

Analysis of User Satisfaction with E-Learning Services During the Covid-19 Pandemic Using the PIECES Framework

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ABSTRACT

During the Covid-19 pandemic, the education sector has been able to provide assistance for the continuation of the learning process through e-Learning services. E-Learning is an online-based learning and teaching process that utilizes information technology services. E-Learning is specially designed by the institution and integrated with academic progress data to offer the best support to students who have become increasingly familiar with information technology during the pandemic, addressing its limitations. The objective of this research is to measure user satisfaction with the e-Learning service using the PIECES framework. The PIECES framework consists of Performance, Information/data, Control/security, Efficiency, and Service categories. The PIECES framework is employed for analyzing the information system and consists of six variables: performance, information, economic, control, efficiency, and services. Data was collected through questionnaires distributed to 368 students from different graduation years, spanning from 2018 to 2021, who are users of the e-Learning service. Based on the gathered data analysis, the average satisfaction levels for each variable are as follows: performance scored 3.75, information scored 3.82, economic scored 3.84, control scored 3.74, efficiency scored 3.7, and services scored 3.84. Combining these values and referencing Kaplan and Norton, it can be concluded that the overall user satisfaction level with e-Learning falls into the satisfied category.

Keywords: User Satisfaction, e-Learning, PIECES Framework

INTRODUCTION

The COVID-19 pandemic has slowly changed and brought many new habits for us. As we know and have experienced together, this pandemic has demanded us to indirectly change old habits into new ones known as the "new normal." One of the new habits during this pandemic is social distancing, where we are required to reduce our social activities physically and shift them virtually with the use of information technology (Latip, 2020). The rapid development of information technology has made it easier for us to accommodate the limitations of social access, especially in our education processes (Basar, 2021). With information technology, we can continue our teaching and learning processes anywhere and anytime (Adisel & Pranansa, 2020).

Politeknik Pariwisata Bali is a public campus under the Ministry of Tourism. This educational institution offers various programs in accommodation and tourism services, which are highly sought after by prospective students. To meet the educational needs during the COVID-19 pandemic, the campus has provided various facilities, one of which is online learning. The internet-based learning service is made available through the website <http://e-learning.ppb.ac.id/login>. This site is specially designed by the university and integrated with academic progress data to provide advanced services to students who are increasingly familiar with information technology, especially during this pandemic.

The importance of analyzing user satisfaction arises due to the objectives to accommodate the restricted learning processes of the new normal during the COVID-19 pandemic (Acharya, 2019). One of the objectives of this E-Learning web portal is to disseminate information about teaching and academic

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activities within the campus globally, in a current and accurate manner, especially to students. The PIECES framework takes into account multiple interrelated aspects to assess a good user experience, helping developers understand the significance of considering the entire user experience rather than just focusing on one or two aspects. This method consists of six variables: Performance, Information, Economic, Control, Efficiency, and Service, which also helps developers consider user needs and perspectives in product design, resulting in products that better meet user needs and expectations.

In this research, the PIECES framework is chosen to analyze the user satisfaction level of the E-Learning system based on the six variables: Performance, Information, Economic, Control, Efficiency, and Service (Dwiyantoro, 2019). The Customer Satisfaction Index is used as a measurement tool, which assesses the strengths and weaknesses or the overall quality of a service according to users (Chen et al., 2020). Customer satisfaction or dissatisfaction is a customer's response to the perceived alignment or mismatch between their expectations and the actual performance of a product after use. Hence, a reanalysis is necessary to measure service quality and ensure user satisfaction. The purpose of this study is to analyze the level of student satisfaction as users of the E-Learning service implemented using the PIECES framework. Additionally, it aims to identify the recommended suggestions based on the analysis of user satisfaction with the information system using the PIECES framework.

