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AI Adoption in Higher Education Institution: An Integrated TAM and TOE Model

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Abstract: Artificial Intelligence (AI) impacts various daily activities and features, including higher education. Educators and academics now see AI in education to be essential. The benefits of higher education and how universities adjust to shifting student and faculty attitudes on learning are topics of growing discussion. This study aims to explore how policymakers and educators may apply AI and modify it for the learning domain. The integrated technology acceptance model (TAM)-TOE model was implemented in a conceptual model that was released. It was tested with survey data obtained from 200 respondents who participated in an online survey, and a structural equation model (SEM-PLS) was utilized to assess the suggested hypotheses. The results show that organizational readiness, organizational compatibility, and partner support on 1perceived ease of use had been correlated with any significant relationship evaluated in the setting of higher education. It is anticipated that the approach will help authorities facilitate the use of AI in higher education. Furthermore, as AI is still in its infancy, more academic study is required before it can be used to the sector of education.

Keyword: Artificial Intelligence (AI), Technology Acceptance Model (TAM), technology organization environment (TOE)

INTRODUCTION

Artificial intelligence (AI) is a popular issue for discussion in various forums, including in the context of international relations. According to the Organization for Economic Co-operation and Development (OECD), AI is a machine-based system that produces outputs like content, predictions, decisions, and recommendations, or either explicitly or implicitly, through the inputs it receives, and has the potential to influence physical or virtual environments. Manongga et al. (2022) explain that AI is a system that is able to develop and

innovate in various fields of study in the form of machines or computers with intelligence that is equal to or even exceeds humans in adaptation, cognition, and learning. With sophisticated algorithms, AI can learn patterns, make predictions, recognize images, and interact with humans. This is what makes AI have tremendous good potential. The role of AI is increasingly important and its scope is expanding in various development sectors, including public services, health, education, and others.

According to a study published by the Brookings Institution, global investment in AI has reached USD 60 billion in 2020, and is predicted to more than double by 2025.In the period between September 2022 and August 2023, the internet world was invaded by a wave of AI visits that reached more than 24 billion. This marks a significant trend in the adoption of AI technologies by the global community (Teniwut, 2024). These numbers are only reported from the top artificial intelligence applications. The United States is the largest user of artificial intelligence applications in the world. Uncle Sam's country generated 5.5 billion visits to AI apps from September 2022 to August 2023. This is equivalent to 22.62% of total traffic/visits. India took second place with 2.1 billion visits to artificial intelligence apps. This was followed by Indonesia, which generated 1.4 billion visits to AI apps, accounting for 5.6% of total traffic.

Furthermore, numerous countries have created AI with a wide range of uses and capabilities. For instance, Venezuela has introduced the "carnet de patria," a cutting-edge smart card identification system. (Unver, 2024). The use of an integrated electronic medical record (EMR) is another instance of AI advancement occurring in the United States. This system lowers healthcare expenses and the time and effort needed to handle patient information by making it simple for medical professionals and health departments to access and update patient records (Kumari & Chander, 2024).. However, not all AI can be practiced completely, such as in China, which implements a hybrid between AI and contemporary technology tailored to the needs of the government or the public sector (Long & Gil-Garcia, 2023).

In Indonesia, based on findings from a Populix survey, over 45% of companies and employees have used artificial intelligence (AI) apps. According to the survey's findings, 52% of Indonesians stated ChatGPT was the most popular AI app in April 2023. Only 11% of respondents stated they used Outmatch to help their job, while 12% stated they utilized Dalle and Lalal.ai. 29% of respondents implement Copy.ai. Oracle and Luminar AI, which are utilized by 18% and 15% of respondents, respectively, come in second and third place. According to the poll, the majority of participants use AI applications up to 40 times each month. Additionally, some responders utilize the service once per two months and once a month (11%).

