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Empirical lecturers' and students' satisfaction assessment in e-learning systems based on the usage metrics

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ABSTRACT

Nowadays, in the pandemic of COVID-19, e-learning systems have been widely used to facilitate teaching and learning processes between lecturers and students. Assessing lecturers' and students' satisfaction with e-learning systems has become essential in improving the quality of education for higher learning institutions. Most existing approaches have attempted to assess users' satisfaction based on System Usability Scale (SUS). On the other hand, different studies proposed usage-based metrics (completion rate, task duration, and mouse or cursor distance) which assess users' satisfaction based on how they use and interact with the system. However, the cursor or mouse distance metric does not consider the effectiveness of navigation in e-learning systems, and such approaches measure either lecturers' or students' satisfaction independently. Towards this end, we propose a lostness metric to replace the click or cursor distance metric for assessing lecturers' and students' satisfaction with using e-learning systems. Furthermore, to obtain a deep analysis of users' satisfaction, we tandem the usage-based metric (i.e., completion rate, task duration, and lostness) and the SUS metric. The evaluation results indicate that the proposed approach can precisely predict users' satisfaction with e-learning systems.

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INTRODUCTION

Information technology has been widely used in education to facilitate lecturers and students to enhance communication and interaction during the learning process. E-learning grows up utilization of information technology to improve the education process from conventional learning to electronic-based learning (Caputi & Garrido, 2015; Sadikin, 2017; Sadikin et al., 2016). Hong et al. (2017) defined e-learning as an online learning which provides a collaborative means to achieve knowledge, creation, and interactions among lecturers and students. The participation of lecturers and students is a key to make a desirable outcome in higher-level learning (Kim, 2013). E-learning system helps lecturers as well as students to work and communicate (collaboratively) using web technology tools in different time and space (Casamayor et al., 2009; Gameel, 2017). Moreover, e-learning system provides a new approach to give an orientation for the learner in learning processes and is convenient to use anytime and anywhere (Navimipour & Zareie, 2015).

The discussion is a concept of interaction whereby users are responsible for learning activities and give contribution in e-learning system (Asoodar et al., 2016a; Haron et al., 2017; Lin, 2018; Zhang et al., 2017). To make successful communication in a forum based on students and lecturers' feedback in the learning process, there are some activities of users in e-learning system

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such as knowledge sharing (upload some course materials) and problem-solving (Horvat et al., 2015; Koohang et al., 2016; Sandiwarno, 2016). The quiz is also an indicator used by lecturers to see the performance of students in the learning process. In the e-learning system, lecturers can upload questions such as multiple choice or essay, then lecturers give time for students to answer and finish them. Assessments of the quiz are usually done weekly, and auto-graded and peer-graded assignments (Sun, 2016).

To facilitate the learning process, several platforms, such as Learning Management Systems (LMS) have been proposed to support activities in e-learning and help users. Moodle is one of the common platforms of LMS and is mostly used for assisting users in the learning process (Liberona & Fuenzalida, 2014). Moodle is an LMS software which is publicly available and one of the pertinent e-learning system widely used in learning institutions (Ifinedo et al., 2018; Muñoz et al., 2017). Kerimbayev et al. (2017) used Moodle to share materials and users' knowledge to increase the motivation in an online course.

Assessing users' satisfaction in the e-learning system is necessary because it highlights the satisfaction level of users on using e-learning system. Satisfaction is the condition of users' emotional issue that can be viewed as consideration based on personal experiences and belief to products. Moreover, satisfaction is important key to indicate the effective of learning process between lecturers and students.

Most previous approaches have been attempted to assess users' satisfaction in e-learning systems. For instance, Almarashdeh (2016) measured lecturers' satisfaction based on questionnaires, which in separates users' criteria, gender, and age. Asoodar et al. (2016b) assessed users' satisfaction based on the learning process (i.e., course dimension, technology dimension, and design of system) using an anonymous questionnaire and regression analysis. The evaluation results show that the proposed approach can be employed to explain and describe the users' satisfaction in learning process. Cohen and Baruth (2017) in their study proposed an anonymous questionnaire and Analysis of Variance (ANOVA) to evaluate users' satisfaction in difference among groups online learning by their personality. The result indicates that the proposed can be able to use in evaluate users' satisfaction. Po-Olusula (Chen & Adesope, 2016), measuring users' satisfaction in the e-learning system involves different aspects such as technology, criteria of the user, and feature of web-based systems. Ku et al. (2013) contend and demonstrate that measuring users' satisfaction in e-learning system can be done in teamwork, which means dividing the learning participants into two teams of students.

