

Smart Campus and Education: The Study of Individual Performance in E-Learning Environments

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Abstract—The Learning Management System (LMS) is a component of the Smart Campus and is implemented with e-learning. E-learning can be effective if it gives satisfaction to the user and improves academic performance. Therefore, it is important to evaluate online learning users to support learning outcomes. The purpose of this study is to examine the relationship model of individual performance with support for user satisfaction and flexibility in an e-learning environment. This study was carried out using a survey to 615 e-learning users. Users are among the universities students in the city of Bandung (Indonesia). Data were collected quantitatively through questionnaires distributed online. Data processing is done with SmartPLS, where there are two model tests, namely the PLS Algorithm and Bootstrapping. Results of this study model test found that user satisfaction can be increased by information quality from e-learning. Online learning has perceived flexibility that is assessed by users and can increase user satisfaction and individual performance. It was found that user satisfaction was able to support the individual performance achievements of students as e-learning users. The results from this study provide valuable insights into the role of user satisfaction as a mediator in controlling individual student performance, highlighting the significance of integrating Smart Campus solutions.

Keywords—Individual Performance, User Satisfaction, Perceived Flexibility, Information Quality.

I. INTRODUCTION

E-learning is an online learning platform that is offered at the university level [1]. There are many benefits expected by users, including the efficiency and effectiveness of the learning process [2]. However, addressing the drawbacks of e-learning, such as learning motivation and satisfaction with online learning systems [3], can be mitigated through the implementation of Smart Campus initiatives. The integration of Smart Campus technologies has the potential to elevate the e-learning experience at universities, which may consequently

increase student motivation and satisfaction. Ultimately, this holistic approach to online education may positively impact individual student performance. Therefore, user satisfaction becomes an essential metric for assessing the effectiveness of e-learning outcomes facilitated by Smart Campus [4]. Previous studies have explained the position of user satisfaction as the ultimate goal of online learning outcomes [5]. But user satisfaction is the right mediation in supporting student academic performance [6].

User satisfaction is an acknowledgment of e-learning users, namely students, for e-learning services [3]. This assumption is assessed from two sides, namely satisfactory or disappointing. There are several objectives for measuring student satisfaction in e-learning including good relations between students and universities, re-election of e-learning methods, and creating loyalty and willingness to engage with online platforms [2], [7], [8]. The important position of user satisfaction in e-learning is support for learning outcomes. In supporting student satisfaction as e-learning users, service and quality are needed that are in line with user expectations [9]. About online platforms, three things are assessed by users, namely systems, services, and information [2], [10]. Because e-learning is an online learning system that provides learning services and knowledge needed by students. The existence of perceived quality assessed by students ultimately provides opportunities for achieving user satisfaction [2].

Increasing satisfaction in e-learning requires trust from users based on their experience [7], [11]. This means that it is necessary to evaluate the experience of e-learning users, especially concerning flexibility. One of the advantages of online learning is the flexibility of time and place [12], this experience is the goal for many users to choose e-learning methods. Flexibility means that users can study anytime and anywhere, according to the schedule they want [13]. This allows students to adjust learning with other activities and supports the level of student satisfaction and achievement.

Based on online user behavior studies, it is known that there is a problem phenomenon from the implementation of e-learning at universities which is assessed by students. The importance of evaluating user satisfaction to measure individual student performance in online platform learning. Affirming the phenomenon of the problem, this study aims to examine the support of perceived quality and perceived flexibility in student user satisfaction and individual performance. The position of this research examines models that support individual student performance achievements on e-learning platforms at universities.

II. LITERATURE REVIEW

A. Individual Performance

The concept of e-learning is the same as the concept of regular learning, all of which have an academic evaluation of the results of learning both individually and in groups [1]. Individual performance is the result of personal learning from students, in which there is increased quality as a result of adaptation to the online learning system [10]. These improvements include those related to doing tasks faster, minimal failure, and efficiency of learning time [14]. Individual performance is the ultimate goal of the learning process so the sustainable use of e-learning will go well because of the positive impact of online learning. Measuring individual performance can be done by evaluating several things including performance, effectiveness, knowledge, and overall usefulness [1], [10], [14].

