International Journal of Instruction *October 2022 ● Vol.15, No.4*
e-ISSN: 1308-1470 ● www.e-iji.net *p-ISSN: 1694-609X*
pp. 197-220

Article submission code: 20211019034942
Received: 19/10/2021 Revision: 15/04/2022
Accepted: 10/05/2022 OnlineFirst: 27/07/2022

Lack E-Learning Effectiveness: An Analysis Evaluating E-Learning in Engineering Education

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The evaluation should be performed to ensure the effectiveness, efficiency, and positive impact of the learning process for students. Therefore, the objectives of the research are to evaluate the application of e-learning towards the benefits, satisfaction, and impact on students in engineering education. This study employed the quantitative approach in which samples of 504 engineering education students as the study using a saturated sampling method. Furthermore, data were collected through a questionnaire using a Likert scale, and structural equation modeling (SEM) analysis techniques were applied to test the measurement model of the research questions. The results showed that the Context, Input, and Process components of E-learning were categorized in a very good category, while the Product component was included in a good category. The findings are supported by empirical data, with a statistical T value > 1.96 and a P-value < 0.05. Furthermore, the effects of e-learning towards the benefits, satisfaction, and impacts are all positively significant directly and indirectly. In summary, it can be said that e-learning can be an effective educational tool to support students in the learning process as well as a means of communication between students and lecturers.

Keywords: e-learning, evaluating, engineering education, benefits, satisfaction, impact

Citation: Rizal, F., Hidayat, H., Jaya, P., Waskito., Hendri., & Verawardina, U. (2022). Lack e-learning effectiveness: An analysis evaluating e-learning in engineering education. *International Journal of Instruction*, *15*(4), 197-220. https://doi.org/10.29333/iji.2022.15412a

INTRODUCTION

Engineering education prepares graduates with specific competencies to compete in the working life, and they are encouraged to become entrepreneurs with developed careers. The quality of engineering college graduates is affected by the learning process. Furthermore, a learning system that is equipped with easy, practical, and effective learning is required during the Covid-19 pandemic, and it has to be carried out in anytime and anywhere. Information technology provides solutions to these needs, especially in engineering colleges, through the utilization of e-learning that makes learning easily accessible. This system has long been practiced in developed countries such as in the United States and Europe (Valencia, 2019). Furthermore, one of the positive impacts of the development of e-learning is to encourage the growth of digital educators that are able to apply cloud computing technology.

In recent years, online distance education through e-learning has grown rapidly to develop student competencies and increase lecturers satisfaction (M. W. Rodrigues et al., 2018). It requires certain prerequisites due to the integration of the online portal with the academic system. The rapid technological change requires students to adapt and communicate in the latest ways, such as using online communication learning, utilizing PDF files, downloading course materials and uploading coursework files. A proper information technology environment can assist educational actors such as lecturers, coordinators and students. In addition, the type of technology used can also improve the learning process (Tawafak et al., 2020). With the rise of Internet technology, e-learning does not only become more efficient but also faster (Coman et al., 2020). The internet can be used to access various tools that allow users (lecturers and students) to communicate through discussion forums, email, and social networks. Thus, e-learning can be used as the main method or a general form to conduct the learning process. Many benefits can be obtained from these platforms (Chootongchai & Songkram, 2018), e.g., promoting innovation skills and improving thinking, enabling students to share knowledge openly with the community without space and time constraints, as well as exchanging, sharing ideas, and exploring information.

To achieve learning objectives and produce quality graduates, e-learning needs to be conducted through appropriate methods (Wong et al., 2019), and this can be actualized through different strategies (Abdalmenem et al., 2019). However, the lectures' teaching styles are not well adapted to the online environment (Putri et al., 2020). Weaknesses in the use of online content such as mathematical symbols, learning management systems, and multimedia software have also not been optimally conducted (Irfan et al., 2020). Another problem is the more theoretical content does not allow students to practice and learn effectively (Dhawan, 2020).

