities were notified and displayed.	The users can now easily track their events without going to the calendar page.
Calendar view item	The buttons on the calendar view item as follows: View	The buttons on the calendar view item as follows: View	The users can now delete the item without exploring the

	Item, Edit Item, and Cancel.	Item, Edit Item, Delete Item, and Cancel.	other pages involving calendar.
System	The current system has no ability to adapt changes on the screen.	Website Responsiveness	The user can now use mobile browser in using the LMS instead of the mobile application. In the same manner, user of desktop can now resize the browser.

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Biographies

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