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E-Learning Application Usage in Higher Education with Technology Acceptance Model (TAM) for Students' Assessment

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***Abstract*— Disruptions to daily life and business have occurred in nearly every part of the world due to the COVID-19 pandemic. Multiple sectors, including the educational system, have been hit particularly hard. This study focuses on adopting e-learning by students and explores how it can effectively change the old-style classroom environment. Adopting an approach based on the technology acceptance paradigm, the research aims to investigate the e-learning adoption level among students. The study was conducted on 200 students in the art and design faculty at Universitas Negeri Makassar and used e-learning LMS SYAM-OK. The research examined students' intentions to adopt and use online learning in the future can impact their perceptions of the usefulness and ease of technology. The data were analyzed using the SEM methods with IBM AMOS software. The results of the study indicate that there is a significant impact between the variables of AB to BI (coefficient of 0.514; $p < 0.01$) and BI to AU (coefficient of 0.617; $p < 0.01$) of online education platforms during the pandemic. Students are intensely interested in utilizing the e-learning system when they have favorable attitudes. The success or failure of an e-learning program depends on the student's mindset. An individual's opinion of a system is shaped by their experience, particularly its accessibility and practicality. The perceived utility influences the number of individuals willing to return to using e-learning and use it.**

***Keywords*—Behavioral intention; education technology; learning management system; structural equation model.**

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I. INTRODUCTION

Since the pandemic began in 2019, the pattern of education worldwide has changed. Initially, the instruction and education methods were done face-to-face. However, instruction and learning are done remotely using the internet and information and communication technology [1]. Today, pandemics pose a challenge to the creative use of technology, not just in communicating knowledge but also in ensuring that learning is given effectively. This challenge is also an opportunity for all to learn how technology may assist in preparing students and students for the industrial revolution. 4.0. Due to schooling, self-directed learning is a vital skill. This epidemic time can train and instill in kids the habit of being independent learners by participating in various online programs. In addition, students can collaborate to solve learning problems and confront real-world issues [2].

The spread of COVID-19 has presented a problem for Indonesian educational institutions. In preparation for the virus's spread, the authorities implemented measures ranging from widespread social restrictions to physical and social isolation (lockdown). People with this ailment must maintain silence while studying, working, and attending church. Due to this approach, universities and other institutions of higher learning that involved face-to-face instruction were shut down. Instead, instruction is delivered online so students can do it from home.

These impacts have a massive effect on the management of the learning method. Learning that has been taking place in the classroom (real classroom) has turned into learning in virtual classrooms; the change should not reduce the quality and learning process, and it ought to be the basis for enhancing the achievement of the practice and the effects of the learning method. This is possible due to numerous learning benefits over traditional teaching and learning methods. Students in this situation face challenges. Thus, teachers must ensure they comprehend the lesson contents when imparting knowledge [3], [4].

This necessitated an unprecedented mass migration of educators from old-style learning schooling to online learning. Initially, teachers employed online learning, also known as Electronic Learning (E-Learning), to supplement classroom instruction. Later during COVID-19, the epidemic served as a critical method for continuing education. The accessibility, connectivity, adaptability, and capacity of the Internet are utilized in online learning to facilitate a wide range of learning activities [5]. Online learning can utilize various tools and platforms, including applications, websites, social networks, and LMS platforms.

The information system is a collection of pieces collaborating to achieve a specific objective, and it consists of interconnected components that form a tight working relationship to achieve the objective. Consequently, in the present era of globalization, the growth of ICT is accelerating and has permeated all facets of human life, including education, in many nations, including Indonesia. The worldwide education system is under tremendous pressure from Information and Communication Technologies (ICT) since the advancing technology offers institutions a significant chance to improve education administration and learning processes [6].

The accomplishment of online learning through e-learning heavily relies on the improvement of an effective and efficient LMS model and its optimal utilization. A learning management system (LMS) is a modern term that is frequently used interchangeably with "online learning," "digital learning," "virtual learning," and "distance learning" [7]–[9]. This represents a modern concept of educational progress involving many cases using information and communication technology. Users can share knowledge and work together online using the LMS, a system accessible online [10]–[12]. A software program known as an LMS uses the internet to facilitate instruction and learning [13], [14]. Learning Management systems can be utilized by educational institutions and companies focusing on managing the educational process, not just providing courses and electronic training materials. LMS is a generic term for online or distance education that aims to supplement traditional classroom teaching with organized resources and digital tools [15].