LITERATURE REVIEW

E-Learning

During the Covid-19 pandemic, the utilization of E-Learning has evolved beyond being just a trend in the education world. Currently, E-Learning has become a necessity to support the organization of learning activities anytime and anywhere, especially due to the limited social access caused by the pandemic (Maatuk, Elberkawi, Aljawarneh, Rashaideh, & Alharbi, 2022). E-Learning, as defined by experts like Darin E. Hartley is the process of teaching and learning to deliver educational materials using the internet or other computer network services (Mulyani & Haliza, 2021). According to Dong, E-Learning is the use of digital computer devices for learning purposes, aiming to acquire educational materials based on individual needs in an asynchronous manner (Athiyah, 2021).

From the above definitions, it can be concluded that E-Learning is a form of distance learning that harnesses computer network technology, making it a suitable solution for continuing the learning process during the Covid-19 pandemic. There are two primary approaches to implementing online learning, namely the self-paced approach and the facilitated/instructor-led approach. The self-paced approach allows learners to independently use E-Learning, while the facilitated/instructor-led approach involves instructors guiding and providing various levels of support to promote collaboration among educators and learners.

Online learning can also involve various components, such as online content and interactive e-lessons (Suhaili, Yuhasnil, & Mulyani, 2021). Online content refers to non-interactive learning resources like documents, PowerPoint presentations, videos, and audio files, which usually require only passive reading or viewing. On the other hand, interactive e-lessons are website-based learning materials commonly used, incorporating interactions through videos, animations, texts, graphics, audios, and various interactive elements like questions and feedback. E-lessons may also include recommended reading links or online learning sources. According to Mustofa's research, there are three key factors for successful online learning, such as technology, instructor's characteristics, and student's characteristics (Tobi, Osman, Abu Bakar, & Othman, 2021).

User Satisfaction

Satisfaction is a word derived from the Latin term "satis," meaning enough, and "facere," which means to perform or accomplish. Hence, satisfaction can be interpreted as the feeling of contentment or pleasure regarding something that has been done (Boyd, Bond, Vertesi, Dogan, & Magee, 2019). Goods or services

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that can bring satisfaction are those that can captivate consumers, making them continually seek and use such products or services. In the context of consumer behavior theory, satisfaction is often defined from the perspective of a consumer's experience after using a particular product or service (Ahrholdt, Gudergan, & Ringle, 2019). From these definitions, it can be inferred that satisfaction is the perception of a product or service fulfilling user expectations. Therefore, users or customers will feel dissatisfied if their expectations are not met, while they will feel satisfied if their perceptions align with or exceed their expectations.

PIECES Framework

The PIECES Framework is utilized to categorize problems, opportunities, and directions identified in system analysis and design (Andarwati, Amrullah, Thamrin, & Muslikh, 2020). By employing this framework, we can generate new ideas that may be considered in system development. Each letter in PIECES represents a distinct category in problem formulation, namely: P (Performance) or system performance; I (Information) or presented information; E (Economics) or attainable benefits; C (Control) or system security; E (Efficiency) or efficiency of people and processes; S (Service) or provided services. The PIECES Framework serves as a tool to evaluate existing systems and identify improvement opportunities. It is a framework that aids in identifying issues related to existing information systems (Permana, Hapsari, Nugraha, & Jaenul, 2021). PIECES Framework can also be referred to as a classification framework used in analyzing and designing systems, leading to the generation of novel considerations in system development (Belluano, Indrawati, Harlinda, Tuasamu, & Lantara, 2019). The PIECES framework consists of Performance, Information/data, Control/security, Efficiency, and Service categories, each of which can be further divided into several criteria (Aditya & Jaya, 2022).

METHOD

The research conducted involves several stages that can be depicted in the following research framework.



