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Analysis of Factors Influencing Behavioral Intention to Use Cloud-Based Academic Information System Using Extended Technology Acceptance Model (TAM) and Expectation-Confirmation Model (ECM)

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Abstract

Background: Technology Acceptance Model (TAM) and Expectation-Confirmation Model (ECM) integration model are commonly used to analyze the intention to use technology in education. Moreover, the ease of implementation causes various external factors influencing technology acceptance to continue growing. However, limited research focuses on the use of TAM and ECM in the acceptance of cloud-based academic system.
Objective: This research aims to identify factors influencing user perceptions of cloud-based academic information system and the relationships among different factors.
Methods: The research integrated Extended TAM and ECM, subsequently processing data obtained from 261 respondents using Structural Equation Modeling-Partial Least Squares (SEM-PLS). The perceptions proposed included Facilitating Condition (FC), Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Confirmation (CM), Satisfaction (SF), and Behavioral Intention to Use (BIU).
Results: Based on the data processing carried out, the results were PEOU against BIU (H1, β=0.256, p=0.001), PU against BIU (H2, β=0.200, p=0.007), and SF against BIU (H3, β=0.499, p= 0.000). Furthermore, it also comprised FC against PEOU (H4, β=0.839, p=0.000), PU (H5, β=0.849, p=0.000) and SF (H6, β=0.294, p=0.000), as well as CM against SF (H7, β=0.358, p=0.000) and PU against SF (H8, β=0.325, p=0.000). These results showed that each proposed construct significantly influenced behavioral intentions to use cloud-based academic information system.
Conclusion: The results showed that each factor proposed in the construct significantly influenced user intentions to use cloud-based academic system. Consequently, the most influential drivers in using cloud-based academic system were SF, PU, PEOU, and FC.

Keywords: Acceptance, Behavioral Intention, Cloud-Based Academic System, Expectation

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I. INTRODUCTION

Universities are expected to develop strategies to increase competitive advantage, particularly through the provision of an academic system [1]. This is because academic system is very important for the efficient running of administrative activities, supporting various systematic academic operations, and ensuring proper storage of academic records. Typically, the system is able to increase efficiency in both the educational process and student academic activities, thereby providing a quality and efficient educational experience [2],[3]. Higher education institutions need to maintain and improve the quality of academic system to ensure student satisfaction, which is a key indicator of the successful implementation of academic information system [4]. The continually evolving educational standards [5] require policymakers to maximize the use of technological advancements to increase the capacity of universities and the academic system. Consequently, the application of appropriate technological advancements, such as cloud technology, has proven to be very useful in making teaching and learning more dynamic [6].

The use of cloud technology assists in processing and integrating resources and software in a smart, efficient, and scalable manner [7]. Furthermore, the ability to provide real-time and fast data analysis processes [8] leads to rapid access to academic services [9]. Moreover, cloud technology can be reconfigured to meet the specific needs of

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universities for academic services [10]. Cloud technology consists of different computing services that provide resources accessible through the Internet [8] without requiring a direct connection to the hardware where the application resides [11]. Additionally, cloud technology can increase data security and privacy by distributing and processing data, thereby reducing the risk of data breaches and ensuring data safety [12].

The existence of cloud-based academic information system promises fast academic information processing, good compatibility, and functionality. In addition, the system also provides significant advantages over traditional information system, including fast implementation and scalability to meet unexpected demands [13]. The quality of academic system reflects the level of service provided by an educational institution [14]. Effective use of technology in education enables large-scale services, quick access, feedback for decision-making, and timely reporting [15]. Therefore, it is important for universities to adopt technology that is in line with the increasingly complex needs of the educational landscape. Aside from large-scale services, cloud technology enables profitable academic services for data processing and software, simplifying complex processes [16]. However, the implementation of any information system, including cloud-based academic system can fail when rejected by potential users [17].

The current research uses Technology Acceptance Model (TAM) to examine the factors influencing the use of cloud-based academic system. Typically, TAM is a method introduced by Davis (1985) [18], and it is widely used to analyze the perceived ease and usefulness of technology [19], [20]. Furthermore, TAM is easy to implement [21], making it applicable across various fields, including education [22], e-commerce [23], e-government [24], and banking [25], [26]. The model focuses on two main factors, namely perceived usefulness (PU) and perceived ease of use (PEOU). Specifically, PU measures the extent to which users believe technology improves their performance. Meanwhile, PEOU assesses the extent to which users find the technology easy to use [27]. These perceptions predict the intentions of users to adopt and accept technology [28].