E-learning research has previously been extended and based on the Technology Acceptance Model (TAM) (Chang, Hajiyev, & Su, 2017; Salloum et al., 2019; Kimathi, & Zhang, 2019; Sukendro et al., 2020). The implementation of e-learning in engineering education is necessary to evaluate. Evaluation process becomes more and more fundamental to improve learning methods, encourage improvements and enrichment for students, and to place students in more appropriate learning situations according to their

level of ability (Edelenbos, & Van Buuren, 2005), including the importance of evaluating e-learning (Attwell, 2006). Therefore, it is essential to evaluate the system as a whole, including issues with the use of e-learning as well as the quality and delivery of learning content electronically (Muhammad et al., 2020). However, several obstacles hinder the e-learning evaluation process. Different obstacles are faced in developing the models, e.g., an excessive number of measurements of the dependent and independent variables and their interactions (Raphael et al., 2015). Given that this system is an integration of information technology with humans (students and lecturers) and non-human entities (learning management), it is vital to evaluate the various dimensions that influence the successful process of evaluation.

The crucial factor to be recognized is the impact on educational success and the resulting social consequences. Furthermore, the impact has been extensively disclosed on education, and several benefits were found. These include ensuring continuity of education (Akinbadewa & Sofowora, 2020; Seage & Türegün, 2019), enabling lifelong learning (Alharthi, 2019; Serhan, 2019), and reducing high costs associated with traditional education (Al-Husban, 2020). In contrast, limitations of learning methods, scheduling, and time problems also arise since lecturers and students are in separate places (Thompson & McDowell, 2019; Weinhandl et al., 2020). The weaknesses are not limited to the learning process but also affect students accessing teaching materials and results. Furthermore, students' opportunities to access textbooks and resources are hampered by copyright restrictions. A study conducted in Turkey on e-learning applications during the Covid-19 pandemic revealed that students had difficulty doing group assignments due to the lack of e-learning socialization on campus (Hebebci et al., 2020).

This study focuses on three dominant factors influencing e-learning, i.e., the system, benefits, and satisfaction, which then lead to the impact experienced by students. Several studies have examined the relationship between the two variables and concluded the effect on learning outcomes and its impact. Studies on the various applications and their impact have also received substantial attention, for example, those conducted by (Alsoud & Harasis, 2021; Ray et al., 2021; Sigala, 2012). The following variables are the benefit factors associated with their impact, and a study conducted by (Biswas, 2020), reveals that students without adequate technological support, connections, and information technology tools should struggle more to participate in e-learning activities. Meanwhile, those with proper resource support can enjoy significant benefits from this learning system. According to OECD data, 95% of students in Switzerland, Norway, and Austria have a computer to use, while only 34% in Indonesia have one. As the ultimate goal of student development, community progress can be assisted through the support of information technology (Srivastava, 2018). In several places today, student administrators and professional staff use internet-based technologies and resources such as the World Wide Web, e-mail, and chat for their work operations and daily communication purposes. It encourages the utilization of information technology resources and increases the scalability and accessibility of its applications (Naveed & Ahmad, 2019).

Another dominant factor examined is satisfaction, and in increasing this variable, the learning concept should contain interactive elements that involve students. A study reported that interactivity was a significant predictor of student satisfaction and persistence in e-learning participation (Bashir, 2013). The result of a survey conducted at Al-Buraimi University College in Oman showed student satisfaction in learning and assessment through e-learning (Tawafak et al., 2020). Other studies have shown that the use of this system makes the learning process more effective (Jain & Jain, 2021), gives more satisfaction to students (Harandi, 2015), and has an important role in student learning in college, as well as their motivation.

Generally, previous studies have emphasized the use of information technology. However, as technology becomes more reliable and accessible, the subsequent study will focus more on the attitudes and interactions of students and lecturers, as well as their important role in supporting the success of e-learning. Further studies should be conducted to evaluate e-learning systems as well as continuous improvement in the future. Empirical facts showed that success varies greatly depending on the context and strategies used. In developing countries, the main constraints are in resource, accessibility, infrastructure, communication features, and social factors (students and lecturers). Meanwhile, in developed countries, the determining factors include improvements in lifelong education, information quality, system usability, and ethical and legal considerations. Therefore, the objectives of the research are to evaluate the application of e-learning towards the benefits, satisfaction, and impact on students in engineering education. Furthermore, the research question is *does e-Learning have a positive, significant, and mediating effect on Impact, Benefits, and Satisfaction?*