The LMS, which we rely increasingly on to learn, has significant knowledge and skill development potential. Due to the vast array of services this e-learning platform provides, anyone can access and utilize the numerous available resources interactively from anywhere and at any time. In addition, they can construct individualized training regimens, allowing them to develop their skills to their fullest potential. Students can access and use the instructional materials without installing media on their computers. E-learning based on Moodle is a platform for organizing related learning activities through planning, implementation, and evaluation. In this perspective, Moodle represents virtual learning, whereas network-connected open-source software represents the electronic learning process [16]. This innovative learning framework based on constructivist pedagogy is where professors and students collaborate on projects and generate new knowledge.

Learning Management System technology (e-learning) that is growing and increasingly modern provides facilities for the ease of learning in schools, specifically in electronic learning media conducted online or connected to the network. This provides convenience to teachers who can use technology to support learning activities in the classroom and students who can use IT to facilitate all learning activities. The improvement of networks and devices used determines the role of computers as instruments in learning electronics [17], [18]. Computers and networks provide ease of learning and communication between teachers and students, so it is more efficient to use electronic learning as a source of education activities, as a means of delivering and evaluating materials and ways of assessment that can be done by the teacher concerned [19].

The Technology Acceptance Model (TAM) is a framework used to assess IT perceived value and convenience. TAM was created using the Theory of Reasoned Action (TRA) model, but with a critical differentiation being the placement of attitude in TAM [20]. TAM considers perceived utility and ease of use crucial variables for predicting user acceptance of information technology. TAM offers an easy-to-understand rationale for why and how people embrace technological change.

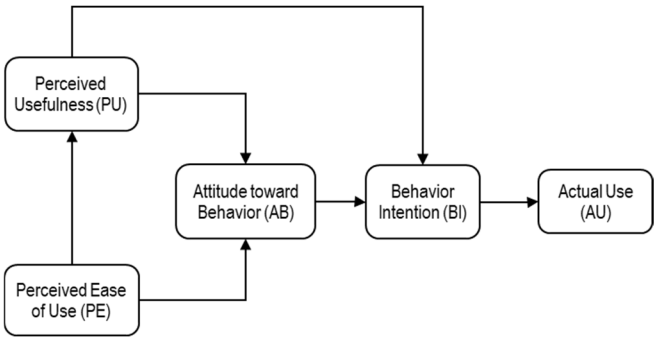

Fig. 1 Technology Acceptance Model

Figure 1 shows that TAM comprises essential perception variables and accessibility. Perception of use refers to individuals positively or negatively improving performance using IT. Perception of accessibility indicates the ease experienced by users in learning individually how to operate technology or information systems.

In the management information system literature, TAM is one of the behavioral models of information technology usage. This proposed TAM formed a mindset around the desire to use IT [20]. The TAM centers on consumers' attitudes toward adopting IT based on their perception of its advantages and user-friendliness. It is one of the most crucial research models to explore the factors influencing IT acceptance. TAM is frequently employed to predict user adoption and usage, considering the perceived utility of IT, which is influenced by perceived accessibility. In other words, TAM considers the accessibility of IT when assessing users' views on the ease of adopting and using it.

The TAM is concerned with the attitudes of IT users, which are shaped by their perception of the benefits and ease of use of IT. It seeks to explain the factors that determine the acceptance of computers in general. Although it is specifically designed for modeling computer usage behavior, TAM draws on decades of research and is thus suitable for modeling computer acceptance. TAM theory will evolve in tandem with

technological development, and researchers seek to use this theory to test the acceptance of new technologies. The phenomenal TAM theory led researchers to use TAM research from 1986 to 2003. His study entitled "Technology Acceptance Model: Past, Present, and Future" found that TAM runs each year continuously and, in its course, is elaborated by researchers to solve existing limitations, introduce new external variables and apply them in different atmospheres, techniques, tasks, and topics [21].

Implementing an LMS will undoubtedly improve the learning system in schools by maximizing the use of existing technologies and communication. Learning uniquely generates substantial interest in learning, particularly among students. In schools that use electronic learning, students can access and use many sources of information on the internet to help them learn. As a result, this study aims to examine the extent to which students have adopted e-learning.