Fig. 1 Research Framework

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Based on the research stages conducted, it can be outlined as follows. Identifying that e-Learning can provide benefits in students' academic learning. This process is carried out through on-site observations, literature studies, and previous research studies. The outcome of this process is an analysis showing that the use of e-Learning can enhance the learning process for students in academic fields. Once the problem is identified, the research proceeds with data collection, including literature studies obtained from journals, internet sources, and similar research, as well as gathering additional data through distributing questionnaires using Google Forms to respondents. Data analysis begins with organizing and structuring the data to ensure it is well-arranged, systematic, and comprehensive for interpretation. This phase will analyze the data based on the variables within the PIECES Framework, which are Performance, Information and Data, Economic, Control and Security, Efficiency, and Service. The results of this analysis provide a comprehensive understanding of areas that need improvement if there is any dissatisfaction in the variables of the PIECES Framework mentioned earlier. Ultimately, this research aims to conclude and offer recommendations for the e-Learning information system.

RESULT

From the conducted research, several data were collected, which will be analyzed by the researchers. The gathered data includes the initial questionnaire results distributed to 30 respondents to test the validity and reliability of the study. Once the preliminary testing of the questionnaire was completed, resulting in valid and reliable data, the researchers proceeded to distribute the full questionnaire to 368 respondents. The overall distribution of the questionnaire yielded data on various aspects: the respondents' general characteristics based on gender, their academic programs, and their academic years. This section discusses the analysis of the obtained data in the study conducted on e-learning at Bali Tourism Polytechnic during the Covid-19 pandemic, utilizing the PIECES framework. The analysis focuses on user satisfaction regarding the variables of performance, information, economic, control, efficiency, and service. To determine the level of user satisfaction with e-learning, the researchers utilized Kaplan and Norton's theory to categorize the levels of satisfaction.

The respondents who participated in this study consisted of active students who utilized e-Learning. Data collection was conducted by distributing online questionnaires to each respondent. The purpose of gathering information on the respondents' identities was to provide an overview of their demographics, including gender, study program, and academic year. The following discussion presents an overview of the respondents' general profile based on their qualifications.

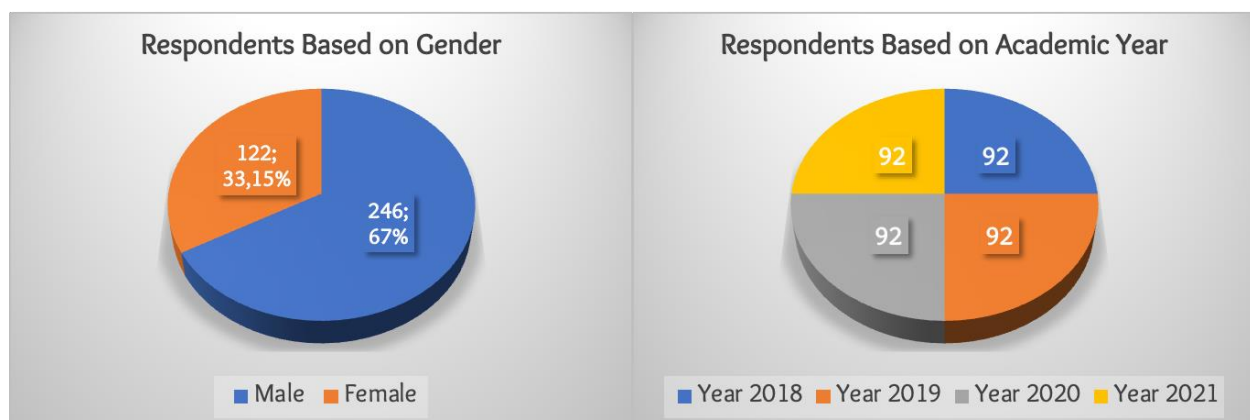


Fig. 2 Respondents Based on Gender and Academic Year

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Table 1
Validity Testing Result