Literature Review

E-Learning

One definition of e-learning is an instructional process that involves the use of electronic equipment in creating, assisting development, conveying information, assessing, and facilitating a learning process conducted interactively, anytime and anywhere, and is student-centered (Sit & Brudzinski, 2017). E-Learning is a type of learning that allows the delivery of teaching materials to students using the internet, intranet, or other computer network media (Eze et al., 2018), and it is said to be efficient in eliminating distances and round-trip flows. The success of educators in implementing e-learning is determined by many factors, including issues that support the systems such as ethics and policies that outline rules, regulations, guidelines, and prohibitions for communicating (Al-Fraihat et al., 2020). The next factors are the rules of task plagiarism, data protection, legal and copyright issues, materials uploaded in the e-learning system, popularity, and policies followed by the organization (Tennakoon & Lasanthika, 2021; Khan & Setiawan, 2019). A significant relationship was found between the e-learning support system and the level of user satisfaction, and factors of the system are thought to have a positive effect on the utilization of e-learning (Al-Gahtani, 2016; Ong & Lai, 2006). This is because providing information before using an e-learning system can increase users' awareness and influence their perception of the overall usefulness.

Engineering Education

The role of engineering education in today's digital era is to prepare graduates with skills and readiness in the new world of work (Tejedor et al., 2018). This is because it prepares graduates with certain competencies required by the business and industrial world (Maryanti et al., 2020). Higher engineering education should prepare graduates with complete and comprehensive competencies to bring out the best potential from students, plan practical learning in the laboratory (Feisel & Rosa, 2005), and develop appropriate curriculum and learning evaluations. However, the challenges in the digital era as well as the emergence of the Covid-19 pandemic have a major impact on learning at engineering colleges (Hindun et al., 2021; Alqahtani & Rajkhan, 2020). The application of e-learning is stated as a viable solution (Widyaningsih et al., 2021; Cevik & Duman, 2018; Hariyanto & Koehler, 2020). In order to prepare quality engineering education graduates in digital challenges (Lent, 2018), especially within the Covid-19 pandemic, e-learning evaluation is urgently needed.

METHOD

The population was 504 students at the Faculty of Engineering, State University of Padang majoring electronic, electrical, mechanical, civil, and mining engineering. The sample is a subset consisting of some members of the population (Lyon et al., 2012). The selection was not conducted at random, but with non-probability sampling using a data-based census method with a saturated technique (Tille, 2020). Furthermore, data were collected by distributing questionnaires to obtain information about e-learning, its benefits, satisfaction, and impact. The questionnaire stands as an effective data collection method to examine the variables to be measured and the answers expected by the respondents (Smith, 2019). The questionnaire applied the Likert scale by providing opportunities to answer each item (Awang et al., 2016). A descriptive data analysis was used to evaluate e-learning, while structural equation modeling using SEM SmartPLS software version 3.2.8 was used to test the measurement model.

The mediation effect test was conducted using the complementary mediation test procedure, namely by analyzing indirect and direct effects and testing the significance of the direction. In addition, the classification of full, partial, and no mediation was conducted with the consideration that the concept of one-dimensional mediation is better seen as two-dimension (Zhao et al., 2010). In the causal model of three non-recursive variables, three patterns consistent with mediation and two patterns with non-mediation were identified. The profiles of the 504 respondents are presented in Table 1 below.

Table 1
Respondent profile

Sample Characterization		Frequency	Percent
Gender	Male	338	67.1
	Female	166	32.9
	Total	504	100
Age	<21 years old	340	67.5
	21-23 years old	149	29.6
	>23 years old	15	3
	Total	504	100
NIM/Student ID Number	2020	190	37.7
	2019	152	30.2
	2018	111	22
	2017	36	7.1
	2016	13	2.6
	2015	2	0.4
	Total	504	100
Major	Electronic Engineering	97	19.2
	Electrical Engineering	68	13.5
	Mechanical Engineering	63	12.5
	Automotive Engineering	116	23
	Civil Engineering	66	13.1
	Mining Engineering	94	18.7
	Total	504	100

Table 1 showed that the respondents consisted of 338 males (67.1%) and 166 females (31.9%). The majority of respondents were aged <21 years by 340 people (67.5%), followed by the age group 21-23 years by 149 people (29.6%), and those aged >23 years by 15 people (3%). Based on the registration year, the majority were students of the class of 2020 by 190 people (37.7%), followed by the class of 2019 by 152 people (30.2%), the class of 2018 by 111 people (22%), class of 2017 by 36 people (7.1%), class of 2016 by 13 people (2.6%); and the last batch of 2015 by 2 people (0.4%).

