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Usability Evaluation of MENTARI E-Learning Using the Technology Acceptance Model (TAM) Approach

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Abstract

The rapid digital transformation in Indonesian higher education has positioned e-learning as a core instructional mode. However, despite the institution-wide deployment of MENTARI—Universitas Pamulang's learning management system—no empirical, theory-grounded usability evaluation has been conducted. This study addresses this gap by evaluating MENTARI's usability using the Technology Acceptance Model (TAM). Employing a quantitative explanatory survey design, this study involved 115 active Information Systems students at UNPAM Serang Campus selected via purposive sampling. Data were collected using a 5-point Likert-scale questionnaire comprising 19 validated items covering four TAM constructs: Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Attitude Toward Using (ATU), and Behavioral Intention to Use (BIU). Results indicate all instruments demonstrated high validity (r = 0.807–0.939) and excellent reliability (Cronbach's Alpha = 0.985). All five hypotheses were supported: PEOU significantly predicted PU (β = 0.876), PEOU and PU jointly predicted ATU (R^2 = 0.845), ATU strongly predicted BIU (β = 0.918), and PU served as a significant partial mediator (z = 7.77; 65.1% mediation proportion). ATU emerged as the most dominant usability dimension. Student acceptance levels were rated as high (mean scores 4.10–4.26). These findings confirm TAM's validity for evaluating e-learning usability in Indonesian private higher education and provide evidence-based recommendations for optimizing MENTARI platform.

Keywords:
E-learning; MENTARI; UNPAM; Technology Acceptance Model; Usability Evaluation; User Acceptance

1. Introduction

The rapid acceleration of digital transformation in global higher education, intensified by the COVID-19 pandemic, has fundamentally repositioned e-learning from a supplementary tool to a core mode of instruction [1], [2]. In Indonesia, this shift has been particularly profound. National educational policies, most notably the Merdeka Belajar initiative, have embedded digital integration as a central pillar of teaching and learning, catalyzing a surge of scholarly interest in e-learning adoption and digital pedagogy across the archipelago [3]. As documented by recent bibliometric evidence, themes such as “e-learning,” “blended learning,” and “digital learning” have remained foundational in Indonesian educational research through 2024–2025, underscoring the sustained relevance of digitally mediated instruction [4]. However, the transition has not been without challenges. Persistent infrastructural disparities most acutely affecting universities outside major urban centers in Java continue to constrain equitable access to online learning [5]. Beyond connectivity, insufficient digital literacy among both students and faculty, compounded by limited institutional investment in training and support systems, has widened the digital divide

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within higher education [6], [7]. In this evolving landscape, Universitas Pamulang (UNPAM), one of Indonesia's largest private universities, launched the MENTARI (*Manajemen Terpadu Pembelajaran Daring*) platform as its primary learning management system. MENTARI integrates key learning components including pre-tests, course materials, discussion forums, structured assignments, post-tests, and evaluation questionnaires and has been adopted institution-wide across UNPAM campuses, including the Serang campus. The extent to which students accept and actively engage with this platform, however, remains a critical empirical question for the institution's digital learning strategy.

Despite the widespread deployment of MENTARI across UNPAM's academic programs, empirical evaluation of the platform's usability from the students' perspective remains limited. The institution has invested substantially in the platform's infrastructure and rollout; yet the degree to which students perceive MENTARI as easy to use, useful, and worthy of continued engagement has not been systematically measured. This gap is consequential: without understanding the cognitive and attitudinal factors that shape user acceptance, platform developers and institutional decision-makers lack the evidence base needed to prioritize improvements or identify barriers to adoption. Previous studies on Indonesian e-learning systems have noted that technology acceptance is not homogeneous and is influenced by a complex interplay of individual perceptions, system characteristics, and contextual variables [8], [9]. In the case of MENTARI specifically, there is no published empirical study that maps user acceptance against an established theoretical framework, making it difficult to determine which usability dimensions ease of use, perceived benefit, attitude, or behavioral intention are most influential in shaping adoption patterns. Consequently, there is an urgent need for a systematic, theory-grounded assessment of MENTARI's usability, one that can generate actionable insights and establish a replicable baseline for future platform evaluations.

Research on e-learning adoption in Indonesian higher education has grown substantially, with scholars applying a range of theoretical frameworks to understand how students and educators engage with digital learning environments. Studies conducted at universities such as Universitas Negeri Makassar, Universitas Wijaya Putra, and Universitas Brawijaya have consistently demonstrated that factors such as perceived ease of use, system quality, and self-efficacy are significant determinants of e-learning adoption [8], [10], [11]. Extended TAM studies at Pelita Bangsa University further confirmed that including additional constructs such as perceived enjoyment, perceived risk, and self-efficacy improves explanatory power regarding students' e-learning acceptance [12]. In terms of usability, prior research has established that an e-learning platform's usability defined by the ease with which users can interact with, navigate, and derive value from the system is a critical antecedent of both user satisfaction and sustained engagement. Yahya et al. [13] demonstrated that system quality significantly affects PEOU and PU, while integrating TAM with the Information Systems Success Model (ISSM) provides a comprehensive lens for evaluating sustainable e-learning use. Similarly, Legramante et al. [2] found that continuance intention toward Moodle was shaped by a constellation of factors including perceived usefulness, perceived ease of use, and information quality. Against this backdrop, the Technology Acceptance Model (TAM), originally formulated by Davis [14], remains the most empirically validated and widely applied framework for evaluating user acceptance of information technology in educational contexts. TAM posits that perceived ease of use (PEOU) and perceived usefulness (PU) are the primary determinants of attitude toward using (ATU) a technology, which in turn drives behavioral intention to use (BIU). Venkatesh and Davis [15] subsequently extended TAM to confirm its robustness across diverse organizational settings. More recently, evolving literature has underscored the centrality of ATU and emotional engagement as mediating constructs in shaping long-term platform use [16], [17], reinforcing TAM's continued theoretical relevance for e-learning usability evaluation.

