Journal of Information Systems and Informatics
Vol. 7, No. 2, June 2025 e-ISSN: 2656-4882 p-ISSN: 2656-5935
DOI: 10.51519/journalisi.v7i2.1104 Published By DRPM-UBD

Improvement of Technology Acceptance Model (TAM) with PLS-SEM: A Systematic Literature Review

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Abstract

The rapid advancement of digital technologies necessitates a deeper focus on user acceptance and satisfaction, particularly within the framework of the Technology Acceptance Model (TAM), analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). This systematic literature review examines 36 articles published between 2020 and 2025, revealing that factors such as trust, system quality, perceived enjoyment, service quality, and technological self-efficacy significantly influence user satisfaction. These external variables enhance the explanatory power of TAM, providing a richer understanding of user interactions with digital platforms such as e-commerce, e-learning, and mobile banking. PLS-SEM's ability to manage model complexity, non-normal data distributions, and interrelated constructs further validates its suitability for this research. The findings suggest that integrating these external factors improves both the theoretical and practical aspects of TAM in the context of technology adoption. Future research could explore additional industry-specific applications for emerging technologies.

Keywords: Technology Acceptance Model (TAM), PLS-SEM, user satisfaction, system quality, technological self-efficacy

1. INTRODUCTION

In recent decades, rapid technological advancements have dramatically reshaped social practices across various domains, including education, business, industry, and public services. These digital innovations offer unprecedented opportunities to enhance both individual efficiency and organizational performance, while also refining existing systems. Yet, despite their potential, the widespread adoption of emerging technologies remains a significant challenge. The issue extends beyond the mere availability of technical infrastructure—deep-seated psychological and socio-structural barriers continue to hinder user acceptance and readiness for change [1].

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To understand and address these challenges, researchers have developed several theoretical models that explore the psychological dynamics of technology adoption. One of the most influential frameworks in this space is the Technology Acceptance Model (TAM). At its core, TAM focuses on two critical factors: perceived usefulness (PU) and perceived ease of use (PEOU). These elements have consistently demonstrated strong predictive power in explaining users' intentions to embrace new technologies [2].

However, as digital technologies evolve and grow in complexity, the original TAM framework must be revisited and expanded to reflect the influence of external factors that shape user experiences and perceptions. Over the years, scholars have proposed integrating additional constructs such as trust, system quality, and service quality into the TAM model to increase its explanatory power [3].

An area gaining increasing attention is the use of Partial Least Squares Structural Equation Modeling (PLS-SEM) in enhancing TAM. PLS-SEM is a robust analytical method that enables researchers to explore complex, non-linear relationships between constructs, particularly in cases where data may not follow a normal distribution. Despite its potential, the integration of PLS-SEM with TAM still lacks comprehensive exploration, especially in contexts requiring nuanced understanding of user satisfaction and comfort [4].

This systematic literature review is designed to address the following research questions:

1) How does the application of PLS-SEM strengthen the predictive accuracy and robustness of TAM in evaluating digital technology adoption?
2) What external factors most significantly influence user satisfaction within a PLS-SEM-enhanced TAM framework?

Key constructs—such as trust, system quality, and technological self-efficacy—are hypothesized to play a pivotal role in shaping user satisfaction and overall acceptance of new technologies. Incorporating these variables into the TAM model offers a more holistic view of user interaction with digital platforms. By examining these factors through a refined theoretical lens, this study aims to contribute both conceptually and practically to the ongoing evolution of the Technology Acceptance Model. Furthermore, it seeks to offer actionable insights into improving technology acceptance in key digital environments like e-commerce, e-learning, and mobile banking.

2. METHODS

This study uses a systematic literature review method in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyzes)

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protocol [5].