Moreover, there are several usability methods which can be used to assess the users' satisfaction when they are interacting in e-learning systems, namely usage-based metrics (i.e., completion rate, task duration, and lostness). Usability is used as the measurement of some useful products, and it is easy to use for the users to get satisfaction goals more effectively and efficiently. Mehmet (Berkman et al., 2018) defined usability as a tool to evaluate software products from subjective users' perspective and questionnaires standardized to confirmed dependability of satisfaction.

Harrati et al. (2016) argued that completion rate (notated as CR) is a metric which used to measure the percentages of users successfully and finished the activities on a specific task of the e-learning system. The high results of completion rate on tasks indicate that users successfully completed the assigned tasks. However, the low score implies that users did not achieve some of the tasks. Task duration (notated TD) is a metric used for measuring the total time that users require to finish the tasks. Task time is usually measured in minutes for long activities and seconds for the short activities (Curcio et al., 2019), whereas lostness is a metric which used to calculate the efficient in the navigation of web pages in which the participants took to complete the task step by step (Ahn et al., 2018; Curcio et al., 2019). Therefore, completion rate, task time and lostness respectively describe to what extent users successful finished each task, how long they take to complete such tasks, and the minimum number of steps that a user must take to finish the tasks.

Harrati et al. (2016) have attempted to assess lecturers' satisfaction based on usage-based metrics (i.e., completion rate, task duration, cursor distance or mouse clicks) and System Usability Scale (SUS) metric. SUS is a metric that is used to assess users' satisfaction based on questionnaires. Cursor distance is a metric that is employed to assess the efforts undertaken by users in the systems through the hand use to move the cursor on the screen. The authors measured the correlation between the completion rate and SUS metrics by adopting Pearson Correlation Coefficient (PCC) metric. The results indicate that, there is a correlation between completion rate and SUS metrics.

Although, the previous approaches have been attempted to assess users' satisfaction and obtained the good results, however, questionnaire of SUS metric is not a sufficient for expressing the level of users' satisfaction. Additionally, the previous approaches assess both lecturers and students separately. Moreover, the aforementioned approaches do not consider evaluating the effectiveness navigation in e-learning systems.

To this end, in this paper, we propose an approach to assess lecturers' and students' satisfaction in using e-learning system, unlike other works which consider lecturers or students separately. Moreover, in conducting users' satisfaction assessment we propose a lostness metric which is part of usage-based metrics to replace cursor distance or mouse clicks. The choice of this metric (lostness) was motivated by previous approaches (Ahn et al., 2018). To the best our knowledge, this paper is the first attempted to introduce assessing users' satisfaction with adding lostness metric. Our proposed approach consists of two parts: (1) employing usage-based metrics to assess users' satisfaction based on task modelling and (2) usability data analysis based on SUS metric. Task modelling is used to capture the activities and track the navigation of users. In addition, we exploit the well-known metrics in usability data analysis to assess the lecturers' and students' satisfaction. Further, we analyze the correlation between the results between usage-based metrics and SUS metric. The main contribution of this study is summarized as follows. First, we propose a new way to assess lecturers' and students' satisfaction based on usage-based metrics with added lostness metric. Second, the proposed approach has been evaluated with the data from users in using e-learning systems. Third, we compared and examined the correlation between usage-based metrics and SUS metric. The evaluation results of this study indicate that there is significant correlation.

The rest of this paper is organized as follows. In section 2, we highlight several related works in assessing users' satisfaction. Section 3 describes the research method of our study. Section 4 presents the results and discussion. In section 5, we conclude the paper and highlight the future work.

METHOD

In this section, we present an approach for assessing the users' satisfaction in an e-learning system (Moodle). The version 3.6.2 Moodle is installed on remote accessible web server with the usage of logger scriplet that is integrated within HTML pages of the website. Empirically, to assess the users' satisfaction, we grouped users into two groups (Trained and non-Trained). The users were such grouped in order to assess the influence of user training on the level of users' satisfaction. Trained users are those with experience and are familiar with using e-learning system, whereas non-trained users are those who do not have experience or are not familiar with using e-learning system.

In assessing lecturers' and students' satisfaction, we explain the framework of the proposed approach as shown in Figure 1. Figure 1 shows the framework of the proposed approach which has two steps. First, we collected the logs activities of users from e-learning system such as discussion forum, quiz, uploading educational materials (e.g., documents, music, and pictures), and record all activities of users in a database. Second, in supporting to assess users' satisfaction, the users had to fill a SUS questionnaire. The following subsections in detail present each of the key steps of the proposed approach.