Question ID	Pearson Correlation Sig. (2-tailed)	Product Moment	Question ID	Pearson Correlation Sig. (2-tailed)	Product Moment
P1	0,57777778	0,25069444	E1	0,62430556	0,25069444
P2	0,60763889	0,25069444	E2	0,61180556	0,25069444
P3	0,60486111	0,25069444	E3	0,62777778	0,25069444
P4	0,61041667	0,25069444	C1	0,64861111	0,25069444
P5	0,61666667	0,25069444	C2	0,64652778	0,25069444
P6	0,60833333	0,25069444	EF1	0,64097222	0,25069444
P7	0,58958333	0,25069444	EF2	0,64236111	0,25069444
I1	0,64305556	0,25069444	S1	0,63125	0,25069444
I2	0,61944444	0,25069444	S2	0,625	0,25069444
I3	0,64097222	0,25069444	S3	0,63333333	0,25069444

The purpose of validity testing is to assess the extent to which the measurement tool used can be trusted. The instrument's validity is achieved when it can produce valid data and effectively measure the intended variables. In other words, a valid instrument is one that accurately measures what it is intended to measure. The statement codes (P1-P7, I1-I3, E1-E3, C1-C2, EF1-EF2, S1-S3) were subjected to calculation, and their calculated R values were compared to the table R value of 0.361. All the R values obtained for the statement codes were higher than the table value, which led to the conclusion that they are valid. The valid statements have R values ranging from 0.832 to 0.934, indicating their reliability and accuracy within the given context. The following presents the outcomes of the validity testing conducted for the research variables.

Based on the results of correlation analysis, which can be observed in the total item statistics output in the total score column of each respondent's answers, these values were compared with the critical r-value at a significance level of 0.05 using a two-tailed test. The study had a total of 10 respondents, and the obtained critical r-value was 0.361, while the calculated r-value was above 0.600. According to Cronbach's Alpha method, if the calculated r-value exceeds 0.600, the instrument can be considered valid.

Furthermore, the reliability calculations aided by SPSS 22.0 for Windows showed that the questionnaire's variables, namely performance, information, economic, control, efficiency, and services, yielded reliable results with a Cronbach's alpha of 0.975, based on 20 statement items. The Questionnaire Result of Performance, Information, Economics, Control, Efficiency and Service (PIECES) Variable displayed ad Figure 3.