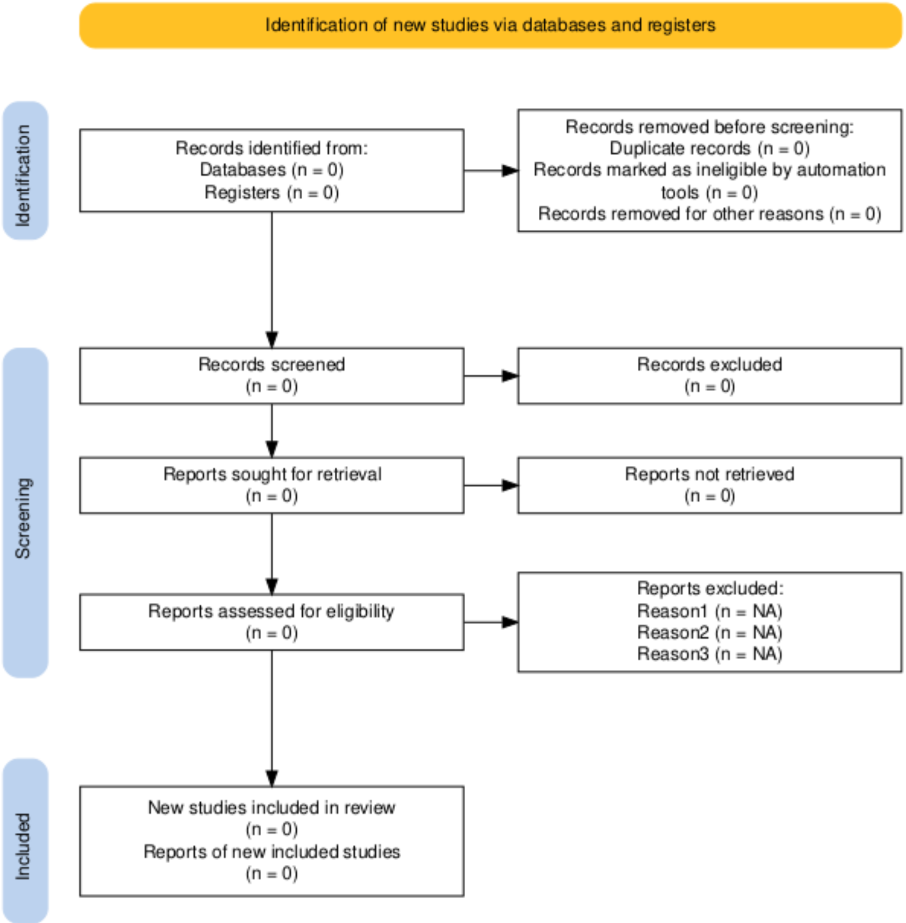

Figure 1. Systematic process used in this literature review

Figure 1 Systematic process used in this literature review, the PRISMA flow diagram which captures the selection process of the articles has been included to provide a clear overview of the selection process undertaken. This diagram illustrates the processes from initial searching to the selection of articles that were chosen for more in depth analysis. It would be best if this PRISMA diagram is placed in the early part of the methods section, as it aids in the descriptive as well as graphical explanations of the methodological steps for the readers who will use this document.

This protocol ensures that only relevant and high-quality articles are analyzed, so that the study results can effectively capture the latest trends in the use of the

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Technology Acceptance Model (TAM) model using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach in analyzing technology acceptance. Searches were conducted in Scopus, IEEE Explore, and ScienceDirect databases, focusing on publications from 2020 to 2025. Keywords such as "Technology Acceptance Model", and "The Least Squares Structural Equation Modeling" were used along with Boolean operators to expand the search parameters. Of the 1,946 articles identified, 471 articles were screened based on their titles and abstracts. After an in-depth quality assessment, 36 articles with a score of more than six were included in the analysis. Non-scientific articles, articles lacking evaluation results, and discussions limited to conventional methods were excluded from the review. Each selected article was evaluated for its relevance to the topic, clarity of methodology, and practical implications of its findings. This research uses descriptive analysis to reveal patterns, trends, challenges, and solutions in the use of the Technology Acceptance Model (TAM) using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach in analyzing technology acceptance. Through the application of PRISMA and careful assessment, the findings of this study provide comprehensive insight into best practices and recent advances in the energy sector. Based on the articles using the PRISMA protocol, 36 articles were analyzed to evaluate the use of the Technology Acceptance Model (TAM) using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach, its performance, and implementation challenges and solutions. The main findings are summarized in the table and discussed further to answer the research questions.