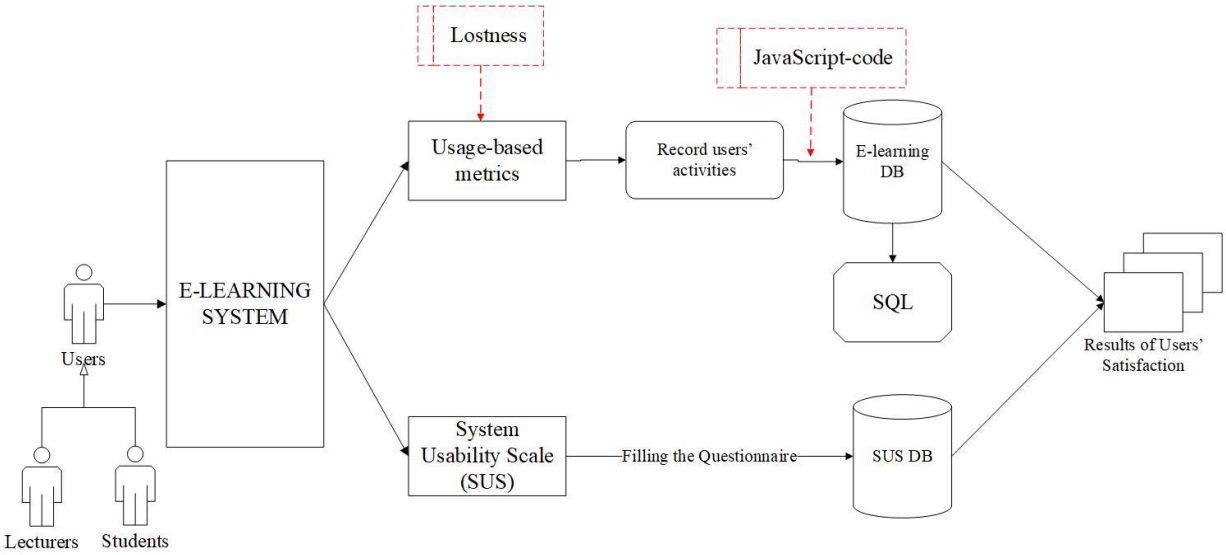

Figure 1. The Framework of the Proposed Approach

Usage-based Metrics

To assess the level of satisfaction based on usage-based metrics, we define the series of tasks (task descriptor), which are generally conducted by lecturers and students in e-learning system. The task descriptors of lecturers and students are similar, but some tasks are different. The task descriptor (task modelling) of lecturers consists of login, open and choose the course, making discussion forum, respond to the discussion forum, and also uploading quiz. On the other hand, the task descriptor of students consists of login, open and choose the course, respond discussion forum, uploading the discussion forum, and responding to quizes. The performed activities by the lecturers and students are similar in task 1 and task 2. The steps in task 1 are such that users must open e-learning system by typing the e-learning address on the browser address bar. Once open, on the start page of an e-learning system, the users will see the login form, which should be filled in by entering the login credentials. This step is a validation process which means if users are registered or have the credentials of the e-learning system then users are given access into the system. After successful login, users will have access to the main menu of the e-learning system. For creating a discussion forum or quiz that is shown to students in e-learning system, the lecturer opens the page of forum or quiz, fills out the form of forum or quiz, and also uploads some materials for discussion. After the lecturer creates a forum, students can interact with the lecturer. After the students upload the forum, then lecturer can provide feedback to the forum that has been done. Therefore, tthe student can also reply to the forum provided by the lecturer.

In acquiring data of the courses in the e-learning system, we collected from the data logs of the e-learning system and put-on JavaScript code into the e-learning system for collecting data of activities performed by the lecturers and students in the course. The events were recorded by JavaScript in order to assess the users' satisfaction based on system usage, we define the series of tasks (task descriptor), which are generally conducted by lecturers and students in e-learning system. The task descriptors of lecturers and students are similar, but some tasks are different. The task descriptor of a lecturer consists of login, open and choose the course, making discussion forum, respond to the discussion forum, and uploading quiz. Task descriptor of students consists of login, open and choose the course, respond to discussion forum, uploading the discussion forum, and responding quiz. In supporting the assessment of the users' satisfaction based on activities, we employ commonly usage-based metrics including: completion rate, task duration and lostness.