TAM alone is insufficient for encouraging sustained use of technology, because it primarily addresses ease and usefulness, not long-term adoption [29]. Therefore, TAM needs to be integrated with a popular method, namely Expectation-Confirmation Model (ECM) [30], which was developed by Bhattacherjee (2001). ECM modifies Expectation-Confirmation Theory (ECT) introduced by Oliver (1980) [31]. Furthermore, ECM evaluates factors influencing the ongoing use of technology, such as user expectations, post-use expectations, perceived benefits, satisfaction levels, and continued usage [32], [33]. Confirmation of performance and benefits is closely related to user satisfaction, which is responsible for the continuing use of technology [32]. Similar to TAM, ECM has also been implemented in various fields, including e-commerce [34], social media [35], transportation [36], healthcare [37], and others.

Previous research has discussed the implementation of TAM and ECM to examine the factors influencing the use of technology in different subjects. For example, research conducted by [38] investigated the implementation of online courses among students at Chinese universities after COVID-19. The research focused on perceptions of expectations, attitudes, perceived impact, and satisfaction with online learning, with an 81.9% response rate. According to the results, online learning positively affected convenience, which eventually had a positive effect on satisfaction. However, usefulness had a negative impact on practical courses and a positive effect on theoretical courses. Additionally, satisfaction positively impacted the continued use of online learning. Another research [39] examined the factors influencing user intentions regarding learning management systems in Nigeria. Considering 500 respondents, the results showed that the integrated learning system enhanced interaction between teachers and students, facilitating knowledge exchange and sharing of learning information. Further research [40] on e-wallet usage showed that confirmation, perception, convenience, compatibility, and trialability positively affected satisfaction, perception, and habitual use. Moreover, research [41] on student factors using e-learning system found that behavioral intention, usefulness, and convenience positively influenced e-learning adoption. In addition, research [42] on integrating TAM and ECM identified the determinants of students' intention to use educational management systems, with 500 respondents. However, the confirmation aspect (ECM) did not significantly affect the comprehensive integrated model.

Research on technology acceptance using TAM and ECM models in cloud-based academic system is quite limited. To address the limitation, the current research aims to identify the factors influencing the use of cloud-based academic system, which is crucial when implementing new technology [43]. Compatibility between the applied technology and user experience is essential for the sustainable use of technology [28]. The research is supported by the integration of TAM and ECM to explore and investigate the factors affecting the use of cloud-based academic system in depth. The integration of these two methods will assist in overcoming limitations in explaining the formation of information system acceptance expectations [35]. Similarly, adapting TAM and ECT to the characteristics and needs of cloud-based academic system can provide valuable knowledge and recommendations for the platform’s continued development and improvement. In addition, the research can identify specific factors that play an important role in the successful use of cloud-based academic system. This implies that integrating ECM and TAM into a comprehensive framework is an efficient method of explaining users' intentions to continue using certain information system and service [32].

II. Literature Review

A. Hypothesis Development and Proposed Framework

The difference between this research and the previous is the integration of TAM model framework with ECM. Specifically, this current research expands the theoretical model using six variables, which include Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Satisfaction (SF), Confirmation (CM), Behavioral Intent to Use (BIU), and Facilitating Condition (FC). The actual use of cloud-based academic system is the extent to which a student will use the academic system in the future [44], [45]. Typically, this model proposes that PU and PEOU determine the intention to use cloud-based academic system. Furthermore, the model assumes that behavioral intention influences the actual use of cloud-based academic system. SF and CM are proposed to influence SF and confirm or refute expectations. Meanwhile, FC examines the influence of facilities on the intention to use cloud academic systems[22]. This proposed model shows the combined effects of PU, PEOU, SF, CM, and FC on the intention to use cloud-based academic system, providing valuable insights for designers, developers, and educators [46], [47].