These independent reviewers completed the data extraction simultaneously for each individual study. For every article received, restoration was performed to retrieve pertinent information involving the method employed, the technology sector being evaluated, the assessed outcomes, and the challenges faced in each study. Data extraction is performed using spreadsheet software to create fields for publication year, source, methods, results and other attributes to ensure reproducibility and evidence transparency. If there are disagreements on the data extraction processes, disagreements are resolved through discussion or intervention of a third reviewer to achieve a consensus.

2.1. Search Process

The literature search process was conducted systematically through several leading academic databases, namely Scopus, IEEE Xplore, and ScienceDirect. The selection of these sources was based on the coverage of high-quality scientific publications and relevance to the field of information technology and computer science. A combination of keywords with Boolean operators was used to ensure comprehensive search results. The focus of the search was limited to the years 2020-2025 to ensure the relevance and currency of the research.

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The search process follows the following steps:

1. Keywords are identified based on the main topic and related terms (e.g. machine learning, deep learning, energy prediction).
2. Keywords are combined with Boolean operators such as AND, OR, and NOT to expand or narrow the scope of the search.
3. Initial search results are filtered based on relevant titles and abstracts.
4. A further selection process was carried out to ensure that the literature used matched the focus of the research. The following is a table of sources and Boolean keywords.

Table 1. Boolean Resources and Keywords

Source	Boolean Keywords
Scopus	("technology acceptance model" OR TAM)) AND ("partial least squares" OR "PLS-SEM" OR "structural equation modeling") AND (acceptance OR adoption OR "user acceptance") AND (construct* OR variable* OR factor* OR determinant* OR dimension*)
IEEE Xplore	("Technology Acceptance Model" OR "TAM") AND ("Partial Least Squares Structural Equation Modeling" OR "PLS-SEM")
ScienceDirect	(" Technology Acceptance Model " OR "TAM") AND ("Partial Least Squares Structural Equation Modeling" OR "PLS-SEM")

Table 1 shows the combinations of keywords and Boolean operators used for literature searches in Scopus, IEEE Xplore, and ScienceDirect. This combination was designed cover research on the use of the Technology Acceptance Model (TAM) using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach in analyzing technology acceptance. The results of this table ensure that the scope of the search includes the TAM and PLS-SEM models and their applications in technology acceptance, such as the development of information technology and the factors influencing technology acceptance. The use of specific keywords such as "Technology Acceptance Model" and "Partial Least Squares Structural Equation Modeling" helps focus the search results on current trends in smart and renewable energy.

2.2. Inclusion and Exclusion Criteria

The literature selected for this review was screened based on strict inclusion and exclusion criteria. These criteria ensured that only relevant and recent studies were considered.

Table 2. Inclusion and Exclusion Criteria

Inclusion	Exceptions
Publication in the 2020-2025 timeframe	Publication before 2019
English article or valid translation	Articles in languages other than

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Inclusion	Exceptions
Publication in the 2020-2025 timeframe	Publication before 2019
	English without translation
Focus on the application of computer science Deep	Articles that only discuss conventional methods
Studies on technology acceptance in various sectors	Research outside the context of computer science
Peer-reviewed journal or conference article	Books, theses, or articles that have not been peer - Reviewed
Contains experimental and evaluation results with clear metrics	Conceptual study without empirical evaluation

Table 2 summarizes the inclusion and exclusion criteria used to screen the literature in this study. Included articles focused on using the Technology Acceptance Model (TAM) using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach in analyzing technology acceptance, published between 2020-2025, and provided empirical evaluation with clear metrics. Articles in languages other than English or without the use of the Technology Acceptance Model (TAM) using the Partial Least Squares Structural Equation Modeling (PLS- SEM) approach were excluded. The result of applying these criteria ensures that only relevant and high-quality articles are analyzed, thus supporting the research focus on current trends and technology implementation in the energy sector.