Completion Rate

Completion rate is a metric used to measure the success of any activities performed by users, calculated by Formula (1). The percentage of this success ranges from 0% (failure) to 100% (success) (Harrati et al., 2016; Tullis & Albert, 2013).

$$Completion\ Rate = \frac{\sum task_{complete}}{\sum task_{undertaken}}\ x\ 100\% \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (1)$$

Task Time

Task time is a common way to measure the usability of a product. Task time is simply the time elapsed between the start of a task (St) and the end of a task (Ft), usually expressed in minutes and seconds, calculated as in Formula (2) (Tullis & Albert, 2013).

$$\text{Task Time} = (St - Ft) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (2)$$

Lostness

To calculate the lostness, Formula (3) is employed, where n represents the number of different web pages visited while performing the task, s is defined as the pages visited total number to indicate each task, r is denoted as the minimum number of task in pages which should be visited to finish the task, s is total number of page visited.

$$L = \sqrt{\left(\frac{n}{s} - 1\right)^2 + \left(\frac{r}{n} - 1\right)^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (3)$$

System Usability Scale (SUS)

From Bareeq et al. (AlGhannam et al., 2017), SUS with 10 questions was used, where each question has the concept of the SUS, and the positive statements presented in odd-numbered and the negative statements are even numbered. The respondents choose from a five-point Likert-scale that is represented by numbers from strongly disagree (1) to strongly agree (5) accordingly. Each item's score contributes from 0 to 4. The sum of the scores is multiplied by 2.5 to obtain the overall SUS score and the number of scores for each respondent ranges from 0 – 100, as formulated in Formula (4).

$$SUS = 2.5 \left[\sum_{n=1}^{5} (x_i - 1) + (5 - x_i)\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (4)$$

Experimental Setup

In this section, we explain the experimental setup of two methods. These two methods are the usage-based metrics and SUS metrics.

Usage-based Metrics and SUS Metrics

For evaluation, we compared the proposed method against the approaches that only use completion rate (notated as Cr), task duration (notated as Td), lostness (notated as L), and SUS metrics. Note that, the Cr results indicate that users are satisfied in range of 70% - 100% (Harrati et al., 2016; Tullis & Albert, 2013). The result of lostness metric should be less than 0.5 to consider satisfaction (Smith, 1996; Tullis & Albert, 2013). The SUS results indicate that users are satisfied if the score is not less than 70% (AlGhannam et al., 2017).

Data Collection from e-Learning

The data of this study is the logs of the activities which are performed by the lecturers and students from online courses in the a university located in Jakarta, Indonesia. The lecturers were grouped based on gender, age, and academic qualification, whereas the students were grouped based on gender and age. The total number of users is 1906, out of which lecturers are 50 and students are 1856.

Table 1. The Distribution of Lecturers and Students

Lecturers		n-data	%
Gender	Male	30	60
	Female	20	40
Age Distribution	25-35	25	50
	36-45	10	20
	46-56	10	20
	57-67	5	10
Academic Qualification	Junior Lecturers (AA)	25	50
	Senior Lecturers (L)	15	30
	Associate Professor (LK)	5	10
	Professor (Prof.)	5	10

Students		n-data	%
Gender	Male	464	50
	Female	464	50
Age Distribution	17-19	464	50
	20-22	464	50

Table 1 shows the distribution of lecturers and students, in which the lecturers consist of the junior lecturer (*Asisten Ahli* or AA), senior lecturer (*Lektor* or L), associate professor (*Lektor Kepala* or LK) and Professor (Prof.) In order to acquire data of the courses in the e-learning system, we collected from the data logs of the e-learning system (Moodle) and put-on JavaScript into the e-learning system for collecting data of activities that are performed by the lecturers and students in the course. The events were recorded by JavaScript, in certain items such as how many clicks the users make to go to the intended page, because before the users use e-learning system, we identified the minimum number of click links that are required to reach each part of the system.

FINDINGS AND DISCUSSION

In this section, we present and discuss the results obtained from the experiment based on usage-based metrics, SUS metric, and finally a results discussion.

Findings

Usage-based Metrics Evaluation

Table 2 depicts the results for the completion rate, duration, and also lostness for the two groups of lecturers. We note that, on average, all of the trained lecturers were able to complete the assigned activities successfully, except in task 4 and 5. In a total of eight lecturers and 14 lecturers out of 50 lecturers failed to complete the assigned activities fully task 4 and task 5 respectively. Then, we further noted that for the non-trained lecturers, though the majority were able to complete the assigned activities, but some of them failed to fully complete the activities in all the tasks. Moreover, the results generally suggest that the trained lecturers spent less time to complete the tasks (an average of 16 minutes for the long task), whereas non-trained lecturers spent about 37 minutes for the same task (task 5). Finally, according to the recorded values for the lostness metric, the results suggest that the trained lecturers efficiently navigated through the system comparing against the non-trained lecturers. In addition, Table 3 provides the detailed results of the lecturers based on their biographical information. The comparison of the trained and non-trained lecturers for the three usage-based metrics is further pictorially depicted in Figure 2.