The majority of respondents were students majoring Automotive Engineering with 116 people (23%), followed by Electronic Engineering with 97 people (19.2%), Mining Engineering with 94 people (18.7%), Electrical Engineering with 68 people (13,5%), Civil Engineering with 66 people (13,1%), and Mechanical Engineering with 63 people (12,5%)

The method of determining this test is the saturated sample method. Saturated sampling method is a sampling method in which all members of the population are sampled. In this study, the sample was determined based on the type of non-probability sampling where this type of sample was not chosen at random. Not all elements and elements of the population have the same options to be selected as a sample (Tillé, 2020).

The mediation effect test was conducted using the complementary mediation test procedure, namely by analyzing indirect and direct effects and testing the significance of

the direction (Zhao et al., 2010). In addition, the classification of full, partial, and no mediation was conducted with the consideration that the concept of one-dimensional mediation is better seen as two-dimension (Zhao et al., 2010). In the causal model of three non-recursive variables, three patterns consistent with mediation and two patterns with non-mediation were identified.

FINDINGS

The results are presented as follows:

E-learning Program Evaluation

Evaluation of the e-learning program was conducted on four components namely Context, Input, Process, and Product. The results of the data analysis of respondents' assessment are presented in Table 2.

Table 2
Statistics of e-learning components

		Context	Input	Process	Product
N	Valid	504	504	504	504
	Missing	0	0	0	0
Mean		3.8367	3.9024	3.5710	3.3937
Std. Deviation		.74355	.72665	.89649	.96514

Table 2 shows that the Context, Input, and Process components are in the very good category with mean values of 3.84, 3.90 and 3.57 on a scale of 1.00 to 5.00. Meanwhile, the Product components are also remained in the good category with slightly lower average values, by 3.39. Therefore, the e-learning program has been running properly as expected.

Measurement Model Assessment

Measurement Model Assessment (MMA) examines the relationship between latent variables and their indicators or statement items. Furthermore, MMA shows the relationship of each indicator with latent variable (Sarstedt & Cheah, 2019), and the tests performed are as follows:

Convergent Validity

Convergent validity test aims at analyzing the bending effects of the measurement items of certain variables (Henseler et al., 2015), and in this test, four criteria should be considered: the item is declared valid when the outer loading > 0.7; the data is said to be reliable when Cronbach's alpha > 0.7; the required composite reliability value > 0.7; the required average extracted variance (AVE) value is > 0.5

Table 3
Internal consistency reliability dan convergent validity results

Variable	Item	Outer Loading >0,7	Cronbach's Alpha	Composite Reliability	AVE >0,5
E-learning	EL15	0.827	0.964	0.968	0.716
	EL16	0.876			
	EL17	0.858			
	EL18	0.852			
	EL19	0.888			
	EL20	0.855			
	EL21	0.846			
	EL22	0.876			
	EL23	0.874			
	EL24	0.867			
	EL3	0.761			
	EL8	0.763			
Benefit	M10	0.893	0.953	0.964	0.842
	M2	0.929			
	M3	0.928			
	M6	0.913			
	M8	0.925			
Satisfaction	K1	0.907	0.962	0.969	0.816
	K2	0.914			
	K3	0.929			
	K4	0.872			
	K5	0.926			
	K7	0.870			
	K9	0.903			
Impact	D1	0.838	0.960	0.965	0.714
	D11	0.888			
	D12	0.875			
	D2	0.812			
	D3	0.863			
	D4	0.796			
	D5	0.810			
	D6	0.884			
	D7	0.852			
	D8	0.832			
	D9	0.836			

All invalid items that have an outer loading value of < 0.7 are removed from the model. Table 3 shows that all statement items, on the e-learning, Benefit, Satisfaction, and Impact variables are declared valid since they have an outer loading value > 0.7. E-learning AVE = 0.715, benefits = 0.842, Satisfaction = 0.816 and Impact = 0.714; all have values > 0.5. Therefore, the measurement variance is categorized into latent variables. Then, the composite reliability value = 0.968, Benefits = 0.964, Satisfaction = 0.969 and Impact = 0.965; all have values > 0.7. Furthermore, the value of E-learning

Cronbach's alpha = 0.964, Benefit = 0.953, Satisfaction = 0.962 and Impact = 0.960; all values are also > 0.7. Therefore, the measurement of each item of the E-learning, Benefits, Satisfaction, and Impact produces reliable and consistent data.