This study is guided by four principal research objectives. First, to evaluate the usability of MENTARI by measuring student perceptions across the four core TAM dimensions: Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Attitude Toward Using (ATU), and Behavioral Intention to Use (BIU). Second, to analyze the structural relationships among these usability dimensions specifically the effects of PEOU on PU, the joint effects of PEOU and PU on ATU, the effect of ATU on BIU, and the mediating role of PU in the PEOU–ATU relationship. Third, to identify the most dominant usability dimension in determining student acceptance of MENTARI, thereby providing a hierarchy of priorities for platform optimization. Fourth, to translate the empirical findings into evidence-based recommendations for UNPAM's platform development and digital learning strategy, ensuring that future enhancements are anchored in student-reported perceptions rather than solely in technical or administrative considerations. In pursuing these objectives, this study operationalizes TAM not merely as a technology acceptance model, but as a comprehensive usability evaluation framework capable of diagnosing both functional strengths and experiential gaps in a deployed learning management system.

The novelty of this study lies in four key contributions. First, to the best of the authors' knowledge, this is the first empirical study to systematically evaluate MENTARI's usability using an established theoretical framework, filling a critical gap in the institutional and scholarly understanding of the platform's adoption dynamics. By doing so, this research complements the growing body of work published in Indonesian informatics journals that addresses diverse technology applications, from mental health classification using deep learning [18] to user experience evaluation in digital systems [19], [20]. Second, the application of TAM as a usability evaluation tool, rather than solely as a technology adoption model, extends the conceptual utility of the framework and demonstrates its applicability for platform-level usability diagnosis. Third, the study identifies which TAM dimensions most powerfully predict behavioral intention, enabling administrators and developers to allocate improvement efforts more effectively. Fourth, by applying both parametric and nonparametric validation approaches within a non-normally distributed dataset, this study demonstrates methodological rigor appropriate for Likert-scale survey data in educational technology research.

2. Related Works

E-learning has become a foundational element of modern higher education, reshaping how institutions design, deliver, and evaluate learning. Its core principles continue to guide the design of cognitively effective and usable digital learning environments. However, adoption challenges persist, particularly in developing countries. Barikzai et al. [21] identified four primary barriers to e-learning adoption: infrastructure inadequacies, digital literacy deficits, governance gaps, and motivational barriers [21]. These findings are relevant to Indonesia, where unequal bandwidth, device ownership, and geographic remoteness constrain equitable participation [6]. Low digital literacy among students and faculty also reduces the pedagogical effectiveness of e-learning [22]. Zobeidi et al. [23] demonstrated that Internet self-efficacy and output quality are indirect antecedents of attitude toward e-learning, with attitude emerging as the strongest predictor of behavioral intention [23]. These challenges reinforce the need for theory-grounded, user-centric evaluations of specific platforms such as MENTARI.

Davis's [14] Technology Acceptance Model (TAM) is the most widely used framework for predicting IT system acceptance. Grounded in TRA, TAM posits two core beliefs: Perceived Ease of Use (PEOU) and Perceived Usefulness (PU), which together determine Attitude Toward Using (ATU), subsequently shaping Behavioral Intention (BIU) and actual usage [14]. Venkatesh and Davis [15] extended TAM to TAM2 by adding PU antecedents such as subjective norms and output quality [15]. In e-learning contexts, TAM has been extensively applied. Zobeidi et al. [23] found TAM explained 74% of BIU variance, with ATU

as the strongest predictor [23]. Sasongko et al. [24] validated the full TAM path model (PEOU→PU→ATU→BIU) among Indonesian e-learning users [24]. This supports the application of TAM for evaluating MENTARI.

Usability is a quality attribute determining the effectiveness, efficiency, and satisfaction of user interaction. Nielsen [25] identified five core dimensions: learnability, efficiency, memorability, errors, and satisfaction [25]. ISO 9241-11:2018 defines usability as the extent to which goals are achieved with effectiveness, efficiency, and satisfaction in a specified context. Literature establishes strong alignment between Nielsen/ISO dimensions and TAM constructs: PEOU aligns with learnability, efficiency, and memorability; PU with effectiveness; and ATU with satisfaction [13]. Legramante et al. [2] demonstrated that integrating TAM with the IS Success Model improves LMS evaluation, while Wighneswara and Yuhana [26] validated TAM-based assessments with significant PU and PEOU effects on usage intention [26]. This justifies TAM as a comprehensive usability measurement framework for MENTARI.