2.3. Quality Assessment Process

Quality assessment (QA) ensured that only relevant, high-quality literature was used in the study. Each piece of literature selected through the initial search phase was assessed against quality criteria to ensure its validity, reliability and contribution to the research topic. This assessment included relevance of content, research methods used, completeness of data, and transparency in reporting results and conclusions. The following is the checklist or rubric used to conduct the quality assessment.

Table 3. Quality Assessment Checklist or Rubric

Criteria	Description	Score (0-2)
Relevance and Theme Focus	The suitability of the discussion with the topic of TAM & PLS-SEM	0-2
Depth of Literature Analysis	Depth of evaluation and discussion of the studies reviewed	0-2
Clarity of Writing Structure	Systematic and easy-to-follow	0-2

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Criteria	**Description**	**Score (0-2)**
and Flow	structure	
Literature Synthesis & Gap Identification	Ability to identify research patterns and gaps	0-2
Understanding of TAM & PLS-SEM	Mastery of theory and methodology	0-2
Innovation or Value-Added Review	A new approach, framework, or unique insight	0-2
Scientific Language Style and Readability	Scientific language, clear and easy to understand	0-2
Accuracy & Completeness of References	Use reliable and appropriate sources	0-2
Visualization (Table, Diagram, Framework)	Use of visual aids to clarify content	0-2
Feasibility as a Basis for Further Research	Potential to be used for basic research (thesis, theses, articles)	0-2

Tabel 3 presents the scoring system for evaluating the quality of the analyzed articles which include ten main criteria with scores ranging from 0 to 2. Criteria assessed are relevance and focus of the theme, the depth of the literature analysis, clarity of the writing structure, literature synthesis and gap identification, understanding of TAM and PLS-SEM, innovation or added value, scientific language style and readability, accuracy and completeness of the references, visualization (tables, diagrams, frameworks), and suitability as foundational research for advanced studies. Each criterion is scored based on the fulfillment of the prescribed quality standards in the article. Nevertheless, there is an inconsistency with the maximum score from the table which is 10, but the score that can be achieved for these ten criteria is 20. hence, adjustment in the scoring system is necessary to align the provided scores with the maximum achievable score.

To reach an agreement on discrepancies in voting or assessing an article, we use multi-reviewer consensus-based approaches. If two reviewers do not reach agreement, discussion is held where effort is made to reach an agreement, in light of the relevance of the article and the quality of the methodology used. If required, a third reviewer may be consulted to ensure that the decision will be objectively and fairly reached. This guarantees that the article review process is transparent and reproducible.

2.4. Data Collection and Data Analysis

The data collection process in this study consisted of several steps:

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1) Articles that have passed the initial screening and QA stages will be analyzed. Each article will be extracted based on the methods used, energy sectors studied, evaluation metrics, and challenges found.
2) Data from each relevant study was stored in a spreadsheet with specific attributes (e.g., year of publication, source, methods, and results).
3) Descriptive analysis techniques were used to find patterns and trends using TAM and PLS-SEM. Key indicators analyzed include the frequency of specific methods, model performance, and the most studied energy sector.

PRISMA Diagram for Literature Selection Process as shown in Figure 2.