Discriminant Validity

Discriminant validity analysis was conducted to analyze the uniqueness of a construct that distinguishes it from others by using the Fornell-Larcker criterion (Fornell & Larcker, 1981). The unique value is obtained when a latent variable sharing variance with the underlying indicator is found greater than what happened to others. It can be interpreted that the unique value appears when the variance of a variable, indicator, or the item is greater than the latent variable compared to others (Fornell & Larcker, 1981; Hair et al., 2011; F. Hair Jr et al., 2014).

Table 4
Fornell-Larcker criterion

Variable	Impact (Y)	E-Learning (X)	Satisfaction (M2)	Benefit (M1)
Impact (Y)	0.845			
E-Learning (X)	0.845	0.846		
Satisfaction (M2)	0.839	0.864	0.903	
Benefit (M1)	0.862	0.825	0.851	0.918

The results of data analysis in table 4 shows that all correlation values of the Fornell-Larcker criteria in each variable meet the requirements of the discriminant validity test. Some are declared established and accepted with a value close to and exceeding 0.9 respectively.

Table 5
Heterotrait-Monotrait ratio (HTMT)

Variable	Impact (Y)	E-Learning (X)	Satisfaction (M2)	Benefit (M1)
Impact (Y)				
E-Learning (X)	0.877			
Satisfaction (M2)	0.871	0.896		
Benefit (M1)	0.899	0.860	0.888	

The conclusion of the Heterotrait-Monotrait Ratio (HTMT) test, as presented in Table 5, is that all variables have a Heterotrait-Monotrait Ratio <0.90. This value indicates a valid (unique) discriminant validity. Furthermore, the variables/constructs under review are completely different from others. Henseler (2015) also uses a measurement standard with a value of 0.90 as the upper limit of the ratio and stated that the distribution of the ratio value below 0.9 is declared a valid discriminant.

Structural Model Assessment

Structural Model Assessment (SMA) predicts causality between latent variables. Evaluation of SMA on SEM PLS was conducted by performing R and Q square tests. The significance test to predict the existence of a causal relationship was carried out through bootstrapping (Sarstedt & Cheah, 2019). Furthermore, PLS research questions testing does not assume the data is normally distributed, instead, it refers to a non-

parametric bootstrapping procedure to test the significance of the coefficients (F. Hair Jr et al., 2014).

R-Square dan Q-Square

R Square (goodness-fit model test) is used in testing latent (endogenous) variables, and it measures how large the endogenous variable is influenced by the exogenous. The R square value of 0.26 and above is used as a criterion in the structural model to indicate a large influence of exogenous variables on endogenous ones. Furthermore, the range of values between 0.13 – 0.25 indicates that the impact under consideration is in the moderate category, while the range of 0.02 – 0.12 indicates a weak effect (Cohen, 2013).

Q Square (predictive relevance) is used to predict the measurement value generated by the model and to estimate the parameters. The value which is greater than 0 (zero) indicates that the model has predictive relevance. Meanwhile, a value less than 0 (zero) shows the lack of it, and when it is 0.35 and above, then the predictive relevance in the structural model is included in the good category. However, when the number obtained is between 0.15 - 0.35, then it belongs to the medium category. Values in the range of 0.02 - 0.15 indicate a weak category (F. Hair Jr et al., 2014).

Table 6
R Square and Q square

Variable	R Square	Category	Q Square	Category
Impact (Y)	0.806	Good	0.566	Good
Satisfaction (M2)	0.806	Good	0.649	Good
Benefit (M1)	0.681	Good	0.566	Good

Table 6 presents the value of the R square of the Impact variable (Y) of 0.806. This value indicates that the Impact variable (Y) is influenced by E-Learning, Benefits, and Satisfaction by 80.6% and belongs to the good category (Cohen, 2013). Furthermore, the variable has a Q square value of 0.566, indicating that E-Learning, Benefits, and Satisfaction can predict Impact properly. The R square for the Satisfaction variable of 0.806 indicates the effect of E-Learning and Benefits on Satisfaction is 80.6% or is in a good category (Cohen, 2013). The Q square value of the Satisfaction variable of 0.649 indicates the ability of E-Learning and Benefits to predict satisfaction properly. Meanwhile, the R square obtained by the Benefit variable is 0.681. This refers to the effect of E-Learning on Benefits as much as 68.1% with good predictive power. Finally, the Q square value of the Benefit variable is 0.566, which means that the ability of E-Learning to predict Benefits is included in the good category.