1) Perceived Ease of Use (PEOU)

Ease of use refers to the extent to which technology is considered easy to understand, learn, or use [48]. When users perceive convenience, they feel confident that the technology will improve performance [18]. Ease of use significantly influences the continued use of technology [18]. Furthermore, research has also found a significant influence on the actualization of cloud technology with ease in higher education [49]. Additionally, the intention to use cloud technology is higher when users perceive it as convenient [50]. Based on these results, the following hypothesis is proposed:

H1: PEOU has a significant influence on BIU

2) Perceived Usefulness (PU) and Satisfaction (SF)

PU is defined as a person's belief in the way technology can improve their performance [18] and also motivates users to consider technology as a facilitator while working [51]. Several research across different subjects have shown that PU significantly affects the acceptance of new technology [18]. Similar results were reported by [52], showing a significant influence of PU on application usage intentions. Additionally, it significantly affects user satisfaction, [53], which is an assessment of whether a service meets user expectations based on their experience [54],[55],[30]. Previous research found that perceived usefulness had a positive influence on user satisfaction [55],[56],[57]. Based on these results, the following hypothesis is proposed:

H2: PU has a significant influence on BIU
H3: PU has a significant influence on SF

3) Confirmation (CM) and Satisfaction (SF)

Confirmation is considered the extent to which users feel their initial expectations are met based on experiences during use [58]. When building a relationship to retain users, SF needs to be considered [30] because it promotes continued intention to use technology. This user experience often arises from confirmation of high expectations [30], hence, confirmation could be considered to have a significant effect on SF [58]. In other words, when user expectations are met or exceeded, such experience leads to SF, which eventually creates the intention to continue using the technology [59], [60]. Based on these results, the following hypothesis is proposed:

H4: CM has a significant influence on SF
H5: SF has a significant influence on BIU

4) Facilitating Condition (FC), Perceived Ease of Use (PEOU), Perceived Usefulness (PU) and Satisfaction (SF)

FC is an important factor in understanding user intentions [61][62]. In the context of cloud-based academic services, FC refers to the availability of IT, adequate infrastructure, and technical services or training. Additionally, it has a significant effect on perceived usefulness, because when the facilities provided are comprehensive, users tend to further perceive the benefits of the technology [63]. These facilitating conditions promote new technologies and minimize problems during usage. Various research has shown the significant influence of FC on PEOU, PU [63], [64], and SF [65], [66] across various subjects. Based on this result, the following hypothesis is developed:

H6: FC has a significant influence on PEOU
H7: FC has a significant influence on PU

H8: FC has a significant influence on SF

This model was proposed to explore the use of academic system based on the proposed hypothesis, hence, the following framework was designed in Fig.1.

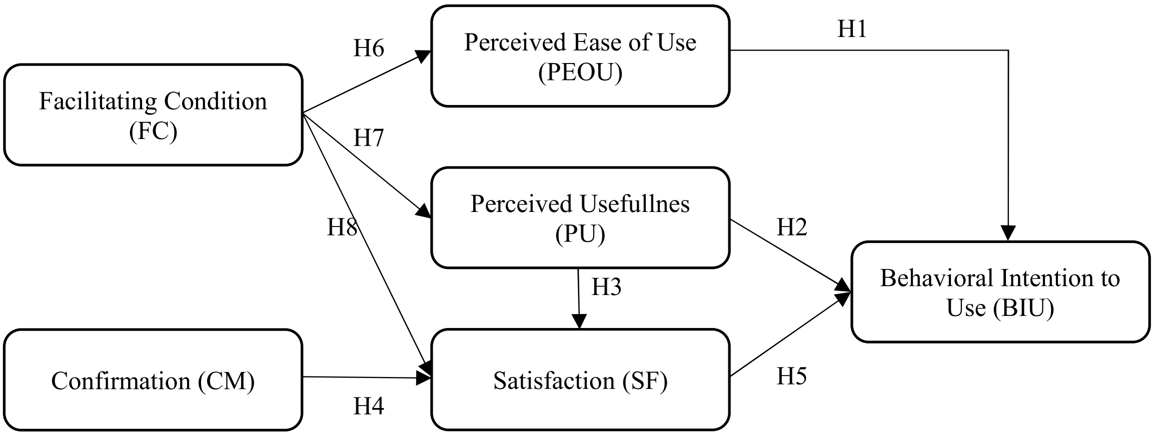

Fig. 1 Theoretical framework of integrated Technology Acceptance Model (TAM) and Expectation-Confirmation Model (ECM) models