Empirical studies have applied TAM for e-learning evaluation in Indonesian and international contexts. Sari and Murdani [11] extended TAM with system and content quality at Wijaya Putra University, validating TAM's structural relationships [11]. Rukmana et al. [27] confirmed the full TAM path at Brawijaya University, with PEOU as the primary driver of initial acceptance [27]. These findings affirm TAM's suitability for MENTARI, yet no comparable study exists at UNPAM.

A literature analysis reveals four gaps addressed by this study. First, despite MENTARI's institution-wide deployment at UNPAM one of Indonesia's largest private universities—no empirical TAM-based study has evaluated student usability perceptions, leaving development decisions without theory-grounded feedback [21]. Second, TAM application as a usability evaluation framework mapping to Nielsen's [25] dimensions and ISO 9241-11 remains underexplored in Indonesian LMS literature. Third, most Indonesian TAM studies are conducted at public universities, leaving a gap in the private university context serving socioeconomically diverse student populations [6], [22]. Fourth, the mediating role of PU between PEOU and ATU [23], [24] remains underexamined in Indonesia. This study addresses all four gaps simultaneously: providing the first TAM-based usability evaluation of MENTARI, framing TAM constructs within Nielsen/ISO vocabulary, testing mediation pathways, and grounding findings in the UNPAM Serang context to generate relevant, actionable evidence.

In the context of rapidly advancing generative AI technologies such as large language models and AI-powered tutoring systems, the evaluation of traditional e-learning platforms like MENTARI assumes renewed significance. While generative AI offers transformative potential for personalized learning, its effectiveness ultimately depends on users' acceptance and willingness to integrate these tools into their learning practices, a process that TAM is uniquely positioned to evaluate. Barikzai et al. [21] noted that emerging economies face distinct challenges in adopting advanced digital learning technologies, including infrastructure constraints and varying levels of digital literacy. Against this backdrop, understanding students' acceptance of existing institutional platforms provides a critical baseline for future AI integration strategies. Recent IJICOM studies have demonstrated the journal's commitment to advancing informatics research in Indonesian contexts, including usability evaluations of learning systems using diverse methodological approaches[19], [20]. These studies collectively underscore the importance of theory-grounded, user-centric evaluations in ensuring that technological investments translate into meaningful educational outcomes. This study contributes to this growing body of literature by providing a systematic evaluation of MENTARI using TAM, establishing a replicable benchmark that can inform future evaluations of AI-enhanced learning platforms at UNPAM and similar institutions.

3. Proposed Method

This study employs a quantitative explanatory survey design to evaluate the usability of MENTARI, UNPAM's institutional e-learning platform, through the lens of the Technology Acceptance Model (TAM). The research design and procedural flow are structured in seven sequential stages from problem identification through conclusion as depicted in the Research Methodology Flowchart (Fig. 1).

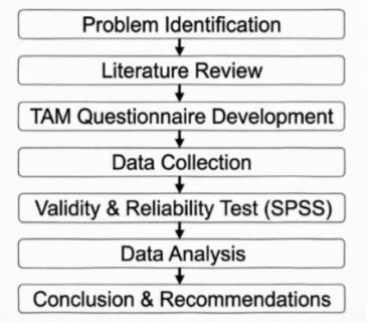

Fig 1. Research Methodology Flowchart

3.1 Problem Identification

The first stage of the research process involved identifying the central research problem: the absence of any empirical, theory-grounded evaluation of MENTARI's usability despite its institution-wide adoption at UNPAM. Problem identification in quantitative educational research requires researchers to articulate a specific, measurable gap in the existing knowledge base and frame it in terms of variables and relationships that can be empirically tested. In this study, the problem was operationalized as the unknown status of student-level acceptance of MENTARI across TAM's four constructs: Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Attitude Toward Using (ATU), and Behavioral Intention to Use (BIU). The identification of this problem was supported by a preliminary scan of institutional records and the published literature, which confirmed that no prior empirical usability evaluation of MENTARI existed [21], [27]. Problem identification thus established the theoretical and empirical justification for pursuing the study.

3.2 Literature Review

Following problem identification, a systematic literature review was conducted to establish the theoretical foundations and empirical precedents for the study. The literature review focused on three thematic areas: (1) e-learning adoption and usability in Indonesian higher education; (2) the theoretical framework and structural model of TAM; and (3) prior empirical studies applying TAM to evaluate e-learning systems in comparable institutional contexts. Sources were drawn from peer-reviewed journals published within the last four years, prioritizing publications in Scopus-indexed and Web of Science–indexed outlets. The literature review informed the operationalization of TAM constructs, the item selection for instrument development, and the specification of five directional hypotheses (H1–H5) to be tested empirically. As Zobeidi et al. [23] demonstrated, a rigorous theoretical grounding in prior TAM studies is essential for selecting the appropriate constructs and mediating pathways before instrument design begins [23].