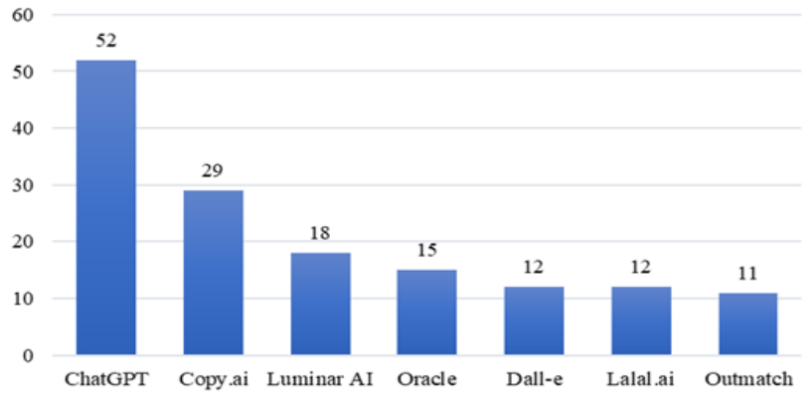

Figure 1. The most popular AI apps in Indonesia as of April 2023.

As stated before, AI phenomena have started to appear in many spheres of life, including education; they are no longer just found in industries that employ robotics or robots. Figure 2 below illustrates the usage of AI.

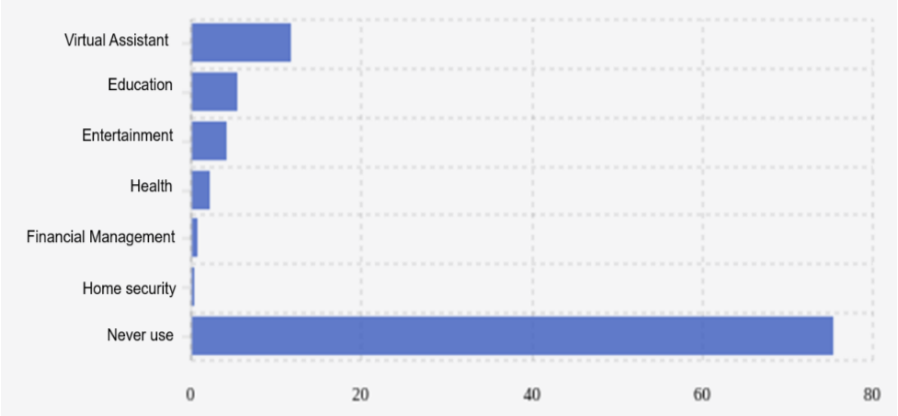

Figure 2. The usage of AI

Based on figure 2 above, it is known that most do not use or adopt AI in their activities. This shows that there is a fairly high gap phenomenon that can occur due to certain factors in their behavior to use or acceptance of AI. Regarding the behavior of using or acceptance technology, especially AI, researchers found that many studies have been conducted based on several theories, including the Technology Acceptance Model (TAM) developed by Davis, (1985, 1989), Technology Organization Environment (TOE) frameworks (Tornatzky & Fleisher, 1990), the Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh et al., 2003). This research tries to find the adoption of the TAM and TOE. There are many reasons for considering integrated TAM-TOE model. Maartje et al., (2018), the strongly correlated variables in These models provide explained variance that is abnormally high. The TOE framework fully explains the elements influencing adoption decisions. This paradigm may explain any contemporary technology in terms of its technical, organizational, and technological aspects, as well as its socio-environmental context (Hossain & Quaddus, 2011).

By doing so, this study aims to contribute to the existing body of knowledge by addressing the identified research gaps. It seeks to provide a more comprehensive understanding of the factors influencing the adoption of AI in higher education, particularly in regions that have been underrepresented in the current research landscape. This could potentially inform policy and practice, facilitating AI integration in higher education that is more successful in Indonesia and similar contexts.

METHOD

This study was done to identify and define problems, as well as to better understand and investigate the acceptance and implementation of AI in higher education. Figure 3 illustrates our research flow. It begins with defining the study subject, followed by a literature analysis on AI's use in education to determine existing understanding and gaps. Using the integrated TAM-TOE model as the theoretical framework, the study develops hypotheses to investigate variables that influence AI adoption.