III. Methods

A. Measurement Instrument

Developed and validated measurement scales for behavioral intentions to use a cloud-based academic system were considered in this research. Table 1 shows the measurement scales for BIU, consisting of 2 items, namely PEOU and PU each comprising 5 items adopted from [18]. SF and CM, comprising 3 and 4 items, respectively, were adopted from [30], [33], while FC, consisting of 3 items, were adopted from [67].

TABLE 1
Construction Measurements, Items, and References

Construct	Items	Items
Perceived usefulness (PU)	PU1	Using the Cloud-based Academic System helps my lecture process.
	PU2	The Cloud-based Academic System allows me to complete Course Selection Sheets faster.
	PU3	Using the Cloud-based Academic System increases my effectiveness in lectures.
	PU4	Using the Cloud-based Academic System improves the quality of the lectures I do.
	PU5	Using the Cloud-based Academic System will make it easier for me to lecture.
Perceived ease of use (PEOU)	PEOU1	I easily use Cloud-based Academic System.
	PEOU2	I rarely make mistakes when using Cloud-based Academic System.
	PEOU3	I rarely need help when using Cloud-based Academic System.
	PEOU4	I don't find it difficult to use the Cloud-based Academic System.
	PEOU5	Overall, I found the Cloud-based Academic System easy to use.
Behavioral Intention to Use (BIU)	ITU1	Whenever possible, I intend to use a Cloud-based Academic System in my lectures.
	ITU2	As far as possible, I intend to use a Cloud-based Academic System to conduct lectures.
Satisfaction(SF)	SF1	I am very satisfied with the performance of the Cloud-based academic system.
	SF2	I am satisfied with the experience of using a fast, cloud-based academic system in my lectures.
	SF3	Overall, I am satisfied with the fast Cloud-based academic system that I use.
Confirmation(CM)	CM1	My experience with the fast Cloud-based academic System was better than I expected.
	CM2	Academic activities with a Cloud-based academic system turned out to be more efficient and effective than I expected.
	CM3	Overall, most of my expectations for using a Cloud-based academic System have been confirmed.
	CM4	A cloud-based academic system can meet requests beyond what I need during lectures.
Facilitating Condition (FC)	FC1	I have the necessary resources to use a Cloud-based academic System.
	FC2	I have the necessary knowledge to use a Cloud-based academic System.
	FC3	I feel comfortable using a cloud-based academic system.

B. Data Collection

This research adopted a qualitative method using a questionnaire developed from several references and adjusted to specific needs. Typically, the process was carried out by distributing questionnaires online to respondents who had used cloud-based academic information system. All respondents have given their permission to participate in this research after being informed of all relevant aspects. Data collection was carried out from 23 August 2023 to 2 September 2023. Among 262 respondents, 1 response was deleted due to incompleteness, leaving 261 valid responses. This number met the minimum requirement based on questionnaire indicators [68]. Specifically, the questionnaire used a 5-point Linkert scale, where 1 indicated strongly disagree and 5 represented strongly agree. Additionally, the survey questionnaire also included demographic variables such as gender, age, semester, and faculty as shown in Table 2.

TABLE 2
RESPONDENT DEMOGRAPHICS

Descriptions	Frequency
Gender	
Male	60
Female	201
Age	
17	1
18	20
19	88
20	64
21	45
22	30
23	13
Semester	
1	10
3	126
5	48
7	65
9	12
Faculty	
Faculty of Teacher Training and Education	86
Faculty of Usul al-Din	23
Faculty of Da'wa and Communication	31
Faculty of Sharia and Law	18
Faculty of Islamic and Business	31
Faculty of Adab and Humanity	3
Faculty of Science and Technology	69

IV. RESULTS

The data collected were analyzed using Structural Equation Modeling (SEM), which was designed with SmartPLS application. Furthermore, the analysis was used to calculate variable loading factors, validity, reliability, discriminant validity, and path coefficients. Specifically, validity was determined by using Average Variance Extracted (AVE), while reliability was calculated using Composite Reliability (CR) and Cronbach's Alpha (CA).