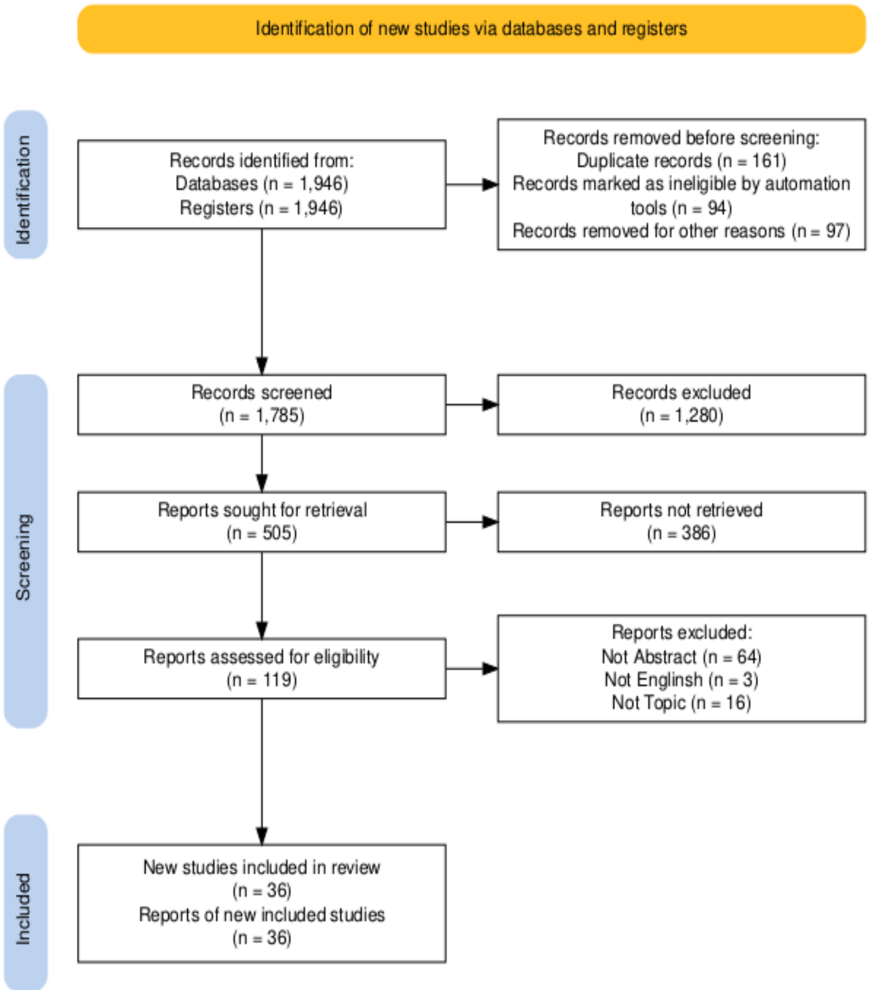

Fig. 2 Systematic process used in this literature review

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Figure 2 Systematic process used in this literature review: The process of article search and selection in this study follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology. During the identification phase, articles were obtained from two main sources: databases and registers, totaling 1,946 articles originating from Scopus (661), ScienceDirect (1,811), and IEEE Xplore (66), resulting in a total of 1,946 identified articles. Before the screening process began, several articles were removed due to duplication (161 articles), deemed ineligible by automation tools (94 articles), and removed for other reasons (97 articles). After this initial elimination, 1,785 articles proceeded to the screening stage.

In the screening stage, all articles were reviewed based on their titles and abstracts. As a result, 1,280 articles were excluded due to irrelevance, leaving 505 articles considered potentially eligible for further analysis. However, from that number, only 119 articles were successfully retrieved in full-text form, while 386 articles were inaccessible. Subsequently, during the eligibility assessment stage, 119 articles were thoroughly analyzed. Of these, 64 articles were excluded due to the absence of abstracts, 3 articles were written in languages other than English, and 16 articles were not relevant to the research topic, leading to the elimination of 83 articles. Finally, 36 articles were deemed eligible and included in the literature review.

3. RESULTS AND DISCUSSION

3.1. PLS-SEM for TAM

People were still using Partial Least Squares Structural Equation Modeling (PLS-SEM) for Technology Acceptance Models (TAM) until September 1999, when a review of research tools was published in Management Science. Although there have been many changes in recent decades regarding our attitudes toward technology, one thing has remained constant. Partial Least Squares Structural Equation Modeling (PLS-SEM) is frequently used in technology acceptance research. The aim of this study is to evaluate and analyze the latest developments in the application of Partial Least Squares Structural Equation Modeling (PLS-SEM) in the Technology Acceptance Model (TAM). Based on a systematic literature review, several significant findings were identified regarding the use of PLS-SEM in enhancing the understanding and measurement of factors influencing technology adoption by users [6].