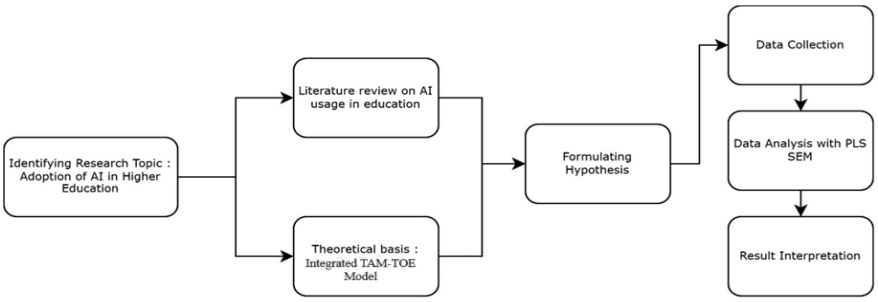

Figure 3. Research process flow.

Respondents were teachers and students from private universities in west Java, Indonesia. We approached 200 individuals to complete the questionnaire. Data was collected over a one-month period using a convenience sample approach. Data collection and analysis are then carried out using Partial Least Squares Structural Equation Modeling (PLS-SEM). Partial least squares (PLS) regression analysis was used to evaluate the conceptual model and assumptions. Finally, the findings are analyzed to give perspectives and consequences regarding AI adoption in higher education.

RESULTS AND DISCUSSION

Assessment of Measurement Model

The measuring model has been developed to investigate the constructs and indicators' convergent validity, discriminant validity, and reliability of internal consistency (Hair et al., 2022). Item loading, each scale's composite reliability, and each concept's abstracted average variance are used to assess convergent validity. Hair et al. (2022) state that average (AVE) values should be more than 0.5 and standardized loading values should be greater than 0.70. The findings indicate that the composite, items, and reliability all above the recommended threshold of 0.70. Furthermore, the AVEs came quite close. The square roots of each construct's AVE, which ought to be 0.5, are shown by the bolded diagonal values.. Table 1 illustrates that the measures utilized had convergent validity.

Table 1. Estimation of CR, AVE and Cronbach's Alpha.

Variables	Composite Reliability	AVE	Cronbach's Alpha
Organizational competency (OCM)	0.913	0.720	0.894
Organizational complexity (OCX)	0.912	0.789	0.896
Organizational readiness (ORE)	0.916	0.792	0.887
Organizational compatibility (OCO)	0.913	0.789	0.888
Competitive advantage (COA)	0.911	0.786	0.891
Partners Support (PSU)	0.914	0.723	0.880
Perceived usefulness (PU)	0.917	0.635	0.889
perceived ease of use (PEOU)	0.912	0.724	0.891
Intention to adopt (IAA)	0.913	0.723	0.897

For the purpose of determining discriminant validity, pairwise correlations between items are found. This approach of comparing correlation to extracted variance was first out by Fornell and Larcker in 1981. In addition to the criteria of Fornell and Larcker, a test of HTMT (heterotrait-monotrait) correlational ratio was employed (Henseler et al., 2014). According to the findings, every construct value is below 0.85 (Voorhees et al., 2016). Every concept has discriminant validity, as Table 2 shows.

Table 2. Fornell Larcker criterion

Construct	OCM	OCX	ORE	OCO	COA	PSU	PU	PEOU	IAA
OCM									
OCX	0.34								
ORE	0.46	0.51							
OCO	0.32	0.44	0.46						
COA	0.19	0.33	0.33	0.44					
PSU	0.27	0.26	0.27	0.36	0.28				
PU	0.24	0.19	0.24	0.37	0.37	0.43			
PEOU	0.46	0.17	0.20	0.39	0.46	0.19	0.27		
IAA	0.27	0.32	0.39	0.17	0.29	0.31	0.25	0.34	

Analysis of Structural model and hypothesis testing

To determine coefficients of the inner model's path, 200 subsamples were used in a Smart PLS bootstrap (Figure 4).