II. Material and Method

A. Materials

The Moodle LMS is integrated into the Makassar State University System and Management Open Knowledge (SYAM-OK) service. One of the systems for new learning services at Universitas Negeri Makassar was used during the pandemic. The learning model applied to the course combines e-learning and face-to-face lectures in the classroom; this model is often called blended learning [22]. The e-learning learning model applied to the database course is asynchronous. The teaching and learning process is still limited to asynchronous learning features, namely, lecturers and students at different times and places.

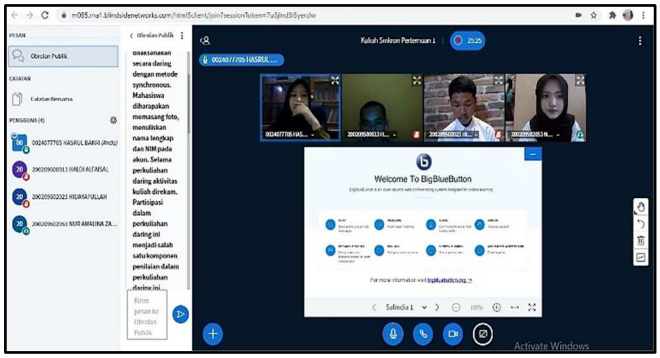

Fig. 2 Display activities in Learning Management System (LMS) SYAM-OK.

SYAM-OK Universitas Negeri Makassar stands for System and Application Management Open Knowledge, which is an application service for managing an integrated information system that contains several services, namely a Learning Management System, Course Management System, Lecturer Workload, Lecturer Evaluation by Students, Academic Information System, Intellectual Assets, and International Accreditation. SYAM-OK Universitas Negeri Makassar is accessed at https://syam-ok.unm.ac.id. Learning Management System services are accessed through https://lms.syam-ok.unm.ac.id.

B. Method

1) Population and Samples: A generalization area called a population comprises objects or people with attributes and characteristics that the researcher has chosen to investigate and derive conclusions. The participants in this research were active students in the art and design faculty at Universitas Negeri Makassar and used LMS SYAM-OK as learning. The total sample size is proportional to the total indicators in the structural model. The total of samples is estimated by multiplying the total number of indicators by 5-10 observations [23]. Because this study uses the Maximum Likelihood, it is suggested by Hair et al. [24], [25] that the proposed sample size ranges from 100 – 200. The calculation results obtained as many as 170 respondents, but the number of samples used was as many as 200 respondents to anticipate the existence of outlier data when processing data. The selection of sample members is carried out using a method known as random sampling. This is a strategy in which each person in the population, either on their own or as a group, is provided with an equal opportunity to be chosen as a sample member.

2) Procedures and Instruments Research: A questionnaire-based survey is employed to obtain the data. Survey research is used to solve large-scale issues with a large population, so considerable sample size is required. Collecting data using a questionnaire is the primary data source [26]. Respondents are requested to offer succinct answers via a questionnaire for survey research, and all responses are analyzed using quantitative analytic procedures [27], [28]. This research measured each variable through a Likert scale comprising five categories from "strongly disagree" to "strongly agree." Table I displays the indicators of the instruments utilized in the research.

TABLE I
Research Instrument

Variables	Construct
Perceived Usefulness	Facilitate the learning process (PU1)
	Improve learning effectiveness (PU2)
	Make more productivity (PU3)
Perceived Ease of Use	Easy to access (PE1)
	Easy to operate (PE2)
	Easy to learn (PE3)
	Flexibility (PE4)
	Straightforward and easy to master (PE5)
Attitude Toward Behavior	Convenience in interacting (AB1)
	Pleased to use (AB2)
	Not boring (AB3)
	Enjoy using (AB4)
Behavior Intention	Has helpful features (BI1)
	Always use (BI2)
	Sustainable media use (BI3)
Actual Use	Frequency and duration of media use (AU1)
	Use of technology/media in practice (AU2)

The structure of the questions in the questionnaire is closed so that the data obtained from respondents is more focused and accurate. The instruments used to measure the variables of this research have been used in previous studies, making it possible to increase the measuring instrument's validity and reliability.