B. User Satisfaction

E-learning is an online system that is adopted by users, namely students [15]. It has impact on user behavior which is assessed as the level of user satisfaction [3]. There is experience which is the main subject of user satisfaction, however, it does not guarantee the level of user satisfaction with the length of time using the online platform [6], [16], [17]. It is because satisfaction is assessed from the function and usability of online learning [16]. In general, user satisfaction is conveyed as a user assessment of an e-learning system that meets expectations and helps users solve their problems [4]. Measuring the level of user satisfaction can be done by evaluating the benefits of e-learning considered by users, namely the level of platform support, the efficiency and effectiveness of the platform, and the suitability of expectations that occur [10].

C. Perceived Flexibility

The flexibility of e-learning is related to the learning process, which can be carried out and adapted to the wishes of students [12]. Many studies explain the position of e-learning flexibility that changes user behavior, especially in academic performance [18]. Perceived flexibility is defined as the concept of freedom of time and place given to students in learning [12], [19]. Flexibility is becoming a trend because it supports the effectiveness of users in learning time management [20]. Measuring flexibility can be done by assessing the effectiveness of work and time, the value of financial and time benefits, the flexibility of time to take classes, and the speed of completing studies [12], [21].

D. Perceived Quality of E-Learning

Quality is an important thing in the learning process through e-learning, because it becomes an assessment when

adapting to the system [16]. Accepted or not from e-learning by users depends on the quality delivered, including those related to systems, services, and information from quality [2], [10]. As an online learning system, e-learning should take into account the level of ease of users in using the system to support user satisfaction [22]. This is because the purpose of e-learning is to serve the learning process. Therefore, the service quality of e-learning needs to be considered because it becomes an evaluation factor for users [10]. E-learning itself has knowledge in it that students will seek and use [2]. Therefore, quality is needed both in terms of content and context to be able to support user satisfaction. It can be concluded that there is perceived quality from the concept of e-learning including system quality, service quality, and information quality [2], [10], [22]. System quality is evaluated through ease of navigation, ease of search, ease of structure, and ease of use [22]. Service quality is assessed from behavior related to the level of response, function, and platform interaction [10]. While information quality is known as useful, undesirable, interesting, and reliable [2].

E. Hypothesis Development

The research study conducted focuses on online user behavior with e-learning objects at universities. The first objective of the research is to evaluate student user satisfaction with the concept of learning through e-learning. Analysis has been carried out from previous research related to user satisfaction, where many explanations point to the importance of assessing system and service quality in e-learning [2], [10]. Systems and services are an important part of the information system, where the implementation of a good information system supports the achievement of user satisfaction [8], [23]. The essence of the research findings confirms that there is a relationship between the system and service quality in user satisfaction outcomes. Added to separate research from which knowledge exists in e-learning, it is explained that the usefulness of e-learning is seen by users because of the knowledge that supports user needs [23]. The essence of these findings can be interpreted as the quality of information that can change the satisfaction of users. The analysis of previous research is summarized in the design of three hypotheses as follows.

- Hypothesis 1 System quality has a positive impact on user satisfaction (H1).
- Hypothesis 2 Service quality has a positive impact on user satisfaction (H2).
- Hypothesis 3 Information quality has a positive impact on user satisfaction (H3).

The second objective to be evaluated is the achievement of individual performance. Analysis was carried out on individual performance supporting factors on the concept of e-learning. E-learning is considered to have flexibility [19], this advantage gives satisfaction to users because there is time flexibility in choosing the time and place of study [18]. On the one hand, it is considered that the flexibility of e-learning provides more engagement in user performance [20]. The analysis of the research studies conducted explains that there is good support from perceived flexibility in user satisfaction and individual student performance. Furthermore, in a separate study, a finding was conveyed that the level of satisfaction is the main goal of what will be achieved from the

e-learning learning process [12] because user satisfaction determines student learning performance. Of course, in line with this theory, it confirms a good relationship between user satisfaction and individual performance [17], [20]. Based on the study conducted, three hypotheses were proposed, and the model proposed was in line with the hypotheses (Fig. 1).