Loading Factor value obtained from the analysis of the use of cloud-based academic system was greater than 0.7, denoting acceptable reliability [69]. The value showed that more than 50% of the variance in the indicators could be explained by the latent variables. Table 3 showed loading factors from the analysis results, with values ranging from 0.851 to 0.963, all of which were significant, confirming the reliability of the measurement [69].

Discriminant validity was examined by comparing the square root of AVE for each construct with the correlation between constructs. For discriminant validity to be established, the square root of AVE for a given construct had to be higher than the correlation between that construct and any other constructs. As shown in Table 4, the square root of AVE for each construct exceeded the correlation between constructs, confirming the instrument discriminant validity [47], [70].

Convergent validity was assessed using AVE, which represented variable convergence [71]. It should be acknowledged that AVE value for each variable exceeded 0.5 [71], representing good convergent validity. Additionally, a good construct reliability scale, measured by CA and CR, needed a minimum of 0.7 [71]. AVE, CA, and CR values for all variables were shown in Table 5, while the results of SmartPLS analysis were shown in Fig 3.

Fig. 3 and Table 6 showed the summary of the model from this research. It was observed that intention to continue using the cloud-based academic system was significantly influenced by all the proposed constructs. For example, the intention to use cloud-based academic system was significantly influenced by PEOU (H1, β=0.256, p=0.001), PU (H2, β=0.200, p=0.007), and SF (H3, β=0.499, p=0.000). In addition, facilitating conditions had a significant effect on ease of use (H4, β=0.839, p=0.000), PEOU (H5, β=0.849, p=0.000), and SF (H6, β=0.294, p=0.000). Similarly, confirmation significantly affected SF (H7, β=0.358, p=0.000), and PU significantly affected SF (H8, β=0.325, p=0.000).

TABLE 3
LOADING FACTOR VARIABEL

	BIU	CM	FC	PEOU	PU	SF
BIU1	0.962					
BIU2	0.963					
CM1		0.928				
CM2		0.930				
CM3		0.925				
CM4		0.901				
FC1			0.935			
FC2			0.925			
FC3			0.928			
PEOU1				0.879		
PEOU2				0.851		
PEOU3				0.869		
PEOU4				0.934		
PEOU5				0.894		
PU1					0.893	
PU2					0.868	
PU3					0.936	
PU4					0.940	
PU5					0.935	
SF1						0.942
SF2						0.974
SF3						0.951

TABLE 4
DISCRIMINANT VALIDITY

	BIU	CM	FC	PEOU	PU	SF
BIU	0.963					
CM	0.874	0.921				
FC	0.884	0.878	0.929			
PEOU	0.849	0.834	0.839	0.886		
PU	0.855	0.863	0.849	0.837	0.915	
SF	0.894	0.897	0.885	0.853	0.884	0.956

TABLE 5
VALIDITY AND RELIABILITY

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
BIU	0.921	0.921	0.962	0.927
CM	0.940	0.941	0.957	0.849
FC	0.921	0.924	0.950	0.864
PEOU	0.931	0.933	0.948	0.785
PU	0.951	0.953	0.963	0.837
SF	0.952	0.953	0.969	0.913

V. DISCUSSION

The result of this research was different from the ones conducted previously, as few discussed the use of cloud-based academic system by combining TAM and ECM theoretical frameworks. Typically, the framework used a quantitative design, targeting users of cloud-based academic system.

The convenience felt by users of cloud-based academic system was a key factor in the continuous usage of the system. In this research, PEOU had a significant effect on BIU, implying that users would continue to use cloud-based academic system because they find the technology easy to use. The perceived convenience included features that were easy to understand, accessible anywhere and anytime, and easy to learn. This result was consistent with previous research [47], [72], [73] on different subjects. However, different results were obtained by research [74], stating that PEOU had no significant effect on BIU.