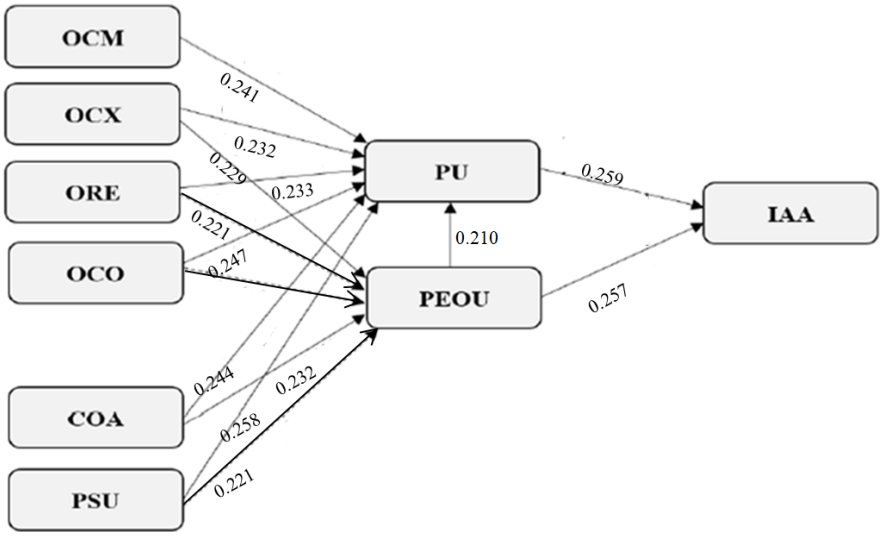

Figure 4. Structural model with path coefficient

The strength of the proposed connections between the research items was shown by the findings of structural model evaluation (Table 3). This coefficient indicates the degree to which the independent variable or factors may explain the dependent variable.

Table 3. *t*-Statistics of path coefficient.

Path	Coef.	p-value	Remark
Organizational competency -> Perceived usefulness	0.241	0.002	supported
Organizational complexity -> Perceived usefulness	0.232	0.001	supported
Organizational readiness -> Perceived usefulness	0.233	0.030	supported
Organizational compatibility -> Perceived usefulness	0.247	0.040	supported
Competitive advantage -> Perceived usefulness	0.244	0.035	supported
Partners Support -> Perceived usefulness	0.258	0.045	supported
Organizational complexity -> perceived ease of use	0.242	0.032	supported
Organizational readiness -> perceived ease of use	0.229	0.015	supported
Organizational compatibility -> perceived ease of use	0.221	0.000	supported
Competitive advantage -> perceived ease of use	0.242	0.002	supported
Partners Support -> perceived ease of use	0.232	0.001	supported
perceived ease of use -> Perceived usefulness	0.210	0.000	supported
Perceived usefulness -> Intention to adopt	0.259	0.046	supported
perceived ease of use -> Intention to adopt	0.257	0.042	supported

According to the results, perceived usefulness is significantly affected by organizational competency, hence confirming Hypothesis H1. This shows that the organization's workers have the talents, skills, and information necessary to function effectively, which will benefit the company. Prior studies have also supported the idea that an organization's competence helps its workers focus on information relevant to their jobs and enhances their efficiency of performance (Long et al., 2013; Lee et al., 2017). Because organizational complexity significantly affects perceived usefulness and perceived ease of use, the results support hypotheses H2a and H2b. Perceived usefulness is significantly affected by organizational readiness, confirming Hypothesis H3a. This supports the findings of previous research (Ransbotham et al., 2017), which note that there won't be any barriers to implementing an innovative technology provided the right technical and financial resources and skilled personnel are available. On the other hand, it has also been proposed that perceived ease of use is greatly influenced by organizational preparedness (H3b). This is corroborated by previous research (Aboelmaged, 2014), most likely because that study was carried out in a Western country whose cultural disposition differs entirely or in part from India's, whose answers were utilized to test the hypothesis (H3b) in this study. Perceived usefulness is significantly affected by organizational compatibility, as evidenced by the validity of the corresponding hypothesis (H4a), which is consistent with previous research (Peng et al., 2012). Users will want to utilize the new technology if it is determined to be compatible with the current technologies and practices, according to the study by Peng et al. (2012). As demonstrated by the support for Hypothesis H4b, perceived ease of use is significantly impacted by organizational compatibility. This outcome validated previous research (Geczy et al., 2012).