3) Data Analysis: The study employed structural equation modeling, which combines factor analysis, structural model, and path analysis, to analyze the data [29]. This statistical methodology combined factor analysis with simultaneous equation models and investigated direct and indirect impacts [30]. Unlike other multivariate methods, the study utilized a multivariate SEM procedure that combines measurement and structural models [30]. The data were treated using AMOS software.

C. Hypotheses Development

Numerous TAM-based e-learning studies have confirmed the positive effects that PE and PU have on BI while utilizing digital instructional tools (e-learning) [1, 2]. PE and PU directly affect students' BI to utilize e-learning, so the more accessible and valuable the platform, the higher the likelihood that students will intend to use it [3]. Therefore, PE has become a key factor influencing the use of e-learning by educators [4]. The TAM model has five components where PE and PU influence students' AB in e-learning. Additionally, BI is influenced by AB, and BI influences AU.

Two outcome variables (BI and AU) and three independent variables (PU, PE, and AB) exist. Multiple studies have confirmed the existence of a correlation between PU, PE, AB, BI, and AU in the context of Information Systems. Many studies show that PE affects PU and AB, PU affects AB and BI, AB affects BI, and BI affects AU [5–9]. These hypotheses are based on previous research in the field.

H1: PE has a significant effect on PU.
H2: PE has a significant effect on AB.
H3: PU has a significant effect on AB.
H4: PU has a significant effect on BI.
H5: AB has a significant effect on BI.
H6: BI has a significant effect on AU.

III. Result and Discussion

A. Descriptions of Respondents

The study was divided into three categories of respondents' characteristics, namely gender, age, and faculty the respondents. Following is a table with brief descriptions.

TABLE II
DESCRIPTIONS OF RESPONDENTS

Category	N=200	Percent
Gender		
Male	85.00	42.50%
Female	115.00	57.50%
Age		
< 20 years	124.00	62.00%
> 20 years	76.00	38.00%
Faculty Art and Design		
Fine Arts Program	39.00	19.50%
Drama, Dance, and Music Programs	52.00	26.00%
Visual Communication Design Program	74.00	37.00%
Dance Program	35.00	17.50%

Table II shows that women dominate most respondents, 115 respondents (57.50%), and the remaining 85 respondents (42.50%) are men. In the age category of respondents, 124 respondents (62.00%) are under 20 years old, and 76 respondents (38.00%) are over 20 years old. There are 4 study programs at the Faculty of Art and Design at Universitas Negeri Makassar. Respondents in this study were dominated by visual communication design programs with 37 percent (74 respondents), Drama, Dance, and Music Programs with 26 percent (52 respondents), Fine Arts programs with 19.50 percent (39 respondents), and Dance programs with 17.50 percent (35 respondents)

B. The Goodness of Fit (GOF)

Theoretically, the GOF Test seeks to ascertain whether the sample data distribution matches a specified theoretical distribution. Then, a few experts shared their thoughts on the required reportable size of the model fit. Garson [39] recommends reporting one baseline fit (IFI, CFI, TLI, RFI, NFI) and one parsimony fit (PCFI or PNFI). In contrast, Gefen [40] only recommends RMSEA, TLI, CFI, AGFI, GFI, RNI, SRMR, and Chi-square parameters. Schumacher and Lomax [41] only suggested GFI, CFI, and RMSEA. Then Kline [42] recommended CMIN/DF, Probability, SRMR, CFI, Chi-square, and RMSEA for GOF reporting. The results of the GOF tests are presented in Table III below.

TABLE III
GOODNESS OF FIT (GOF) RESULT

Criteria	Value	Cut-Off	Sources
Chi-Square (X^2)	0.994	≥ 0.050	[30], [43], [44]
CMIN/DF	0.698	≤ 2.000	[41], [45], [46]
GFI	0.959	≥ 0.900	[41], [43], [47]
RMSEA	0.000	≤ 0.080	[41], [48]–[52]
TLI	1.166	≥ 0.900	[41], [53], [54]
CFI	1.000	≥ 0.900	[52], [55], [56]
IFI	1.106	≥ 0.900	[57]
PNFI	0.599	≥ 0.500	[58], [59]
PCFI	0.732	≥ 0.500	[58], [59]

The GOF criteria determine whether a model may be approved or rejected by performing a feasibility test with numerous indices and cut-off valuation criteria [60]. Table III shows that the GOF criteria have been met, indicating that the model is stable and ready for further analysis.