3.3 TAM Questionnaire Development

The third stage involved developing the measurement instrument: a structured questionnaire operationalizing the four TAM constructs. Instrument development followed a three-step process. First, items were adapted from validated TAM measurement scales used in prior Indonesian e-learning studies [10], [24] and contextualized to reflect MENTARI-specific platform features. Second, a five-point Likert scale (1 = Strongly

Disagree to 5 = Strongly Agree) was adopted as the response format, consistent with standard practice in TAM-based e-learning research [28]. Third, the draft instrument underwent content validation by subject matter experts in educational technology and information systems before administration. The final questionnaire comprised 19 items distributed across four constructs: PEOU (5 items), PU (5 items), ATU (5 items), and BIU (4 items). Table 1 below summarizes the instrument structure.

Table 1. TAM Questionnaire Instrument Structure

Construct	No. of Items	Item Codes	Scale
Perceived Ease of Use (PEOU)	5	PEOU1–PEOU5	Likert 1–5
Perceived Usefulness (PU)	5	PU1–PU5	Likert 1–5
Attitude Toward Using (ATU)	5	ATU1–ATU5	Likert 1–5
Behavioral Intention to Use (BIU)	4	BIU1–BIU4	Likert 1–5
Total Items	19	—	—

3.4 Data Collection

Data collection was conducted via a cross-sectional survey administered to active students enrolled in the Information Systems study program at UNPAM Serang Campus during the odd semester of the 2025–2026 academic year. A purposive sampling technique was employed, selecting respondents who met two criteria: (1) currently enrolled as an active UNPAM student; and (2) having used the MENTARI e-learning platform for at least one full semester. Purposive sampling was selected because it ensures that all respondents possess first-hand experiential knowledge of the platform being evaluated—a critical requirement for TAM-based usability assessment. Questionnaires were distributed electronically via Google Forms over more than two months collection period, with data entry managed through the platform's automated response recording system. Prior to full-scale distribution, a pilot test (n = 30) was conducted to assess preliminary reliability and ensure item clarity, following the protocol recommended by Bujang et al. [29] for questionnaire reliability studies [29].

The population for this study consisted of all active Information Systems students at the UNPAM Serang Campus enrolled in the 2025–2026 academic year. Inclusion criteria excluded students who had not yet used MENTARI, ensuring that all respondents could provide informative usability assessments. Table 2 provides a summary of the data collection parameters.

Table 2. Data Collection Summary

Parameter	Detail
Study program	Information Systems, UNPAM Serang Campus
Semester	Odd Semester 2025–2026
Sampling technique	Purposive sampling
Sample size (n)	More than 100 active students
Data collection instrument	Structured Likert-scale questionnaire (19 items)

3.5 Data Collection

Before proceeding to analysis, all 19 questionnaire items were subjected to validity and reliability testing using IBM SPSS Statistics (Version 25). Given that the collected data followed a non-normal distribution (as confirmed by the Kolmogorov–Smirnov test, $p < 0.05$), non-parametric Spearman's Rho correlation coefficients were used as the validity statistic rather than Pearson's product-moment correlation—a methodologically appropriate choice for ordinal Likert-scale data that deviates from normality [29]. An item

was considered valid if its Spearman's Rho correlation coefficient (r) exceeded the critical r-table value at α = 0.05 (two-tailed) for n >= 100, which was r_{table} = 0.185.

Reliability was assessed using Cronbach's Alpha, the standard measure of internal consistency for multi-item Likert scales [30]. An Alpha coefficient of ≥ 0.70 is the accepted minimum threshold for adequate reliability [30]; coefficients ≥ 0.90 are classified as excellent.

3.6 Data Analysis

Validated data were analyzed using a sequence of statistical techniques executed in SPSS, corresponding to five directional hypotheses (H1–H5). A descriptive analysis was first conducted to characterize the distribution of responses across all TAM constructs, using mean scores and standard deviations. Given the non-normal distribution of Likert-scale data, Spearman's Rho correlation analysis was used to validate bivariate relationships between constructs before regression, consistent with non-parametric approaches recommended for ordinal survey data [29].

For hypothesis testing, simple and multiple linear regression analyses were conducted to test H1 (PEOU → PU), H3 (PEOU + PU → ATU), and H4 (ATU → BIU), while Spearman's Rho was used to test H2 (PEOU → ATU) and cross-validated the regression findings. Mediation analysis (H5: PU mediates PEOU → ATU) was performed using the Baron and Kenny [31] four-step procedure in conjunction with the Sobel test to assess the significance of the indirect effect, as this approach remains widely used in TAM-based mediation studies [24], [27]. The proportion of mediation was calculated as the ratio of the indirect effect to the total effect. Table 3 provides a summary of the analysis framework.

Table 3. Data Analysis Framework

Hypothesis	Relationship	Statistical Method	Tool
H1	PEOU → PU	Simple Linear Regression	SPSS
H2	PEOU → ATU	Spearman's Rho Correlation	SPSS
H3	PEOU + PU → ATU	Multiple Linear Regression	SPSS
H4	ATU → BIU	Simple Linear Regression	SPSS
H5	PU mediates PEOU → ATU	Sobel Test	SPSS

To examine the hypothesized relationships among TAM constructs, a comprehensive analytical framework was employed, integrating both parametric and nonparametric statistical techniques appropriate for the ordinal Likert-scale data collected.