- Hypothesis 4 Perceived flexibility has a positive impact on user satisfaction (H4).
- Hypothesis 5 Perceived flexibility has a positive impact on individual performance (H5).
- Hypothesis 6 User satisfaction has a positive impact on individual performance (H6).

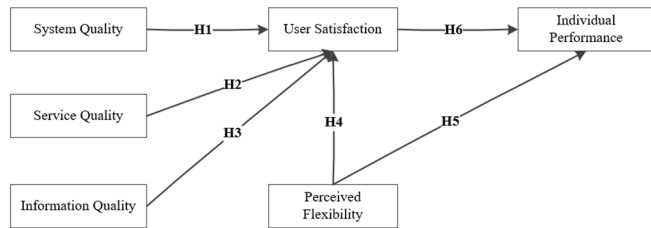


Fig. 1. Hypothesis Model

III. RESEARCH METHOD

The study focuses on student behavior towards e-learning platform, based on their previous experience. The behavior studied includes perceived quality which consist of systems, services, and information. Other variables studied include perceived flexibility and user satisfaction, intending to examine individual student's performance on e-learning platforms. The analysis was carried out by testing the research model based on the research hypothesis that had been designed (Fig. 1).

A quantitative survey were obtained 615 data from online questionnaires among universities students in the city of Bandung, one of the cities of education in Indonesia. Tabulated data from the questionnaire were then processed using SmartPLS analysis tool. There were two tests carried out, namely the PLS Algorithm, to study the standard algorithm and to calculate the factor components, while Bootstrapping, to assess the level of significance or probability of the relationship between variables [24], [25]. The results of statistical data processing were analyzed based on the research's hypothetical design (Fig. 1).

IV. RESULT AND DISCUSSION

This section demonstrated the results of the study which were based from the statistics testing of the study model with supporting data. It is followed by a discussion explaining the results of the tested model with its analysis to find the novelty of the study. In general, this study novelty is focused on conceptual models, in line with the design of the research hypothesis. This study does not discuss the description of the respondents, because it is not the aim of the research.

Based on data tabulation from the questionnaire, model testing was carried out. The model in question is based on the previous research hypothesis design (Fig. 1). The first test was through the PLS Algorithm with the test results shown in Figure 2. It was concluded that all the relationship variables were considered positive, meaning that each antecedent variable contributed to enhance the individual performance of

student. However, when examined more detail, there were two relationships does not have a significant impact, namely system and service quality, on user satisfaction with low correlation values, 0,033 and 0,069. The test results were carried out by a fit measure, the results of which are presented in TABLE I. From the two measurements, the SRMR and NFI values were supported, which means that the model is said to be fit for analysis. The model test results also appear in TABLE II, where there are validity and reliability test values. The conclusions obtained are satisfactory because all measurement values are above 0,7 (Cronbach's Alpha, Composite Reliability, and AVE) [26].

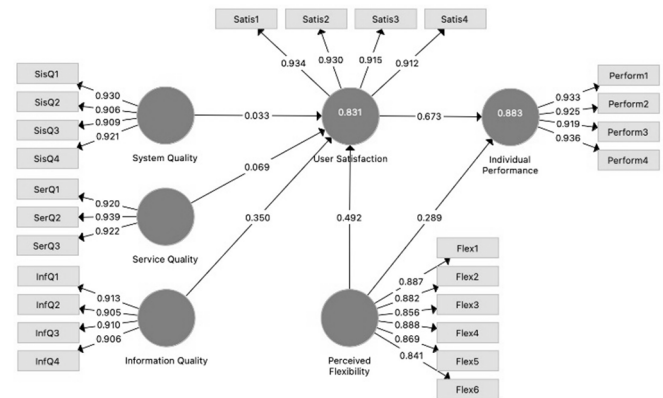


Fig. 2. PLS Algorithm Result

TABLE I. SUMMARY MODEL TEST

Fit Measures	Saturated Model	Results
Standardized Root Mean Square Residual (SRMR)	0,030	Supported (<0,8)
Normed Fit Index (NFI)	0,913	Supported (>0,9)