C. Loading Factor, C.R, and AVE

Each hidden variable must explain the indicators' discrepancy by at least 50%. Therefore, there must be an absolute correlation greater than 0.70 between latent variables and indicators [61]. If reflective indicators have factor loadings that are less than 0.40, they should be eliminated from the measurement model [23]. As can be observed in Table IV, the measurement model's loading factor value is generally reasonable.

TABLE IV
LOADING FACTOR, C.R, AND AVE

Construct	Loading Factor	C.R	AVE
PU1	0.858	0.766	0.883
PU2	0.719		
PU3	0.721		
PE1	0.734	0.771	0.928
PE2	0.715		
PE3	0.756		
PE4	0.731		
PE5	0.858		
AB1	0.812	0.722	0.863

Construct	Loading Factor	C.R	AVE
AB2	0.759		
AB3	0.838		
AB4	0.711		
BI1	0.738	0.787	0.894
BI2	0.885		
BI3	0.758		
AU1	0.735	0.817	0.910
AU2	0.761		

A small number of constructs (indicators) may be able to effectively explain the link between latent variables if specific values are below the indicated level. The correlation value is indicated by a loading factor value greater than 0.70. Therefore, the reflective construct in the structural model is entirely above the necessary threshold, and the missing latent variables are unnecessary.

Validity and reliability are evaluated to assess the measurement model's quality. One way to measure reliability is to use Cronbach's Alpha, which measures the reliability among all the indicators in the model. An ideal result for Cronbach's Alpha is at least 0.70 and even better at 0.80 or 0.90. Table IV shows that the C.R value resulting from the SEM study of the measuring method was > 0.70, indicating that all models are sufficiently reliable and can be used confidently.

AVE value indicates the extent to which the latent variable accounts for variation in the construct it represents. A value of 0.50 or higher is recommended for good convergent validity [62]. Table IV presents positive results, with an AVE value of 0.84, indicating that the structural model has excellent validity, with the latent explanatory variables accounting for over half of the variance in the average indicators.

TAM is the most suitable model for explaining how users accept technology. TAM suggests that two beliefs, PU and PE, determine a user's BI to use technology. Perceived utility refers to the extent to which a technique will enhance presentation, while PE is the degree to which a user believes using the scheme is accessible [63]. TAM also proposes that external factors such as system features, education procedures, and training affect the intention to use by mediating the effect of PU and PE. Additionally, TAM suggests that usability effects are influenced by perceived. The SEM measurement estimation with the IBM AMOS software is presented in Figure 2.