Perceived utility and perceived ease of use are significantly impacted by competitive advantage, which supports Hypotheses H5a and H5b. This conclusion is supported by previous research (Curran & Purcel, 2017), which shows that implementing AI technology and its techniques would give an organization a competitive advantage over those that do not use them financially. Additionally, it would increase employees' capacity to embrace any new technology. Thus, partner support has supported Hypothesis H6b because the validation supports the findings of other research by indicating that partner support significantly affects PEOU (H6b) (Koka & Prescott, 2002). This is most likely due to the fact that, even though employees are sufficiently knowledgeable about the technology, other external factors may make it difficult for organizations to adopt new systems, even though they can receive financial assistance and knowledge sharing through partner support. The study found that perceived ease of use influences perceived usefulness (H7), perceived usefulness influences intention to use AI (H8), and perceived usefulness influences intention to adopt AI (H9).

Limitation and Future Research

There is potential for improvement as this study is still in its early stages. Indonesian institutions' usage of AI is limited by tools that have not yet been utilized to their full potential. A potential area of research is the further investigation of different AI approaches. Additionally, enlisting participation from people other than teachers and students might increase the likelihood of receiving more replies. There is still discussion over the ethical ramifications of Indonesian educational institutions' high AI adoption rate. As a result, all syntheses are predictive. Furthermore, because the participants are located in an educational setting, the four moderator models proposed by Venkatesh et al. (2003) were not included in this study. This has a direct bearing on the study's context. Future research might look at using the four moderator models to predict how well the combined TAM-TOE model works.

Implication

The theoretical background section explains the rationale for the use of the TOE-TAM-based integrated model. This study aims to elucidate the aspects that may impact the desire to embrace artificial intelligence. This research essentially examines how AI is being adopted in businesses. An improved standard adoption model may have been employed in this investigation. The study has dared to choose more appropriate antecedents from integrated models of TOE-TAM-framework, nonetheless. Drawing inspiration from Davis (1989), two mediating factors that influence the desire to embrace AI are perceived usefulness and perceived ease of use. In order to implement AI technology, this study has been able to combine a number of social, technological, environmental, and elements. It has also developed a novel approach to presenting the integrated model of TOE-TAM by utilizing perceived utility and simplicity of use.

The study's conclusions may also be utilized to assess managerial implications for how AI technology adoption intentions will evolve in organizations going forward, particularly in higher education. Two significant endogenous factors impacting higher education's propensity to adopt AI are perceived utility and usability (Davis, 1989). When describing the advantages of AI technology in organizations to all parties involved, lecturers and students must be honest. Designers and developers of AI technology need to pay close attention to make sure the technology isn't too complex. The management of the private universities must be aware of the significance of this deployment of AI technology so that its acceptability by all stakeholders is not limited.

CONCLUSION

The purpose of this study was to show the technological and socio-environmental factors that motivate businesses to use AI. The study effectively employed a hybrid model based on TOE-TAM for this objective. The TOE's primary function was to identify socio-environmental problems, whereas the TAM helped identify technological ones. According to the study's findings, perceived utility and perceived usability are important factors that influence students' intentions to utilize AI in West Java, Indonesian higher education. The study also showed that perceived usefulness is favorably impacted by organizational competency, complexity, preparedness, and compatibility. Additionally, competitive advantage has a favorable impact on perceived ease of use.

AI has transformed learning patterns by offering individualized study material recommendations and customizing information based on each student's needs. In the future, artificial intelligence may be able to produce created teaching programs based on student performance and preferences. Administrative professionals use AI to support learning by automating routine administrative tasks like student registration and transcript processing, as well as supporting technological aspects in achieving the goals of education.

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