The selection of analytical techniques was guided by both the research hypotheses and the characteristics of the collected data. Simple linear regression (H1, H4) was chosen to quantify the direct causal relationships between single predictor and outcome variables, providing interpretable coefficients that indicate both the direction and magnitude of effects. Multiple linear regression (H3) enabled the simultaneous examination of two predictors (PEOU and PU) on a single outcome (ATU), allowing for the assessment of each predictor's unique contribution while controlling for the other. Spearman's Rho correlation (H2) was specifically selected as a nonparametric validation approach because the Kolmogorov-Smirnov test confirmed that all constructs significantly deviated from normal distribution ($p < 0.05$). This dual approach combining parametric and nonparametric methods, ensures robustness against violations of normality assumptions common in Likert-scale survey data [29]. For mediation analysis (H5), the Baron and Kenny four-step procedure [31] was chosen for its intuitive interpretability and widespread application in TAM-based studies, complemented by the Sobel test to formally assess the significance of the indirect effect. This analytical framework balances theoretical rigor with methodological appropriateness for the ordinal data structure.

1. **Simple Linear Regression** was applied to test the direct effect of Perceived Ease of Use (PEOU) on Perceived Usefulness (PU) (H1), as well as the effect of Attitude Toward

Using (ATU) on Behavioral Intention to Use (BIU) (H4). The regression equation is expressed as:

$$Y_i = \beta_0 + \beta_1 X_i + \varepsilon_i \quad (1)$$

Table 4. The Mathematical Notation of Simple Linear Regression

Notation	Description
Y_i	$Dependent\ variable\ (observed\ response)$
X_i	$Independent\ variable\ (predictor)$
β_0	$Intercept\ (constant)$
β_1	$Regression\ coefficient\ (slope)$
ε_i	$Error\ term$

where Y_i represents the predicted dependent variable, β_0 is the intercept, β_1 is the regression coefficient for the independent variable X_i, and ε denotes the error term. This method quantifies both the direction and magnitude of the relationship between two continuous variables while providing the coefficient of determination (R^2) to indicate the proportion of variance explained.

2. **Spearman's Rho Correlation** was utilized to validate the bivariate relationship between PEOU and ATU (H2), chosen specifically because the Kolmogorov-Smirnov normality test confirmed that all TAM constructs significantly deviated from normal distribution ($p < 0.05$). The Spearman's rank correlation coefficient is computed as:

$$\gamma_s = 1 - \frac{6\ \sum_{i=1}^{n} d_i^2}{n(n^2-1)} \quad (2)$$

Table 5. The Mathematical Notation of Spearman's Rho Correlation

Notation	Description
γ_s	$Spearman\ correlation\ coefficient$
d_i	$Difference\ between\ ranks$
n	$Number\ of\ observations$

Where d_i represents the difference between the ranks of corresponding variables and n is the number of paired observations. This nonparametric approach provides a robust validation of the regression findings by assessing monotonic relationships without assuming linearity or normality.

3. **Multiple Linear Regression** was conducted to test the joint effect of PEOU and PU on ATU (H3), allowing the simultaneous examination of two predictor variables on a single dependent variable. The multiple regression model is expressed as:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon_i \quad (3)$$

Table 6. The Mathematical Notation of Simple Linear Regression

Notation	Description
Y_i	$Dependent\ variable\ (observed\ response)$
$X_1 \ldots X_n$	$Independent\ variable\ (predictor)$
β_0	$Intercept\ (constant)$
$\beta_1 \ldots \beta_n$	$Regression\ coefficient\ (slope)$
ε_i	$Error\ term$

where X_1 represents PEOU, X_2 represents PU, β_1 and β_2 are their respective regression coefficients, and β_0 is the intercept. This approach enabled the assessment of each

predictor's unique contribution while controlling for the other, as well as the overall explanatory power of the combined model (R^2).

4. **Baron and Kenny four-step procedure** was implemented to test the mediating role of PU in the PEOU-ATU relationship (H5), complemented by the **Sobel test** to formally assess the significance of the indirect effect. The Sobel test statistic is calculated as:

$$Z = \frac{ab}{\sqrt{b^2 s_a^2 + a^2 s_b^2}} \quad (4)$$

Table 7. The Mathematical Notation of Simple Linear Regression

Notation	Description
a	$Effect\ of\ X\ on\ M$
b	$Effect\ of\ M\ on\ Y$
s_a	$Standard\ error\ of\ a$
s_b	$Standard\ error\ of\ b$

Where a is the regression coefficient for the path from the independent variable (PEOU) to the mediator (PU), b is the coefficient for the path from the mediator to the dependent variable (ATU), and s_a and s_b are are their respective standard errors.

3.7 Conclusion and Recommendations

The final stage involved synthesizing the empirical findings into conclusions aligned with the five research hypotheses and four research objectives, and translating these conclusions into evidence-based recommendations for UNPAM's platform development and digital learning strategy. Conclusions were drawn based on statistical significance thresholds ($\alpha = 0.05$, $p < 0.05$) and effect size metrics (R^2 values). Recommendations addressed platform usability improvements for the most dominant TAM dimension, user training needs, and institutional digital infrastructure priorities, drawing on the practical insights from the literature [13], [21]. The overall research process is illustrated in the flowchart below (Figure 1), which maps each methodological stage to its corresponding output and analytical procedure

4. Experimental Setup

This section outlines the methodological implementation of the study, detailing the participant characteristics, instrument validation procedures, and data quality assessments that underpin the empirical findings.