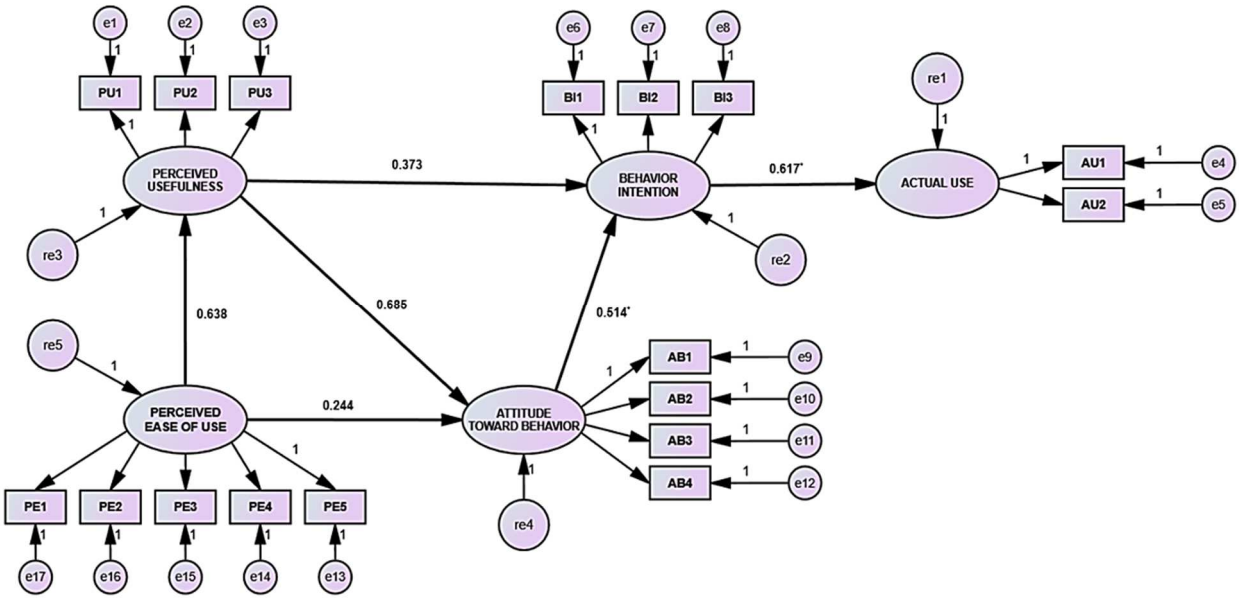

Fig. 3 TAM Model Research Result

Figure 3 show that between the variables PU and AB (β = 0.685, p > 0.05), PU and BI (β = 0.373, p > 0.05), PE and PU (β = 0.638, p > 0.05), PE and AB (β = 0.244, p > 0.05) obtained insignificant results. The test results indicate that technology users do not care much about the value of benefits or usability in improving their performance and productivity through technology. This is due to the difference in systems approach between hedonic and utilitarian systems [64]. Technology users with hedonic systems aim to seek satisfaction so that in using internet technology, the value of benefits and usability in improving work performance and productivity is not too much attention. The research results related to PE show that users still consider direct learning advantages in terms of convenience and ease of learning [65]. The relationship of PU has no positive result on BI and has also been tested and supported by previous studies [66], [67].

In contrast to earlier research investigating the correlation between PE and PU, this one found a positive connection between the two variables. This is the fundamental connection that TAM suggests between the two things. Previous research using TAM meta-analyses, such as King and He, have shown that simplicity positively influences perceived usefulness [68]. The present study also supported this finding. Schepers and Wetzels found that out of 53 studies on the relationship between PE and PU, 51 reported a significant influence [69]. Anuar and Othman suggested that consumers value procedures that are accessible as they are perceived to have a higher value [70]. Gumussoy and Calisir also found that if a

new system is easy to operate and requires little time to master, users' efficiency increases [71]. Therefore, online educational services should be designed to be simple to use. Based on these findings, improving the usability of online educational services could enhance online education outcomes.

This study is supported by previous investigations that found that the required resources to access the internet, such as money, time, and skills, do not affect users' intentions to try or plan to use technology. This is likely the case because the costs incurred, the amount of time required, and the skills required are still relatively low and relatively reasonable [72], [73].

Then between AB and BI ($\beta = 0.514$, $p < 0.01$), as well as Intention and Actual Use ($\beta = 0.617$, $p < 0.01$), obtained significant results. The findings align with those found in the research conducted by Robinson [74], which focused on the acceptability of e-learning among non-traditional student responses. The study's results indicated no notable correlation between PU and AB. However, it was found that there was a significant connection between PE and PU, and PU had a significant relationship with AB. Additionally, a strong relationship was observed between AB and BI. The study also discovered that respondents' convincing belief in using e-learning usages influenced their intention to continue using them. The acceptance of the results showed a significant impact between AB and BI.

The external factor of COVID-19 perceived severity was added in the current study, and it was found to have a good association with the interface of TAM and objective. The pandemic's perceived severity will make seeing how valuable technology is more accessible than usual. Education was continued with the aid of technology, and all parties involved in learning recognized the value of the technology. If educators, parents, and students do not recognize the gravity of the condition, protests may ensue against e-learning. Failure to recognize the severity of the condition may result in students and parents, who had already paid for in-person lessons, rejecting the concept of online learning [75].

The TAM comprises three main components: attitudes toward technology, PU, and PE. It is widely accepted that PU and PE are essential factors that directly or indirectly influence behavioral intention. These variables are listed first because they are more likely to be examined [76]. In several research, an external variable has been coupled with the model to investigate its effect on the participant's goals. The model's efficiency was evaluated by applying it to various settings involving online education using external variables [77]–[79]. To evaluate the approval of e-learning, measuring the factors of the TAM model is essential. The research suggests that PE and PU of e-learning are critical elements in the acceptance of e-learning [80]–[82]. However, a study by Ibrahim et al. found that the perceived effectiveness of e-learning had little influence on the intention to use it, while PE had a significant impact [83].