TABLE II. PLS ALGORITHM RESULT

Constructs	Cronbach's Alpha	Composite Reliability	AVE
Individual Performance	0,947	0,962	0,862
Information Quality	0,930	0,950	0,826
Perceived Flexibility	0,936	0,949	0,758
Service Quality	0,919	0,948	0,860
System Quality	0,937	0,955	0,840
User Satisfaction	0,942	0,958	0,851

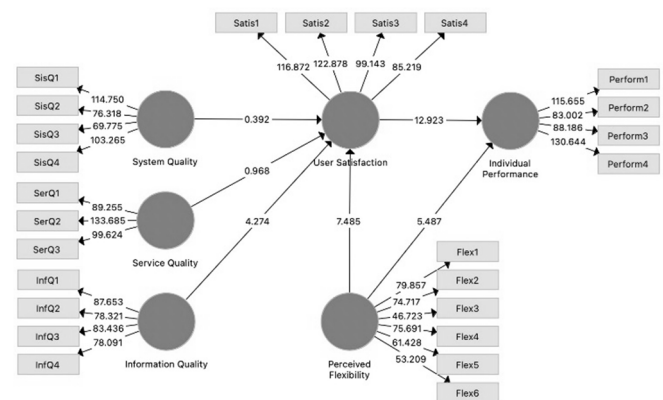


Fig. 3. Bootstrapping Result

TABLE III. OUTER LOADING VALUES

Constructs	Outer Loading Values
Individual Performance	
Information useful (Perform1)	0,933
Information understandable (Perform2)	0,925
Information interested (Perform3)	0,919
Information reliable (Perform4)	0,936
Information Quality	
Easy to navigate (InfQ1)	0,913
Find easily (InfQ2)	0,905
Well structured (InfQ3)	0,910
Easy to use (InfQ4)	0,906
Perceived Flexibility	
Work effectively (Flex1)	0,887
Schedule effectively (Flex2)	0,882
Advantages of money (Flex3)	0,856
Spend more time (Flex4)	0,888
Allowed me to take a class (Flex5)	0,869
Finish my degree more quickly (Flex6)	0,841
Service Quality	
Responsiveness (SerQ1)	0,920
Functionality (SerQ2)	0,939
Interactivity (SerQ3)	0,922
System Quality	
Easy to navigate (SisQ1)	0,930
Find easily (SisQ2)	0,906
Well structured (SisQ3)	0,909
Easy to use (SisQ4)	0,921
User Satisfaction	
Support (Satis1)	0,934
Efficient (Satis2)	0,930
Effective (Satis3)	0,915
Expectation (Satis4)	0,912

The results of the Bootstrapping test process are presented in TABLE III, there are loading factors for all research constructs. The test results for all research instrument values above 0,7 which have the meaning of instrument support in forming a research model. Bootstrapping results are also presented in the results of hypothesis testing (Fig. 3), where the t-statistic value is known. All relationships between variables are said to be accepted if the t-statistic value is above 1,69. In line with the results of the model test, it is known that there are two that do not support, namely system quality and service quality on user satisfaction. Further analysis will be explained in the study of each research hypothesis to find novelty in research related to online user behavior with a focus on e-learning at universities.

A. Antecedent of User Satisfaction

The first discussion is presented based on hypotheses H1, H2, and H3 (Fig. 1). Based on the results presented, it is known that the antecedent variables for user satisfaction include system, service, and information quality (Fig. 3). System and service quality are declared not to support the achievement of user satisfaction with a t-statistic value below 1.69, meaning that the system and service quality in the e-learning concept is not able to increase student satisfaction in using e-learning. In contrast to information quality, which have a t-statistics value above 1,69, namely 4,274. This means that the information contained in e-learning is more concerning to students. Students concern for the useful, undesirable, interesting, and reliable contained in e-learning information has an impact on satisfaction with using the concept of e-learning on campus. In line with previous studies

which explained the importance of understanding the material presented in e-learning [23], the main purpose of e-learning is to make it easier to convey knowledge [2]. The essence that can be explained the result of study.