Some of the studies analyzed in this review confirm that dimensions such as perceived ease of use (PEOU) and perceived usefulness (PU) remain the two primary factors influencing users' intentions to adopt new technology. PLS-SEM provides the ability to test direct and indirect effects between variables with greater precision, which is crucial for understanding the dynamics between internal and

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external factors influencing technology adoption. In addition, this technique also demonstrates its strength in handling latent variables that cannot be measured directly, which are often found in more complex TAM models. Furthermore, this study shows advances in the application of more advanced TAM, such as the integration of social and cultural aspects as factors influencing technology acceptance. For example, the impact of social support and trust on technology acceptance has been discussed in several recent studies.

By using PLS-SEM, researchers can more easily measure the impact of these additional variables on users' attitudes toward using certain technologies. Overall, the results of this study confirm that applying PLS-SEM to the TAM model makes technology acceptance modeling more dynamic and multifaceted by incorporating external factors, thereby enriching research in the field of software and information technology. With a more structured analysis, this updated TAM model has the potential to contribute to the development of more efficient technology adoption strategies across various fields.

RQ1: **To what extent does PLS-SEM contribute to the robustness of TAM-based models in the evaluation of new digital platforms?**

Partial Least Squares Structural Equation Modeling (PLS-SEM) has proven to be a significant methodological tool in enhancing the robustness of TAM-based models, particularly in the evaluation of new digital platforms. PLS-SEM allows researchers to model complex relationships between latent variables without strict assumptions regarding data distribution, making it suitable for exploratory research in emerging digital environments.

According to. [7], Partial Least Squares Structural Equation Modeling (PLS-SEM) is a widely utilized methodology for assessing constructs related to the Technology Acceptance Model (TAM), particularly perceived usefulness and perceived ease of use. PLS-SEM is favored for its capability to handle intricate relationships among multiple variables and its flexibility concerning sample size and data distribution assumptions, making it a suitable choice for researchers exploring technology adoption. [8] highlighted the utility of PLS-SEM in validating the structural relationships within TAM and in testing hypotheses involving user acceptance of technology in varying digital contexts.

Moreover. [9] Emphasize the value of PLS-SEM in evaluating both explanatory and predictive power (R^2 and Q^2 values), noting its capability in handling complex models that include multiple constructs and mediating variables. This ensures not only the statistical robustness of the model but also its practical relevance for understanding user behavior on new platforms.

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In studies focusing on specific platforms-such as mobile banking, e-learning, and gamified training systems-researchers such as [10] and [11] have shown that PLS-SEM is instrumental in revealing both direct and indirect influences between TAM constructs, thereby enabling a deeper interpretation of the factors that drive adoption and usage intentions. Collectively, these findings suggest that PLS-SEM substantially contributes to the robustness of TAM-based models by enabling comprehensive model validation, supporting theory development, and enhancing the predictive accuracy of user acceptance behavior in the context of emerging digital platforms.

Table 4. Contribution of PLS-SEM to the Robustness of the TAM Model

Study	Methodology	The role of PLS-SEM in TAM	Digital Platform
[12]	PLS-SEM	Evaluate relationships, calculate factor loadings, AVE, CR, CA.	Not referenced
[13]	PLS-SEM	Establish foundation, test hypotheses, validate models.	Not referenced
[14]	PLS-SEM	Test models, assess path coefficients, R^2, Q^2 values.	Not referenced
[15]	PLS-SEM	Poor explanatory power, medium predictive power.	Not referenced
[16]	SEM + PLS-SEM	Effective with small samples, predicts dependent variables.	Not explicitly defined
[17]	PLS-SEM	Analyze TAM data, evaluate functionality, expressiveness, and aesthetics.	Not referenced
[18]	TAM + SEM-PLS	Validate models, prediction-based research.	Not explicitly defined
[19]	PLS-SEM	Positive relationships, explain continuance intention.	Not referenced
[20]	PLS-SEM	Estimate complex models, predict smart education tech usage.	Not referenced
[21]	PLS-SEM	Quantify relationships, estimate complex models.	Not explicitly used
[22]	fsQCA + PLS-SEM	Explore TAM constructs like perceived usefulness and ease of use.	Not defined
[23]	SEM-PLS	Flexible, less conservative requirements.	Not explicitly defined