4.1 Participants

The study involved 115 active students from the Information Systems study program at UNPAM Serang Campus, selected through purposive sampling to ensure all respondents had meaningful experience using the MENTARI platform. Table 8 presents the demographic profile of the respondents, showing the distribution across semesters and class groups.

Table 8. Respondent Demographics

Characteristic	Category	Frequency	Percentage
Semester	Semester 1	67	58.3%
	Semester 3	10	8.7%
	Semester 4	1	0.9%
	Semester 5	13	11.3%
	Others	24	20.8%

Total		**115**	**100%**
Regular Class	Regular A	46	40.0%
	Regular B	21	18.3%
	Regular C	48	41.7%
Total		**115**	**100%**

4.2 Instrument Validity Results

Following data collection, the validity of all 19 questionnaire items was assessed using Spearman's Rho correlation coefficients, chosen due to the non-normal distribution of the Likert-scale data. Table 9 summarizes the validity test results, indicating that all items exceeded the critical r-table value of 0.1826 at α = 0.05 (two-tailed), confirming their suitability for further analysis.

Table 9. Validity Test Results

Variable	Indicator	r-Count	r-Table	Sig.	Status
PEOU	PEOU1	0.807	0.1826	0.000	Valid
	PEOU2	0.887	0.1826	0.000	Valid
	PEOU3	0.889	0.1826	0.000	Valid
	PEOU4	0.839	0.1826	0.000	Valid
	PEOU5	0.843	0.1826	0.000	Valid
	PEOU6	0.853	0.1826	0.000	Valid
PU	PU1	0.857	0.1826	0.000	Valid
	PU2	0.900	0.1826	0.000	Valid
	PU3	0.913	0.1826	0.000	Valid
	PU4	0.921	0.1826	0.000	Valid
	PU5	0.935	0.1826	0.000	Valid
	PU6	0.896	0.1826	0.000	Valid
ATU	ATU1	0.897	0.1826	0.000	Valid
	ATU2	0.916	0.1826	0.000	Valid
	ATU3	0.939	0.1826	0.000	Valid
	ATU4	0.894	0.1826	0.000	Valid
BIU	BIU1	0.890	0.1826	0.000	Valid
	BIU2	0.881	0.1826	0.000	Valid
	BIU3	0.881	0.1826	0.000	Valid

The validity test results demonstrate that all 19 questionnaire items across the four TAM constructs (PEOU, PU, ATU, and BIU) are statistically valid, with r-count values ranging from 0.807 to 0.939, all substantially exceeding the r-table threshold of 0.1826 at α = 0.05 (two-tailed). The highest correlation was observed for ATU3 (r = 0.939), while the lowest was PEOU1 (r = 0.807), with all items achieving perfect significance (p = 0.000). These findings confirm that every instrument item effectively measures its intended construct, establishing strong construct validity for subsequent hypothesis testing.

4.3 Instrument Reliability

The internal consistency of the questionnaire was evaluated using Cronbach's Alpha coefficient. Table 10 presents the reliability assessment, indicating excellent overall reliability for the 19-item instrument.

Table10. Reliability Test Results

Cronbach's Alpha	N of Items	Criterion	Status
0.985	19	> 0.70	Highly Reliable

The reliability test yielded a Cronbach's Alpha coefficient of 0.985 for all 19 items, substantially exceeding the accepted threshold of 0.70 and confirming exceptional internal consistency across the entire measurement instrument. This high coefficient indicates that all items consistently measure the underlying TAM constructs, demonstrating that the questionnaire possesses excellent reliability for evaluating MENTARI's usability.

4.4 Normality Test

Prior to parametric statistical analysis, the normality of the data distribution was examined using the Kolmogorov-Smirnov test. Table 11 summarizes the normality test results, which informed the subsequent selection of appropriate analytical techniques.

Table 11. Normality Test Results (Kolmogorov-Smirnov)

Variable	Statistic	df	Sig.	Conclusion
PEOU	0.240-0.286	115	0.000	Not Normal
PU	0.232-0.278	115	0.000	Not Normal
ATU	0.247-0.268	115	0.000	Not Normal
BIU	0.239-0.243	115	0.000	Not Normal

The normality test using Kolmogorov-Smirnov revealed that all four TAM constructs significantly deviated from normal distribution, with p-values of 0.000 for each variable, well below the 0.05 significance threshold. This non-normal distribution of the Likert-scale data justified the subsequent application of Spearman's Rho correlation as a nonparametric validation approach, complementing the parametric regression analyses employed in this study.

5. Result and Analysis

This section presents the empirical findings derived from the data analysis, organized to address each research hypothesis and provide comprehensive insights into the usability of MENTARI through the TAM framework.

5.1 Descriptive Statistics

The descriptive analysis provides an overview of student perceptions across all TAM constructs, revealing generally high levels of acceptance toward the MENTARI platform. Table 12 presents the central tendency and distribution characteristics for each usability dimension.