The meaning contained in the first result explains that the antecedents of user satisfaction are not all capable of supporting them properly. The analysis of the research findings explains that everything depends on the perceived quality of students and the main purpose of e-learning in disseminating knowledge. Information quality has a better role in explaining e-learning user satisfaction.

B. Mediation of User Satisfaction on Individual Performance

The second discussion explains the relationship between perceived flexibility, user satisfaction, and individual performance in e-learning concepts. The first relationship is related to the relationship between perceived flexibility and user satisfaction for H1 (Fig. 1). The results of the research hypothesis test (Fig. 3) show that perceived flexibility has a t-statistic value of 7,487 (greater than 1,69) on user satisfaction. The meaning of this value explains that the flexibility assessed by students regarding the concept of e-learning has a significant impact on student satisfaction. The findings in this study are in line with previous research and tend to improve because there is a positive relationship between perceived flexibility to student confidence [18]. On the other hand, there is a significant impact of flexibility on individual performance. It is known from the t-statistic value above 1,69 for the relationship between perceived quality and individual performance (Fig. 3). In line with the previous hypothetical design in H5 (Fig. 1), it has been emphasized that individual performance can be controlled with the benefits of e-learning, namely flexibility. Previous studies have conveyed the impact of the advantages of e-learning with the flexibility of time and place on student learning behavior [20]. This is in line with the current study.

In the research model, it was found that there is a good relationship between user satisfaction and individual performance (Fig. 3). This becomes the following discussion related to hypothesis H6 (Fig. 1), where the test results explain that user satisfaction has a t-statistic of 12,923, which means it is greater than the t-table limit of 1,69. Based on these results, it can be emphasized that there is a significant impact of student satisfaction on the concept of e-learning on academic performance. Previous studies have explained the importance of evaluating student satisfaction in e-learning, because of its impact on learning performance [17], [20]. So it is often the ultimate goal of evaluating the implementation of e-learning concepts. Understanding the study results more deeply, it was found that there is the ability of student user satisfaction as a good mediator in improving academic performance. The analysis was carried out based on the results of the PLS Algorithm (Fig. 2), which appears that the value of the relationship from perceived flexibility when mediated by user satisfaction is greater on learning performance than when it is done directly. Flexibility has a direct correlation value to the performance of 0,289. Meanwhile, through user satisfaction, the increase was greater, 0,673. It can be emphasized that user satisfaction is an appropriate mediation in supporting the relationship between perceived flexibility and individual student's performance. The findings in this

study served as a mediation model of user satisfaction, which is expected to be useful information for e-learning providers in Indonesia, such as universities, in evaluating student academic learning performance through e-learning. User satisfaction has an important role, therefore, a study of the antecedent variables is highly recommended. The final goal is to provide opportunities for student learning performance achievements.

V. CONCLUSION AND LIMITATION

The research analysis conveyed that there were several research findings related to online user behavior in the concept of e-learning. It is essential to conduct additional research on the ways in which these findings relate to the implementation of innovative technologies in educational settings, given the rise of Smart Campus initiatives. Gaining an understanding of the ways in which Smart Campus solutions impact the behavior of online users can provide significant insights for enhancing the e-learning experience of students. First, it was found that information quality is the right antecedent in growing student user satisfaction. Furthermore, the advantages of e-learning known as perceived flexibility are an important factor in increasing user satisfaction, as well as having an impact on student academic performance. Another finding is the ability of user satisfaction to be the right mediation between perceived flexibility and individual performance. The model found is an important contributors for organizers of the e-learning concept. The model becomes an academic advisory and is recommended as information to support evaluation of e-learning performance in universities or government policymaker. Education providers such as universities are believed to be able to carry out the e-learning concept properly if there is support from the government as a policymaker.

There are limitation of the study whereby the discussion does not examine other factors besides perceived quality and perceived flexibility. This limitation can become an input for further research, to examine the behavior of other type of online users on the concept of e-learning. Further research can explore students experience of e-learning concept, such as culture and educational background.

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