Path Analysis and Research Questions Testing

The results of data analysis using the bootstrapping technique were used to answer the research questions.

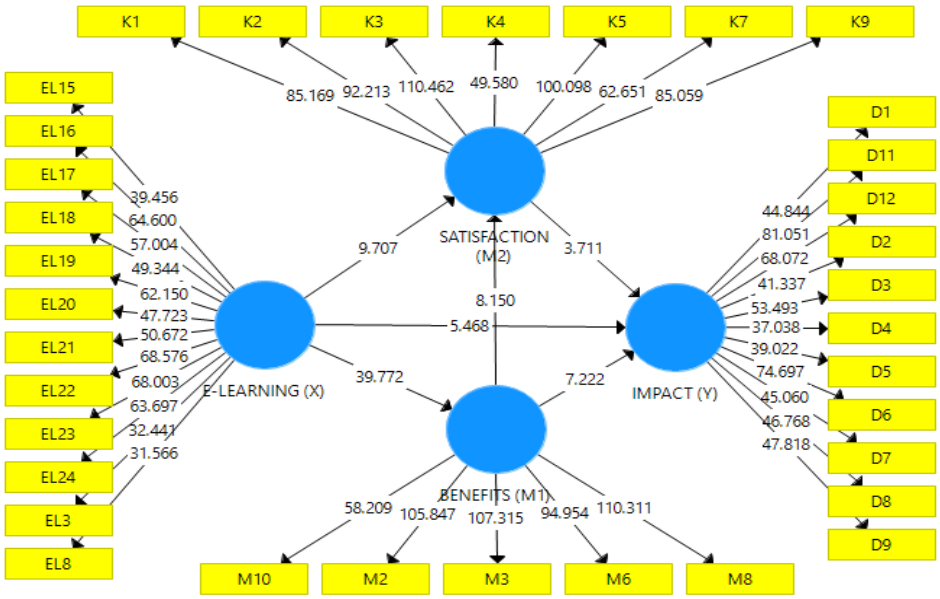

Figure 1
Bootstrapping result (SmartPLS 3.2.8)

Furthermore, the significance of the research questions testing results was observed through the values of T Statistics and P Values. The research questions is accepted when it has a T statistic value > 1.96 and P values < 0.05, indicating that exogenous variables affect endogenous ones, and vice versa (F. Hair Jr et al., 2014).

Table 7
Research questions testing in path analysis

Path Analysis	Original Sample (O)	T Statistics	P Values
E-Learning (X) -> Impact (Y)	0.319	5.468	0.000
E-Learning (X) -> Satisfaction (M2)	0.509	9.707	0.000
E-Learning (X) -> Benefit (M1)	0.825	39.772	0.000
Satisfaction (M2) -> Impact (Y)	0.197	3.711	0.000
Benefit (M1) -> Impact (Y)	0.431	7.222	0.000
Benefit (M1) -> Satisfaction (M2)	0.430	8.150	0.000
E-Learning (X) -> Satisfaction (M2) -> Impact (Y)	0.100	3.552	0.000
Benefit (M1) -> Satisfaction (M2) -> Impact (Y)	0.085	3.493	0.001
E-Learning (X) -> Benefit (M1)-> Satisfaction (M2) -> Impact (Y)	0.070	3.472	0.001
E-Learning (X) -> Benefit (M1) -> Impact (Y)	0.356	6.819	0.000
E-Learning (X) -> Benefit (M1)-> Satisfaction (M2)	0.355	8.006	0.000

The results of the research questions test in Table 7 shows the path significance between variables in the structural model as indicated by the T-statistics value. All independent

variables tested have a significant influence on the dependent ones. It was proven by the T-statistics value greater than 1.96 (two-tailed, = 0.05). Furthermore, Table 6 shows the significant effect of the E-learning variable on the Impact variable as indicated by the original sample value of 0.319; statistical T value 5.468 > 1.96, and P-value 0.000 < 0.05. This result indicates that besides being significant, the effect of e-learning also has a positive direction.