This research further proved a significant relationship between PU and BIU. Specifically, the results showed that the usefulness of cloud-based academic system, as perceived by users, significantly influenced intention to continue using the technology. The use of cloud-based academic system in lecture activities reflected user assessment that the system could improve lecture performance and efficiency [18]. Therefore, users would continue to use cloud-based academic system due to the usefulness. The use of cloud-based academic system was particularly evident during activities such as KRS, viewing lecture schedules, accessing lecturer lists, applying for leave, submitting proposals and theses, and utilizing e-learning services on one platform. This result was consistent with those conducted by [61], [65], [75], [76], indicating that PU of technology significantly affected the intention to continue using the technology.

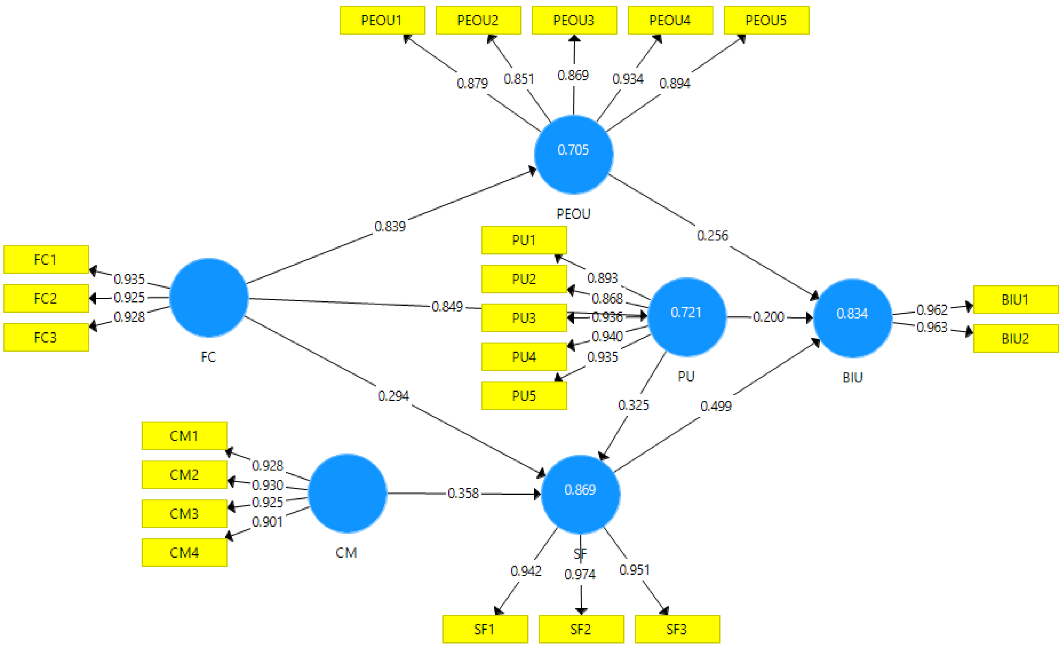

Fig. 2 Results of construct analysis with Partial Least Squares (PLS)

TABLE 6
THE SIGNIFICANCE OF THE RELATIONSHIPS IN THE MODEL

Hypothesis	Relationships	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values*	Status
H1	Perceive Ease of Use ->Behavioral Intention to Use	0.256	0.258	0.074	3.438	0.001	Significant
H2	Perceive Usefullnes -> Behavioral Intention to Use	0.2	0.197	0.073	2.722	0.007	Significant
H3	Satisfaction -> Behavioral Intention to Use	0.499	0.5	0.089	5.575	0.000	Significant
H4	Facilitating Condition -> Perceive Ease of Use	0.839	0.838	0.025	33.369	0.000	Significant
H5	Facilitating Condition -> Perceive Usefullnes	0.849	0.847	0.024	35.833	0.000	Significant
H6	Facilitating Condition -> Satisfaction	0.294	0.293	0.066	4.436	0.000	Significant
H7	Confirmation -> Satisfaction	0.358	0.36	0.075	4.751	0.000	Significant
H8	Perceive Usefullnes -> Satisfaction	0.325	0.325	0.063	5.203	0.000	Significant

*alpha=0.05

The results showed a significant relationship between PU and SF. Generally, cloud-based academic system that proved very useful in lectures increased user SF. PU reflected profitability in lectures and improved performance [51]. Furthermore, PU of cloud-based academic system impacted SF, which eventually influenced the intention to continue using the technology. When implementing cloud-based academic system services, perceived benefits were identified as the most important factor influencing the intention to use the service. This implied that users would have the intention to use cloud-based academic system services after perceiving the benefits, expecting the system to drastically improve productivity and lecture quality. In addition, PU was highly relevant to user SF, implying that the usability of cloud-based services would be a major concern in the adoption of the system. These results were in line with previous research regarding the significant relationship between PU and SF [77], [78], despite different research subjects. Aside from expectations, research [79] found that the relationship between PU and FC was not significant.