Table 2. Lecturers' Satisfaction Assessment

	Task 1	Task 2	Task 3	Task 4	Task 5
Completion Rate					
Trained	100	100	100	97.5	93.8
Non-Trained	64.9	73.2	68.9	55.8	77.5
SD	24.82	18.95	21.99	29.49	11.53
Duration					
Trained	3.18	3.32	11.14	12.32	15.65
Non-Trained	8.39	12.09	35.03	30.24	37.65
SD	3.68	6.2	16.89	12.67	15.56
Lostness					
Trained	0.03	0.13	0.16	0.25	0.14
Non-Trained	0.37	0.44	0.53	0.55	0.66
SD	0.24	0.22	0.26	0.21	0.37

Table 3. Lecturers' Satisfaction Assessment based on Gender, Age, and Academic Qualification

	Gender		Age				Academic Qualification			
	Male	**Female**	**26-35**	**36-45**	**46-56**	**57-67**	**AA**	**L**	**LK**	**Prof.**
Completion Rate										
Trained	99.08	97.68	98.7	99.24	96.24	99.24	98.7	99	95.64	96.94
Non-Trained	67.44	68.98	65.9	62.68	67.38	65.56	68.64	65.1	60.76	73.86
SD	18.28	15.81	18.76	20.12	16.52	18.24	17.83	18.36	19.78	14.63
Duration										
Trained	9.31	9.64	9.32	8.87	8.92	8.92	9.32	8.94	9.14	8.42
Non-Trained	24.48	24.98	24.51	24.73	24.92	24.93	24.51	24.76	24.48	25.27
SD	12.67	12.91	12.78	12.61	12.73	13.01	12.78	12.7	12.54	13.01
Lostness										
Trained	0.19	0.09	0.17	0.19	0.07	0.14	0.17	0.19	0.12	0.05
Non-Trained	0.5	0.53	0.53	0.5	0.65	0.57	0.53	0.5	0.61	0.67
SD	0.19	0.25	0.2	0.2	0.3	0.26	0.2	0.2	0.28	0.34

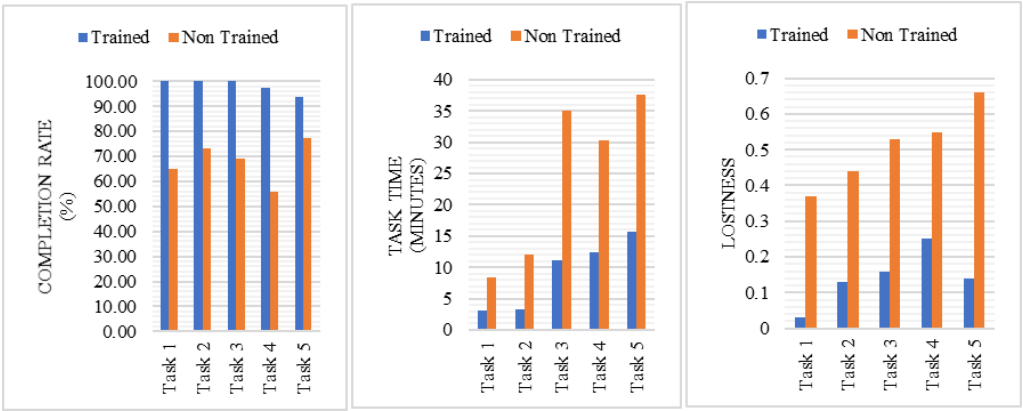

Figure 2. Trained and Non-trained Lecturers' Comparison

Table 4 reports the results for the completion rate, duration, and also lostness for the two groups of students. A total of 1,856 students were grouped into two groups (trained and non-trained) to contain 928 students each. Generally, the results suggest that on average all of the 928 trained students were able to successfully complete the assigned activities in all of the five tasks. Furthermore, a total of 25 non-trained students (3% = 25/928) were unable to fully complete the assigned activities in all five tasks. It was also noted that, generally most of the non-trained students did not fully complete the tasks resulting to an average of 60% completion rate.

Moreover, the results generally suggest that trained students spent less time to complete the tasks (an average of 13.5 minutes for the long task), whereas non-trained lecturers spent about 31 minutes for the same task (task 5). Finally, according to the reported values for the lostness me-

tric, the results indicate that the trained students efficiently navigated through the system comparing against the non-trained students. Table 5 further provides the detailed results of the students based on their biographical data. The comparison of the trained and non-trained students based on the three usage-based metrics is further depicted in Figure 3.