The test results of the E-learning path analysis on the Satisfaction variable have an original sample value of 0.509. It implies that E-learning has a positive influence on the Satisfaction variable. Then, the statistical T value of 9.707 > 1.96 and the P-value of 0.000 <0.05 indicates that E-learning has a significant effect on the satisfaction variable. Furthermore, the effect on the Benefit variable turned out to have a positive direction with the original sample value of 0.825. The significance of the effect of E-learning on the benefits has been shown by a statistical T value of 39,772 > 1.96 and a P value of 0.000 < 0.05. In summary, the E-learning variable has a significant effect on the Benefit variable.

The results of the path analysis test reveal the indirect effect of the E-learning variable on the impact through the Satisfaction variable. Therefore, the Satisfaction variable can play a role in mediating the effect of E-learning on the Impact. There is a significant indirect effect of E-learning on the Impact through the Benefit variable. It can also mediate the effect of E-learning on the Impact variable. In addition, the Benefit variable can also mediate the indirect effect on satisfaction. Finally, the Benefit and the Satisfaction variable can play an effective role in mediating the indirect effect of the E-learning on the Impact variable.

DISCUSSION

The e-learning assessment shows that the Context, Input, and Process components are in the very good category with mean values of 3.84, 3.90 and 3.57 on a scale of 1.00 to 5.00. Meanwhile, the Product components also remained in the good category with slightly lower average values, by 3.39. This result is plausible because the e-learning program has been implemented at the engineering college for a long time.

The results indicate the effect, either directly or indirectly, of E-learning on the Impact variable. Therefore, the better the e-learning is implemented, the higher the impact obtained by the students. To obtain a high impact for students and graduates of engineering colleges (Purwandari, Junus, & Santoso, 2022), it is necessary to improve the quality of learning through e-learning (Santyasa et al., 2021). The results are consistent with several previous studies, which shows that e-learning is a very effective educational tool. It helps students improving the learning process, makes it easier for them to communicate with lecturers and classmates, and has a positive impact (Almulhim et al., 2020; Abdel Jawad & Shalash, 2020; Cheng, 2019; Zhao et al., 2021). This study reveals that the E-learning variable has a significant effect on the Satisfaction variable (AlSoub, Alsarayreh, & Amarin, 2021). It means that the better e-learning is applied, the higher the satisfaction felt by students. Therefore, students can enjoy and feel satisfied with the use of e-learning. Information quality is the quality of output in

the form of information that is generated by the e-learning used. E-learning users certainly hope that by using e-learning they will get the information they need. E-learning that is able to produce timely, accurate, appropriate, and relevant information and meets other criteria and measures of information quality will have a positive effect on the users' satisfaction. The limitations of a human in providing or inputting information will be supported by the quality of the information obtained to make users become satisfied. The findings of this study also confirm and expand the opinion of Nuryanti, et al., (2021) which asserts that users' satisfaction with e-learning is reflected by the quality of the information held. Users' satisfaction with an e-learning can be identified from how the user perceives e-learning in real terms, not only on the technical quality of e-learning (Daultani et al., 2021). These results also support research from Mtebe & Raphael (2018) by providing empirical evidence that the quality of e-learning has a positive and significant effect on users' satisfaction. The higher quality of information produced by an e-learning; will affect the higher end-users' satisfaction of e-learning status. If e-learning users believe that the quality of the system and the quality of information generated from the e-learning used is good, they will feel satisfied using it. The success of an e-learning can be measured by users' satisfaction in using the e-learning, perhaps in terms of the quality of the e-learning and the information produced. The quality of e-learning has three dimensions, namely access, usability, and navigation. Information quality is influential because it has the dimensions of understandability, reliability, and usefulness. This finding strengthens the existing theory and it is consistent with the results of e-learning platforms conducted by several previous studies (Bashir, 2013; Yaakob et al., 2019; Cheng, 2020; Riandi et al., 2021; Gunesekera et al., 2019).