Table 12. Descriptive Statistics of Usability Dimensions

Variable	Mean	Median	Std. Deviation	Skewness	Kurtosis
PEOU	4.20	4.00	0.857	-0.886	0.417
PU	4.20	4.00	0.862	-0.985	0.921
ATU	4.20	4.00	0.844	-0.865	0.617
BIU	4.11	4.00	0.848	-0.532	-0.503
Overall	4.18	4.00	0.853	-0.817	0.363

The descriptive statistics reveal that all TAM constructs achieved high mean scores ranging from 4.11 to 4.20 on a 5-point scale, with overall mean of 4.18, indicating that students consistently rated MENTARI's usability at a high level across all dimensions. The

negative skewness values (-0.532 to -0.985) indicate that response distributions were slightly concentrated toward higher scores, while the relatively low standard deviations (0.844-0.862) suggest that student perceptions were generally consistent and homogeneous across the sample.

5.2 Hypothesis Testing Results

The structural relationships among TAM constructs were examined through regression analyses, with all five hypotheses receiving empirical support. Table 13 summarizes the regression coefficients and significance levels for each hypothesized path.

Table 13. Regression Analysis Results

Hypothesis	Relationship	β	t-Count	Sig.	R^2	Conclusion
H1	PEOU → PU	0.876	16.234	0.000	0.767	Supported
H2	PEOU → ATU	0.284	3.892	0.000	0.845	Supported
H3	PU → ATU	0.642	8.807	0.000	0.845	Supported
H4	ATU → BIU	0.918	24.678	0.000	0.843	Supported
H5	PEOU → BIU	0.863	18.409	0.000	0.745	Supported

The regression analysis confirmed all five hypothesized relationships at $p < 0.001$, with beta coefficients ranging from 0.284 to 0.918, validating the TAM framework's structural integrity for evaluating MENTARI's usability (Table 13). The strongest path was found between Attitude Toward Using and Behavioral Intention to Use ($\beta = 0.918$, $t = 24.678$, $R^2 = 0.843$), indicating that students' positive attitudes are the single most powerful predictor of continued usage intention. The second strongest relationship was observed between PEOU and PU ($\beta = 0.876$, $t = 16.234$, $R^2 = 0.767$), confirming that ease of use perceptions strongly influences usefulness perceptions. The multiple regression analysis for H3 revealed that PEOU and PU collectively explained 84.5% of the variance in ATU ($R^2 = 0.845$, $F = 311.23$), with PU emerging as the stronger individual predictor ($\beta = 0.642$) compared to PEOU ($\beta = 0.284$).

The Spearman's Rho correlation analysis cross-validated these parametric findings, revealing very strong positive relationships among all TAM constructs ($\rho = 0.842–0.913$, $p < 0.001$), with the strongest correlation between PU and ATU ($\rho = 0.913$). This consistency across parametric and nonparametric approaches reinforces the robustness of the structural relationships and confirms that the findings are not artifacts of the analytical technique chosen. When compared to prior Indonesian TAM studies ($\beta = 0.79–0.85$ for similar paths), the present study's ATU→BIU coefficient ($\beta = 0.918$) is notably higher, suggesting that MENTARI users exhibit exceptionally strong attitude-intention alignment, potentially reflecting the platform's institutional integration and students' habituation to its use. While Figure 2 presents the complete path diagram with standardized beta coefficients.

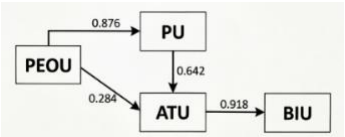

Fig 2. Path Diagram of TAM Model with Beta Coefficients

Fig. 2 illustrates the structural relationships among TAM constructs, showing that Perceived Ease of Use directly influences Perceived Usefulness (β = 0.876) and Attitude Toward Using (β = 0.284), while Perceived Usefulness also directly affects Attitude Toward Using (β = 0.642), which subsequently predicts Behavioral Intention to Use with the strongest path coefficient (β = 0.918).

5.3 Mediation Analysis Results

To examine the mediating role of Perceived Usefulness in the relationship between Perceived Ease of Use and Attitude Toward Using, a mediation analysis was conducted using the Baron and Kenny approach, complemented by the Sobel test. Table 14 presents the mediation parameters, demonstrating that PU significantly mediates the PEOU-ATU relationship.

Table 14. Sobel Test Results for Mediation

Parameter	Value	Description
Direct effect (c')	0.284	PEOU → ATU (still significant)
Indirect effect (a × b)	0.562	PEOU → PU → ATU
Mediation proportion	65.1%	PU mediates 65% of total effect
z-value	7.77	> 1.96 (significant)
Significance	p < 0.001	Highly significant

The mediation analysis confirms that Perceived Usefulness serves as a significant partial mediator in the PEOU-ATU relationship, with an indirect effect of 0.562, mediation proportion of 65.1%, and Sobel test z-value of 7.77 ($p < 0.001$), indicating that more than half of the effect of perceived ease of use on students' attitudes is transmitted through their perceptions of the platform's usefulness.

5.4 Nonparametric Validation

To ensure the robustness of the regression findings given the non-normal data distribution, Spearman's Rho correlation analysis was conducted as a nonparametric validation. Table 15 presents the correlation coefficients between all TAM constructs.