According to this research, confirmation had a significant influence on SF. The academic cloud system met users' expectation, as confirmed by comparing their initial expectations before using the system [80]. Previously, the system had many shortcomings, including limited accessibility outside the confinement of universities, slow access, and an unattractive interface. By comparing with the previous system, users were satisfied with cloud-based academic system. Additionally, confirmation of expectations was an individual's assessment of the benefits provided by technology [81]. When the confirmation provided by users of cloud-based academic system was more, SF tended to increase. Confirmation of expectations regarding cloud-based academic system services determined their SF with these services. Furthermore, support for ICT facilities [82] increased user SF by ensuring smooth access to cloud-based academic system. Despite different research subjects, this result was in line with previous ones, which also found a significant relationship between CM and SF [35], [65], [77], [79], [83].

SF had a significant effect on BIU and also impacted continued usage by enhancing user experience through aspects such as a user-friendly interface, accessibility, application speed, helpdesk support, and internet facilities. This implied that when users remained satisfied, they tended to continue using the system. Therefore, SF could be explained as one aspect that determined the continued use of system [54]. Previous research with different subjects also reported significant results regarding the relationship between SF and BIU [36], [37], [79], [84]. This result further proved that SF motivated future system use.

The presence of adequate facilities significantly influenced PEOU of cloud-based academic system. Typically, there was a significant correlation between FC and PEOU, implying that providing the necessary facilities, such as fast internet service, complaint resolution, comprehensive usage guide with instructional videos, enhanced the ease of using cloud-based academic system. The facilities made the cloud-based academic system accessible even for new users. This result was consistent with previous research, on the relationship between FC and PEOU [85], [86], [87]. In addition, facilitating conditions had the greatest direct influence on PEOU, implying that with adequate support, users found it easier to implement and use cloud-based academic system.

This research discovered that users tended to perceive the system as useful when there was adequate facility support. A significant relationship was identified between FC and PU, hence, the usefulness of cloud-based academic system depended on users feeling supported in their academic activities. In this scenario, users had a positive experience with the system when they received the necessary knowledge, technical support, and ease of access. This result is consistent with previous, which found a significant relationship between FC and PU [63], [88].

FC for the use of cloud-based academic system had a significant effect on SF. Typically, SF reflected user evaluation of their experiences [32] with the system. Furthermore, FC contributed to user SF with the system, while those who were more satisfied tended to have a stronger intention to continue using the system. This result was consistent with previous research that discussed the relationship between FC and SF [65]. The research showed that users experienced SF when supported by adequate facilities to use the application. Access to infrastructure and services helped in creating a conducive environment for users to access cloud-based academic system services.

VI. CONCLUSIONS

In conclusion, each of the constructs significantly influenced the intention to use cloud-based academic system. Specifically, the proposed constructs included PU, PEOU, SF, CM, BIU, and FC. By integrating TAM framework with ECM to examine user factors in adopting cloud-based academic system, this research aimed to comprehensively understand the factors influencing acceptance and use. In addition, there were limitations in previous research that integrated TAM and ECM with modified constructs. These limitations were addressed by extending TAM with ECM and facility availability to predict the actual use of cloud-based academic system and to show the level of acceptance. The results contributed to universities and developers by explaining factors influencing intentions to use the system, thereby promoting improved services. Additionally, scientific insights were provided for the development of information system implementation. Limitations recognized included the assessment of the cloud-based academic system limited to students only. In the future, the scope could be expanded to include lecturers or staff. Even though the model proposed and tested focused on the intention to continue using cloud-based academic system, it could be applied more broadly in future exploration to examine post-adoption user behavior. Furthermore, data were collected through a questionnaire, potentially limiting the validity of respondents' opinions and introducing errors in data analysis, which needed to be addressed.

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