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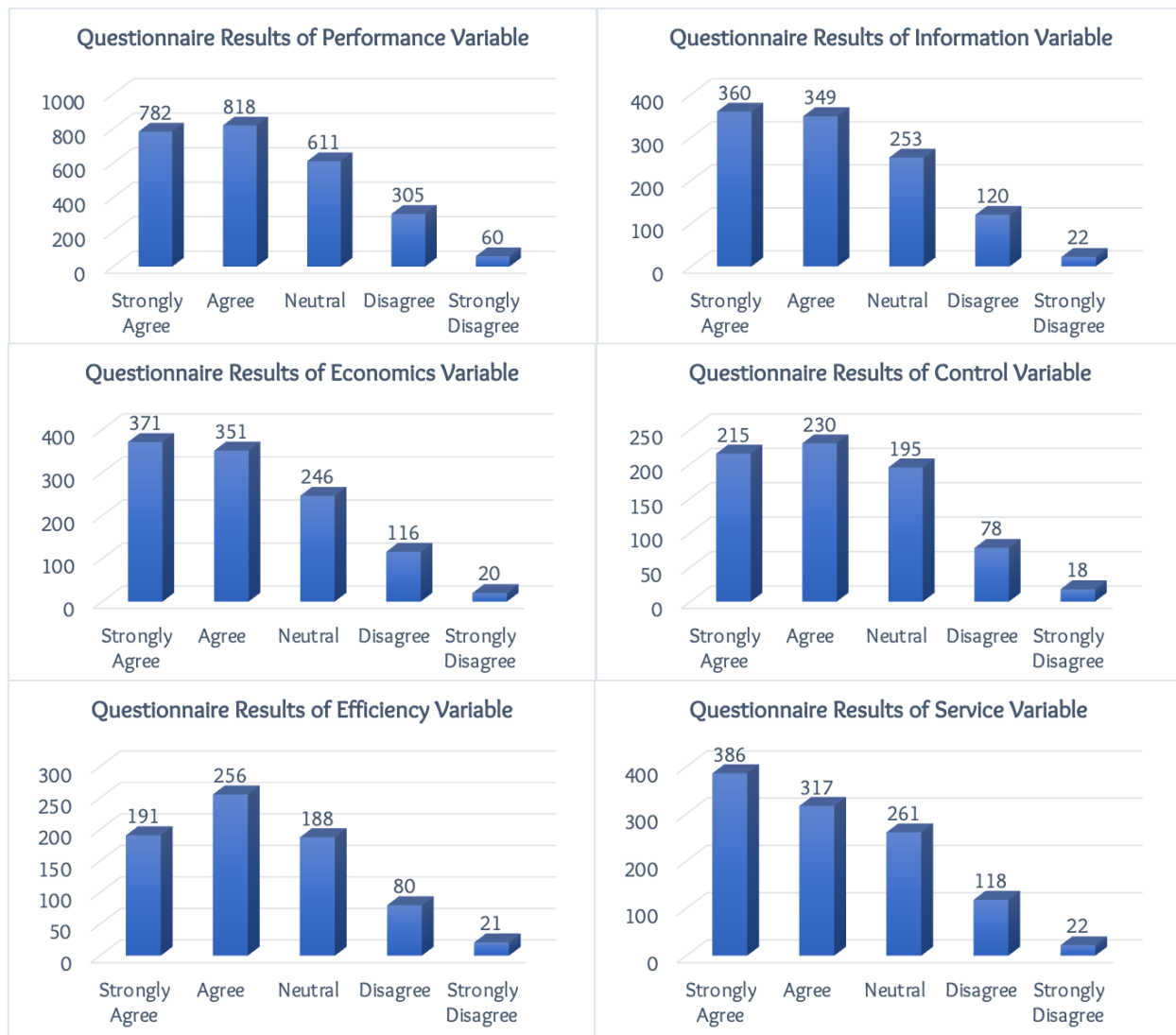


Fig 3. The Questionnaire Result of Performance, Information, Economics, Control, Efficiency and Service (PIECES) Variable

Results of Performance Variable Analysis

The research questionnaire was distributed online using Google Forms to e-Learning users' samples. The Likert scale was employed to assess the users' satisfaction level with e-Learning based on the performance variable, taking into account the provided choices and corresponding scores. Based on Figure 3 in the questionnaire result of performance variable, to assess the satisfaction level, the researchers utilized the theory proposed by Kaplan and Norton, as follows:

$$\text{Average Satisfaction} = \frac{\text{Total Questionnaire Score}}{\text{Number of Questionnaires}}$$

$$AS - \text{Performance} = \frac{(5 \times 782) + (4 \times 818) + (3 \times 611) + (2 \times 305) + (1 \times 60)}{2576} = \frac{9685}{2576} = 3.75$$

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Upon calculating the average satisfaction level, a value of 3.75 was found for the performance variable. Considering the satisfaction levels according to Kaplan and Norton, it can be concluded that the users' satisfaction with e-Learning falls under the category of contentment. This outcome indicates a positive response towards the indicators or aspects covered by the performance variable. Students feel satisfied with the optimization of every menu function in the system, express contentment with the system's prompt response when given commands like upload, download, cancelation, and confirmation processes. They also feel pleased with the suitability of menu functions and buttons, satisfied with the user interface's appearance, and content with the available features. Additionally, students are satisfied with the system's consistency in executing commands, and due to the minimal issues encountered while accessing and using the system, they are overall satisfied with this e-Learning system.