The use of e-learning in lectures shows that the perceived use and convenience variables strongly affect the attitude variable. PU in learning activities influences learners' AB e-learning. Online education can improve performance in lectures, increase the effectiveness of education, and simultaneously increase productivity. PE of the system and construction of trust determines the use of online education systems. Technology helps students achieve education goals because they think the system will help their learning [84]. Anxiety about the ability to use e-learning affects learning satisfaction and learning behavior [85].

If a system is simple and facilitates learning activities, it will be used to its full potential. This study suggests that attitudes about the usage of e-learning are influenced by perceived ease. When using e-learning, students will use it and participate to their fullest potential. Using online learning to start the learning process, Govindasamy [86] suggests that the teaching strategy is based on the interaction between lecturers and students and the need for constructive and meaningful feedback. Likewise, access levels must be tracked to distinguish between high, average, or slow-achieving students. This condition will be used to motivate students positively. Quality for satisfaction with e-learning is seen from three dimensions: data, method, and facility quality [87].

The feature of the IT provided heavily influences the satisfaction and loyalty of users. On the other hand, the quality of a system is linked to several factors, including consistency in the user interface, accessibility, responsiveness in communicating systems, and quality of documentation. A high-quality system positively impacts users, who tend to develop a favorable attitude toward e-learning content. Therefore, it is crucial for universities offering e-learning to focus on the smooth functioning of their systems [88]. The use of technology in education is strongly affected by various variables surrounding students. No matter how good the system or technology used in learning is, if the variables around the learner are not considered, the implementation will not work well. Utilizing e-learning requires more maturity and self-discipline than conventional programs and must provide students with trust, authorization, and responsibility [89]. User perception of e-learning in improving its performance positively affects attitudes and more outstanding achievement [88]. Positive experiences in using e-learning impact individual outcomes that are felt according to needs and self-efficacy [90]. According to research, men had more excellent ratings of computer self-efficacy, perceived utility, PE, and BI to utilize e-learning [91]. These findings also show that gender considerations should be factored into developing and testing e-learning concepts.

The concept of online learning at this time is independent of technology, but much is directed at the possible breadth of diffusion and connection of content [92], [93]. The use of e-learning impacts the learning condition, including text, images, audio, and animation, which are managed by the instructor or teacher [94], [95]. There are three qualities of e-learning in terms of the informative method, namely (1) prerequisites, availability or capability of technology infrastructure, tutor qualifications, (2) learning process, student interaction, learning format, learning culture, learning content and desired goals, and (3) results, there is an increase in the professional competence of students [96]. Govindasamy proposed seven criteria that determine the quality of e-learning: official support, knowledge development, instruction, education activities, lecture structure, learner, facility, and estimation and valuation [86].

The measurement of all the TAM variables has not been included in the study's extended scope; in particular, the original TAM variable AU has not been measured [97]. The

regularity with which respondents use online learning applications indicates their belief and confidence that these programs may deliver benefits and ease. In the future, it is predicted that more comprehensive TAM studies covering hitherto unstudied variables could yield complex results and deeper insights.

IV. Conclusion

The system's acceptance in the learning process describes a specific habit of users every time they encounter this technology. The research results from confirmation that students desire to use the e-learning method if they behave positively. Only then will they be more accessible and used. Acceptance and adoption of new technologies for actual use are complex, complicated, and essential phenomena. The research has given several implications for phenomena in the world of education related to changes in learning methods from direct learning to using IT.

This study shows that external factors from TAM influence the user's desire to use online learning. In comparison, this study has not shown the user's desire to use the e-learning system more often. Technology users must measure the impact of the technology's complexity on their work performance and relate it to the expected business value of building a technology system. Service quality, in this case, is a learning process that has become a measure of satisfaction in obtaining learning. The user's attitude has an essential effect on the use of IT. Attitudes are formed from the PU and PE of a system to be used. Use and usefulness affect intentions and behavior in using e-learning.

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