In summary, the results indicate that there is a significant difference between the recorded results of the three metrics (completion rate, duration, as well as lostness) between the trained and non-trained users (lecturers and students). The results suggest that trained users are significantly better at and also more satisfied with using the e-learning system compared to non-trained users. Furthermore, it is worth noting that trained students generally reported good results comparing with the trained lecturers, whereas non-trained students and non-trained lecturers reported almost similar results.

Table 4. Students' Satisfaction Assessment based on Gender, Age, and Academic Qualification

	Task 1	Task 2	Task 3	Task 4	Task 5
Completion Rate					
Trained	100	100	100	100	100
Non-Trained	60.4	64.6	46.1	51.5	59.58
SD	28	25.03	38.1	34.29	28.58
Duration					
Trained	2.9	3.1	11.16	12.65	13.55
Non-Trained	16.69	14.95	31.49	29.71	30.78
SD	9.75	8.38	14.38	12.06	12.18
Lostness					
Trained	0.08	0.16	0.14	0.18	0.18
Non-Trained	0.38	0.48	0.51	0.51	0.61
SD	0.21	0.23	0.26	0.23	0.3

Table 5. Students' Satisfaction Assessment based on Gender and Age

	Gender		Age	
	Male	Female	18-20	21-22
Completion Rate				
Trained	100	100	100	100
Non-Trained	56.24	56.7	47.38	33.7
SD	23.56	23.44	27.44	35.45
Duration				
Trained	8.49	8.85	8.49	10.34
Non-Trained	26.35	27.12	24.32	25.13
SD	10.25	11.09	10.25	11.09
Lostness				
Trained	0.14	0.14	0.12	0.12
Non-Trained	0.49	0.49	0.45	0.59
SD	0.2	0.2	0.19	0.27

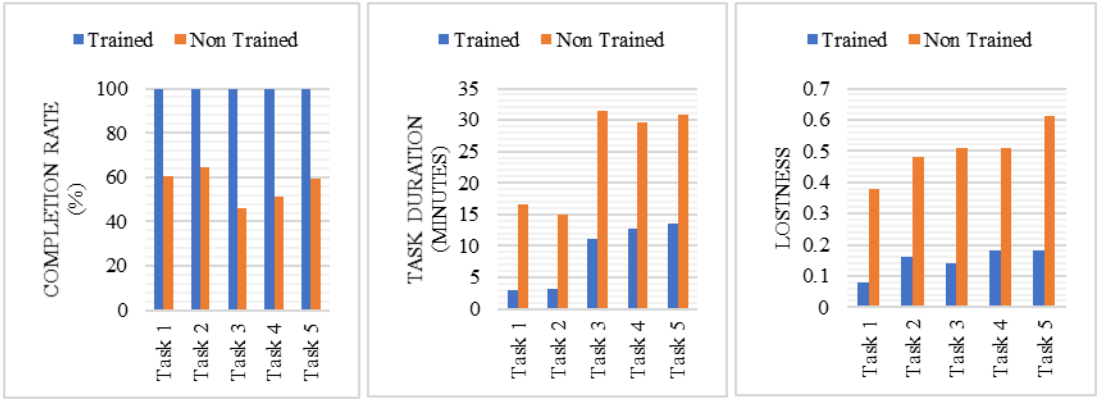

Figure 3. Trained and Non-trained Students' Comparison

System Usability Scale

The system usability analysis aimed at quantifying how students and lecturers perceive the usability of the e-learning system. Table 6 depicts the SUS results for both trained and non-trained lecturers based on gender, age and academic qualification. Generally, the results suggest that, on average the trained lecturers reported more than 90% whereas non-trained lecturers reported 69% with an average standard deviation (SD) of 15.02 on task completion rate. As depicted in Table 6, it is evident that trained lecturers perceived that the system as more usable comparing against non-trained lecturers.

Table 6. Lecturers' SUS Analysis

	Gender		Age				Academic Qualification			
	Male	**Female**	**26-35**	**36-45**	**46-56**	**57-67**	**AA**	**L**	**LK**	**Prof.**
SUS (%)										
Trained	90	92.86	90	95	90.42	92.5	88	94.64	85	86.25
Non-Trained	69.47	67.08	68.96	70	68.75	74.17	69.79	71.94	66.25	65.83
SD	14.52	18.23	14.88	17.68	15.32	12.98	12.88	16.05	13.26	14.44

Furthermore, in Table 7, we report the results of a usability analysis of students based on gender and age. The average results of SUS of trained students were recorded at 87.69% and at 69.84% for non-trained students with an average SD of 12.62 on the completion rate. Similar as trained lecturers, and also the trained students reported higher SUS scores than non-trained students which implies that trained students perceived the system as more usable comparing against non-trained students. Finally, the overall results for both lecturers and students suggest that lecturers ranked the usability of the system higher than the students. In other words, the lecturers were more satisfied with in than the students.