Results of Information Variable Analysis

Based on Figure 3 in the questionnaire result of information variable, to assess the satisfaction level, the researchers utilized the theory proposed by Kaplan and Norton, as follows:

$$AS - Information = \frac{(5 \times 360) + (4 \times 349) + (3 \times 253) + (2 \times 120) + (1 \times 22)}{1104} = \frac{4217}{1104} = 3.82$$

Through the average calculations, the satisfaction level for the variable "information" was found to be 3.82. Considering Kaplan and Norton's satisfaction levels, it can be concluded that users' satisfaction with e-Learning falls into the "satisfied" category. These findings indicate positive indications for each indicator or dimension present in the "Information" variable. In this context, students feel content with the information presented in every system menu, such as class schedules and assignment deadlines. They also find the system's information easy to comprehend and are satisfied with the overall presentation, as the information provided aligns well with their needs.

Results of Economics Variable Analysis

Based on Figure 3 in the questionnaire result of economics variable, to assess the satisfaction level, the researchers utilized the theory proposed by Kaplan and Norton, as follows:

$$AS - Economics = \frac{(5 \times 371) + (4 \times 351) + (3 \times 246) + (2 \times 116) + (1 \times 20)}{1104} = \frac{4249}{1104} = 3.84$$

The average calculation results indicate that the satisfaction level of the economic variable is 3.84. Taking into account the satisfaction levels according to Kaplan and Norton, it can be concluded that users' satisfaction with e-Learning falls into the satisfied category. These findings demonstrate a positive indication for each indicator or dimension within the Economy variable, where students feel content with this service. According to students, this solution enables them to continue their learning process quickly and easily during the pandemic, as they find it helpful for saving on operational costs. The availability of this service allows students to pursue their studies during the limitations imposed by the pandemic, leading to their overall satisfaction.

Results of Control Variable Analysis

Based on Figure 3 in the questionnaire result of control variable, to assess the satisfaction level, the researchers utilized the theory proposed by Kaplan and Norton, as follows:

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$$AS - Control = \frac{(5X215) + (4X230) + (3X195) + (2X78) + (1X18)}{736} = \frac{2754}{736} = 3.74$$

Based on the average calculations, the control variable has a satisfaction value of 3.74. Considering the satisfaction levels according to Kaplan and Norton, it can be concluded that the user satisfaction with e-Learning falls under the category of reasonably satisfied. This outcome indicates a positive trend, as users already feel sufficiently content. It also demonstrates positive indicators for every aspect or dimension of the Control variable, wherein students feel content with the defined boundaries aligned with their user level as students in the system. Furthermore, students' express satisfaction with the confidentiality assurance of the system, as they are unable to access other students' uploaded assignment files and the verification process during login remains secure.

Results of Efficiency Variable Analysis

Based on Figure 3 in the questionnaire result of efficiency variable, to assess the satisfaction level, the researchers utilized the theory proposed by Kaplan and Norton, as follows:

$$AS - Efficiency = \frac{(5X191) + (4X256) + (3X188) + (2X80) + (1X21)}{736} = \frac{2724}{736} = 3.7$$

Based on the average calculations, the economic variable obtained a satisfaction score of 3.7. When combined with Kaplan and Norton's satisfaction levels, it can be concluded that users' satisfaction with e-Learning falls under the category of contentment. These results indicate a positive outlook for each indicator or dimension within the Economics variable, where students feel content with a system that is accessible from anywhere and can be used on various devices with internet services. Students' express satisfaction because the utilization of this system during the pandemic has facilitated a more effective learning process.

Results of Service Variable Analysis

Based on Figure 3 in the questionnaire result of service variable, to assess the satisfaction level, the researchers utilized the theory proposed by Kaplan and Norton, as follows:

$$AS - Service = \frac{(5X386) + (4X317) + (3X261) + (2X118) + (1X22)}{1104} = \frac{4239}{1104} = 3.84$$

Based on the average calculation, the variable "services" has a satisfaction value of 3.84. Combining this with Kaplan and Norton's satisfaction levels, it can be concluded that users' satisfaction with e-Learning falls into the satisfied category. These findings indicate a positive indication for every indicator or dimension present in the "Services" variable. In this context, students feel satisfied with the ease of using features available in the system, such as up-to-date information on academic activities, the presence of a help button for additional information in case any feature is not fully understood by students, satisfaction with the suitability of system features to support the learning process during the pandemic, and overall satisfaction with the ease of using all features within the system.