Several previous studies showed that e-learning is useful in increasing student productivity in completing lecture assignments on time (Ibrahim et al., 2021; Escobar Fandiño et al., 2019; Alshehri et al., 2019), and Satisfaction affects Impact. This illustrates that the higher the satisfaction felt by students, the better the impact. In line with these findings, several studies showed that students were satisfied with the services provided by the lecturers as well as the teaching materials available in e-learning (Vate-U-Lan, 2020; Khan & Setiawan, 2019; Ryan & Poole, 2019). It was shown that the Benefit variable had a positive and significant effect on the Impact. Therefore, the greater the benefits of e-learning obtained by students, the better the impact that follows. This finding strengthens the results that the experience of using e-learning has helped students improve digital communication skills and supported students in learning independently to generate a positive impact (Ismaeel & Al Mulhim, 2019; Turkyilmaz et al., 2019; Elzainy et al., 2020).

The benefits of the e-learning as a mechanism to improve learning performance of campus-based students (Azlan et al., 2020). In addition, it provides an interesting and meaningful experience for students because of their abilities can be integrated directly, so that understanding of the learning material will be more meaningful, easy to understand, easy to remember and easy to express again (Hashim, & Tasir, 2020). The impact and benefits of e-learning improve one's level of understanding and memory on the knowledge conveyed, because of the varied content, interesting interactions (Al-

Adwan et al., 2021). The immediate feedback, and interaction with other e-learners and e-instructors. The students learn independently to explore knowledge through the internet and other information technology media. The independence of students will increase, because each student is required to study and develop the material independently (Wargadinata et al., 2020). Students learn according to their own abilities, so that it will increase trust himself.

Furthermore, the results reveal the effect of the Benefit variable on Satisfaction in a positive and significant way. It can be stated that the more benefits students receive, the higher the satisfaction felt by students. Therefore, the facilities with the provided features used during the learning process can provide satisfaction. Several studies have reported that the experience gained in using e-learning gives students a feeling of satisfaction (Saxena et al., 2021; Tawafak et al., 2019; Nugroho et al., 2019). An e-learning evaluation model that includes the relationship between variables, both direct and indirect, was developed. The indirect effect of the variable on the Impact through the Satisfaction variable, the Impact through the Benefit variable, and the Impact through the Benefit and Satisfaction variable were supported by the results of data analysis. The direction of the effect is positive and statistically significant. Both the Benefit and Satisfaction variables can be a the influence mediators between E-learning and the Impact, and this results are supported by the opinions of previous studies (Safsouf et al., 2020; Burac et al., 2019; Jena, 2019; Afzal et al., 2020).

Evaluation of e-learning is an effort to maintain both the quality of learning and graduates. Several studies stated that graduates of engineering colleges should quickly adapt to advances in information technology in today's digital era to work professionally. Specific expertise related to e-learning is also an important concern in evaluating the systems, which ultimately leads to the impact felt by students. This evaluation is seen as a challenge in improving the quality of continuous education (Forster et al., 2020; Makarova et al., 2017; Odinokaya et al., 2020).

CONCLUSION

The learning process at engineering colleges should be the focus of attention of learning quality assurance units and lectures, which allows graduates to have the competence and be able to compete in the digital work life. Even during the Covid-19 pandemic, the learning process can be carried out widely through e-learning. The evaluation is important to ensure that the learning process runs effectively, efficiently, collaboratively, interactively with a positive impact. The evaluation performed reveals that the Context, Input, and Process components of E-learning are categorized in a very good category, while the Product component is included in a good category.

The implementation of e-learning has an effect, either directly or indirectly, on benefits, satisfaction, and the impact felt by students. In can be concluded that, an e-learning model is supported by the results of empirical data analysis. Furthermore, the results can be used as the basis for improving learning and the quality of e-learning in engineering colleges in the future.

ACKNOWLEDGMENT

Thank you to all who have facilitated and contributed to conducting research, the lecturers, and staff at the faculty, the experts who contributed in providing advice during the implementation of the research. This research activity was also assisted by various data collection and analysis teams to provide comments and information about the e-learning evaluation. Furthermore, thanks to the staff and operators who facilitated the work in the field. This research was supported and funded by the grant research institution No. 739/UN35.13/LT/2021, Universitas Negeri Padang, Padang-Indonesia.

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