Table 7. Students' SUS Analysis

	Gender		Age	
	Male	**Female**	**18-20**	**21-22**
SUS (%)				
Trained	86.18	88.27	87.49	88.81
Non-Trained	69.42	70.31	69.16	70.47
SD	11.84	12.7	12.96	12.97

The Cronbach alpha α which refers to the reliability of assessment is estimated as 0.865 for all scores of tasks. This is an indicative that the questionnaire of SUS metric strong reliability instrument used in the e-learning evaluation according to Borkowska and Jach (2017). They argued that the internal consistency assessing of the α scale should be reached the value above 0.8.

Comparison between SUS and Lostness

The study further compared the SUS and lostness to deduce whether the perceived satisfaction of the system reflects users' actual performance when using the system. In that regard, we compared the SUS scores against lostness, that is because SUS reveals how the users' rate how easy using the system is, whereas lostness reflects to what extent users were able to use the system practically in practice by measuring the ease of navigating within the system. We compared the lostness with the SUS metrics and completion rate with the SUS metrics. In the comparison we examined the correlation between the results of lostness with SUS metrics and completion rate with SUS metrics. We also computed the Pearson Correlation Coefficient (PCC) for lostness with SUS metrics and obtained an average PCC value of $r = 0.658$. Furthermore, PCC for completion rate and SUS metrics we achieved an average PCC value of $r = 0.736$. Figure 4 depicts the comparison of SUS and lostness for lecturers and students respectively. The results generally suggest that there is a close correlation between SUS and lostness.

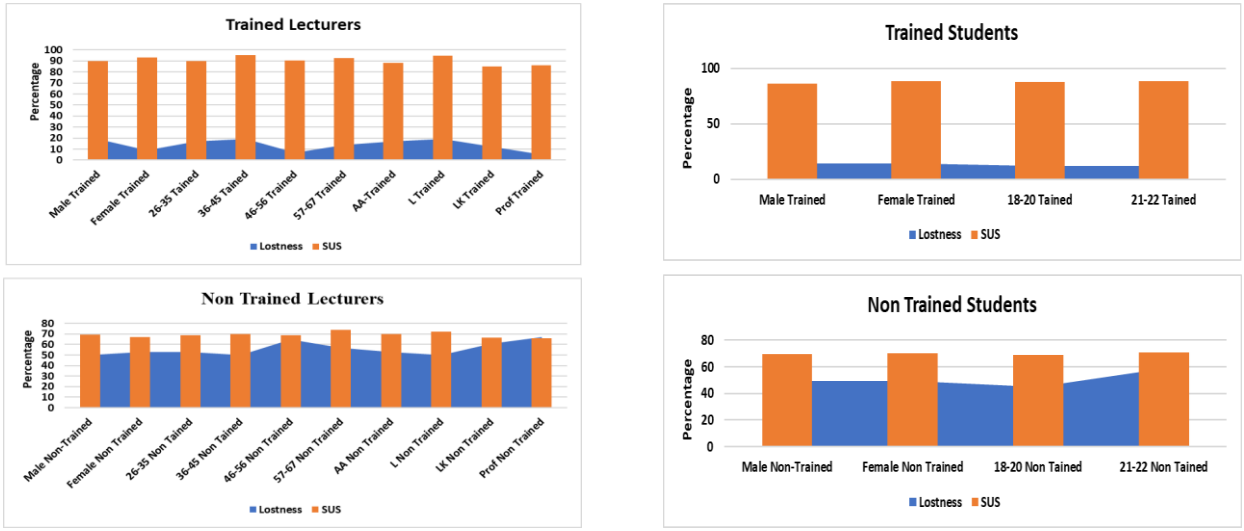

Figure 4. Lostness versus SUS in Lecturers and Student Activities

For example, in Figure 4, comparing the trained and non-trained lecturers, the trained lecturers reported higher scores of SUS which implies they perceived the system to be easy to use, equally their scores on the percentage of lostness were less. Therefore, the SUS assessment fairly evaluated the system. The same case was reported for trained and non-trained students as can be seen in Figure 4. Moreover, it is worth noting that, there were no significant differences between the results reported for SUS and lostness across different age, gender, and academic evaluation.