DISCUSSIONS

The Kaplan and Norton formula was employed to determine the average level of student satisfaction with this e-Learning system. Based on the average calculation, a satisfaction level of 3.75 was obtained for the performance variable. According to Kaplan and Norton's satisfaction assessment, it can be concluded that e-Learning users are content. This result demonstrates positive indications towards the indicators or

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dimensions present in the performance variable, where students are satisfied with the optimization of each menu function in the system, quick response of the system to specific commands like upload, download, cancelation, and confirmation, suitability of every menu and button in the system, user interface design, availability of features, system consistency in executing commands, and minimal student difficulties in accessing and using the system, all contributing to their satisfaction with the system.

The average calculation yielded a satisfaction level of 3.82 for the information variable. It can be concluded that the user satisfaction with e-Learning falls into the "satisfied" category. This positive indication suggests that users are already content. The result indicates positive indicators or dimensions present in the Information variable, where students feel satisfied with the information displayed on each system menu, such as class schedules and task deadlines. They find the system's presentation of information easy to comprehend, and the overall information display meets their needs.

For the economy variable, the researchers calculated an average satisfaction level of 3.84 for the economic variable. When combined with Kaplan and Norton's satisfaction criteria, it concludes that the user satisfaction with e-Learning falls into the "satisfied" category. The results indicate positive indicators or dimensions present in the Economy variable, as students feel satisfied with the service. They see it as a solution to continue learning quickly and easily during the pandemic, helping them save on operational learning costs and enabling learning despite the limitations imposed by the pandemic.

Regarding the control variable, the researchers found an average satisfaction level of 3.74 for the control variable. Combining this with Kaplan and Norton's satisfaction criteria, it can be inferred that the user satisfaction with e-Learning falls into the "reasonably satisfied" category. The results indicate positive indicators or dimensions present in the Control variable, where students feel satisfied with the service, finding it helpful for smooth learning processes during the pandemic and cost-effective in their educational journey despite the limitations imposed by the pandemic.

Lastly, for the efficiency variable, the researchers calculated an average satisfaction level of 3.7 for the efficiency variable. Combining this with Kaplan and Norton's satisfaction criteria, it can be inferred that the user satisfaction with e-Learning falls into the "satisfied" category. The results indicate positive indicators or dimensions present in the Efficiency variable, where students feel satisfied with the system's accessibility and usability on various devices with internet connectivity. Students are content as the system's usage during the pandemic has facilitated effective learning.

In summary, based on the application of the Kaplan and Norton formula for various variables, it can be concluded that the overall satisfaction level of e-Learning users falls into the "satisfied" category. Positive indications were found across the performance, information, economy, control, and efficiency variables, reflecting students' contentment with the system's optimization, information display, cost-effectiveness, ease of use, and accessibility, contributing to their satisfaction with the e-Learning platform.

CONCLUSION

Based on the calculations and data analysis, it can be concluded that the instrument test was conducted by distributing a questionnaire in the form of a Google Form to 30 respondents who were sampled from the population used in the study to determine the feasibility of the instrument to be used. The evaluation of user satisfaction level was carried out to assess the alignment of user needs with the e-Learning information system, using the PIECES Framework and its six variables. The sample size required for this research was determined using the Slovin formula, resulting in 368 users. The research findings indicate that the six variables in the PIECES framework have average scores as follows: 3.75 for performance satisfaction, 3.82 for information satisfaction, 3.84 for economics satisfaction, 3.74 for control satisfaction, 3.7 for efficiency satisfaction, and 3.84 for services satisfaction. From the analysis of the PIECES Framework, it can be inferred that the implementation of the e-Learning system during the pandemic is considered satisfactory by students.

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