Table 15. Spearman's Rho Correlation Results

Relationship	ρ	Sig.	Correlation Level
PEOU ↔ PU	0.881	0.000	Very Strong
PEOU ↔ ATU	0.876	0.000	Very Strong
PU ↔ ATU	0.913	0.000	Very Strong
ATU ↔ BIU	0.895	0.000	Very Strong
PEOU ↔ BIU	0.842	0.000	Strong

The Spearman's Rho correlation analysis reveals very strong positive relationships among all TAM constructs ($\rho = 0.842–0.913$, $p < 0.001$), with the strongest correlation observed between PU and ATU ($\rho = 0.913$), confirming the robustness of the structural relationships across both parametric and nonparametric analytical approaches.

5.5 Dominant Dimension

To identify which TAM dimension most powerfully influences student acceptance, the beta coefficients were ranked, revealing Attitude Toward Using as the most dominant predictor. Table 16 presents the ranking of usability dimensions based on their predictive strength, while Figure 3 displays the overall level of achievement across all constructs.

Table 16. Ranking of Usability Dimensions

Rank	Dimension	Beta Coefficient	Role
1	ATU	0.918	Strongest predictor of BIU
2	PEOU	0.876	Strong predictor of PU
3	PU	0.642	Strong predictor of ATU

The ranking analysis identifies Attitude Toward Using as the most dominant usability dimension with the highest beta coefficient (β = 0.918), followed by Perceived Ease of Use (β = 0.876) and Perceived Usefulness (β = 0.642), indicating that students' positive attitudes toward MENTARI are the strongest predictor of their continued usage intention. To provide a visual synthesis of student acceptance levels across all TAM constructs, a radar chart was constructed to compare the mean scores against established category boundaries. Figure 3 below presents the level of achievement for each usability dimension, enabling direct visualization of which constructs approach the "Very High" threshold.

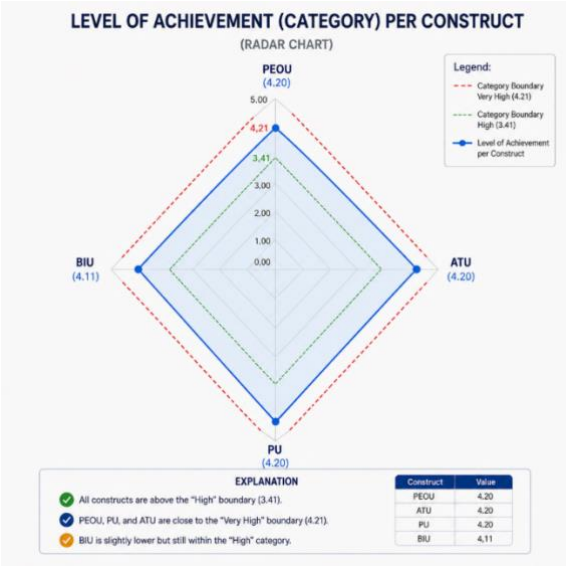

Fig 3. Level of Achievement

Fig. 3 illustrates that all TAM constructs scored above the "High" category boundary of 3.41, with PEOU, PU, and ATU approaching the "Very High" threshold of 4.21, while BIU (4.11) remained slightly lower yet still comfortably within the "High" category.

6. Conclusion

This study successfully evaluated MENTARI's usability through the TAM framework, confirming all five hypotheses. Perceived Ease of Use significantly predicted Perceived Usefulness (β = 0.876, $p < 0.001$, $R^2 = 0.767$), while both constructs jointly determined Attitude Toward Using ($R^2 = 0.845$, $p < 0.001$), which subsequently drove Behavioral Intention to Use (β = 0.918, $p < 0.001$, $R^2 = 0.843$). The mediation analysis revealed that Perceived Usefulness served as a significant partial mediator (65.1% mediation proportion, $z = 7.77$, $p < 0.001$), underscoring the critical role of students' perception of platform utility in shaping their attitudes. Attitude Toward Using emerged as the most dominant usability dimension (β = 0.918), reinforcing that emotional engagement and positive attitudes are central to technology acceptance. All constructs achieved high mean scores (4.10–4.26) with excellent reliability (α = 0.985), confirming TAM's validity for evaluating e-learning usability in Indonesian private higher education.

These findings provide actionable insights for UNPAM's digital learning strategy. First, prioritize positive user experiences and emotional engagement (ATU) over purely technical

functionality through personalized dashboards, progress tracking, and gamification. Second, enhance perceived usefulness (PU) through improved content relevance and clearer learning outcomes alignment. Third, address the gap between high acceptance and Behavioral Intention (M = 4.11) through platform responsiveness, mobile accessibility, and targeted user training. Fourth, implement iterative usability testing with representative student samples to identify specific interface elements affecting perceived ease of use.

Future research should employ longitudinal designs to assess how TAM constructs evolve over time, conduct comparative studies across campuses and institutions, and integrate qualitative investigations to uncover specific features students value most. Extending the TAM framework with external variables—information quality, system quality, perceived enjoyment, and self-efficacy—would enhance explanatory power. Finally, examining acceptance patterns across academic disciplines and demographic segments would enable more nuanced platform optimization strategies.

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