Discussion

This research shows an approach for evaluating the satisfaction of e-learning system based on the SUS and usage-based metrics. The experimental results show that trained users have skills and more experienced in using the e-learning system, while not all non-trained users have experience in using it. The results for measuring users' satisfaction were presented in widely used metrics: completion rate, task time, lostness and SUS. Table 6 shows the results of the lecturers; the average results of trained lecturers reported 90.46% and non-trained lecturers reported 69.2% on completion rate. Table 7 shows average results of trained students of 87.69% and non-trained students achieved 69.84% on completion rate. The combination of trained users reported an average result of 89.08% and non-trained users reported an average result of 69.53% on completion rate. Based on lostness in Table 4, trained lecturers reported an average result of 0.14 and the result of non-trained lecturers was 0.56. Average result of trained lecturers showed better than the trained students, since the average SUS score of trained lecturers was 90.5%, but for trained students, the average SUS score was 87.7%. Further, the average lostness score of trained lecturers was 0.14 while average result for trained students reported 0.13. In summary, there are two indicators for lostness and SUS: (1) trained students are more capable than trained lecturers in using the e-learning system based on lostness, and (2) trained lecturers are more satisfied in using e-learning system than trained students based on SUS. Also, Harrati et al. (2016) and Tullis and Albert (2013) argued that the minimum results of SUS to indicate satisfac-tion level is 70-100%.

As summary, this research presents a number of unique contributions to assess users' satisfaction in e-learning system and explore some factors that can affect the satisfaction level and interactivity performance for the lecturers and students in the university for employing the educational technologies. Firstly, the results achieved by the directed experimentations confirm that the SUS metric is insufficient to reveal the true approval and level of users' satisfaction in using e-learning system. The evaluation of SUS metric should be fulfilled tandem with the usage-based metrics. This would assist to cluster the different lecturers and students and also comportment cavernous the reported usability analysis results based on the participants actual performances.

Therefore, the reported satisfaction results reported by means of SUS questionnaires administrated to a set of users, can be potentiality have different interpretation by the users to express their level of acceptance. In the other words, are the lecturers and students satisfied due to the ease of adopt for the e-learning system or since experiencing a new technological product of learning management system that they felt enjoy and happy about it regardless of the expected results.

The experimental results have revealed that the distinct usage based metrics that including task duration completion rate lostness metrics present equivalently the same part in expressing and analyzing the usability degree of lecturers' and students' interactivity. For other factors related to the participants themselves, the younger users have shown greater motivation and skills to use technological products meanwhile older users have struggled poorly to use the e-learning system. This is in sentence with a number of recent studies which arrived to the same conclusions (Bringula, 2013; Wagner et al., 2014). They argued that the factor of age has a pronounced impact on the users' performance. Moreover, the lecturers with the highest academic qualifications have reported receiving performance with high completion rates. This is instinctively because the comparable connection among the qualification of age and the academic. According to Mentes and Turan (2012), the authors said that the gender is the factor which impacts the users' performance, the results achieved confirm that both genders and ages have almost same usage based metrics with small variances with exception that male users have declared better self-approval with the e-learning system.

We noted that the usage metrics have represented that the lecturers and students in the university have attempted to associate with the platform of e-learning system when deal with the web pages with ample graphical view navigation and tools. This suggests that the partial impoverished usability of the lecturers' and students' interface which should be improved during the stages where highly lecturers and students are not success to comprehensive the e-learning tasks Meantime, the minimal interfaces are evident to be preferable in terms of obtaining objectives with the ease and consistency deducing the correlation among the the task complexity and the time duration number and navigation web with respect to the elements' number and options comprised within the e-learning interface. Moreover, lecturers and students have claimed their satisfaction for adopting the e-learning in the future for supporting online teaching while they have reuqired obviously anymore practicing and directive of how to employ the e-learning system.

CONCLUSION

In this paper, an empirical study was conducted to assess the satisfaction of lecturers and students on using e-learning system. In the experiment, we adopted a widely used e-learning system (Moodle) for tracking users' activities and their evaluation. We used four key metrics (Completion rate, task time, lostness and SUS) to assess users' satisfaction and to quantify the performance of users on using e-learning system. The findings of this study reveals that trained students and trained lecturers are more satisfied in using the e-learning system compared against non-trained lecturers and students. The findings, therefore, suggest that formal training for employing e-learning system is essential to obtain satisfied and experienced users. In our future work, we aim at expanding the usage-based metrics to assess the speed and accuracy of communication within the forum between lecturers and students.

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