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Study	Methodology	The role of PLS-SEM in TAM	Digital Platform
[24]	TAM + SEM-PLS	Analyze e-wallet adoption within TAM.	Gcash
[25]	CB-SEM +PLS-SEM	Evaluate measurement model reliability and validity.	TikTok
[26]	PLS-SEM	Handle non-normally distributed data, complex models.	Not referenced
[27]	PLS-SEM	Theoretical construction for exploratory research.	Not explicitly defined
[28]	PLS-SEM	Explore relationships like cybersecurity awareness.	Not explicitly referenced
[29]	PLS-SEM + CFA	Explore relationships like cybersecurity awareness.	Not explicitly defined
[30]	PLS-SEM + CFA	Validate structural models in social and management sciences.	Not explicitly used
[31]	TAM + PLS-SEM	Evaluate constructs, assess path coefficients, R^2, Q^2.	Blockchain and AI.
[32]	SEM-PLS + UTAUT	Validate data using UTAUT model, factors influencing student acceptance.	Zedemy
[33]	TAM + PLS-SEM	Analyze TAM constructs.	Not referenced
[34]	PLS-SEM	Validate extended TAM model.	Moodle gamification platform.
[35]	TAM + PLS-SEM	Analyze E-Pharmacy service interactions.	Not defined
[36]	PLS-SEM	Role in TAM, no digital platform mention.	Not mentioned
[37]	PLS-SEM	Evaluate e-banking adoption within TAM.	Not mentioned
[38]	PLS-SEM + TAM	Handle formative measurements and moderating effects.	No digital platform.
[4]	TAM + PLS-SEM	Analyze TAM in blockchain adoption.	Not referenced

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Study	Methodology	The role of PLS-SEM in TAM	Digital Platform
[39]	TAM + PLS-SEM	Discusses AMOS, not specific to PLS-SEM.	Not referenced
[40]	TAM + PLS-SEM	Demonstrate validity, analyze TAM relationships.	Not discussed
[41]	TAM + PLS-SEM	Assess construct validity, use bootstrap for accuracy.	Ride-hailing, e-wallet.
[42]	TAM + PLS-SEM	Determine reliability and validity, provide foundational data.	Digital platform mentioned.
[43]	TAM + PLS-SEM	Analyze TAM's perceived usefulness, ease of use.	Not explicitly used
[44]	PLS-SEM	Understand TAM in technology acceptance.	Digital platform mentioned.
[45]	PLS-SEM	Evaluate relationships, calculate factor loadings, AVE, CR, CA.	Not referenced
[46]	UTAUT + PLS-SEM	This approach aligns with the application of TAM	Not referenced

Table 4 presents a summary of various studies that utilize Partial Least Squares Structural Equation Modeling (PLS-SEM) within the Technology Acceptance Model (TAM) framework. The use of PLS-SEM in these studies primarily focuses on validating theoretical constructs, examining the relationships among latent variables, and assessing the model's reliability, validity, explanatory power (R^2), and predictive relevance (Q^2). Several studies also incorporate hybrid methods such as fsQCA, CFA, and SmartPLS to enhance model evaluation and gain deeper insights into technology adoption behavior. Despite the broad application of PLS-SEM across different technological contexts-such as mobile banking, e-wallets, e-learning platforms, and smart education systems-most of the studies reviewed do not explicitly refer to or define the term "Digital Platform." This indicates a potential gap or variation in the definition of digital platforms. This indicates a potential gap or variation in terminology used across studies, even though the underlying constructs related to digital technology acceptance are widely explored. The table demonstrates that PLS-SEM remains a robust and flexible tool for exploring complex models in TAM-related research, especially in emerging technology domains.

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RQ2: **What external variables are the most relevant and effective in explaining user satisfaction in the PLS-SEM based TAM model?**

In TAM-based studies that utilize Partial Least Squares Structural Equation Modeling (PLS-SEM), a growing body of research has emphasized the importance of incorporating external variables to better explain user satisfaction a key outcome variable in technology acceptance. The inclusion of these external constructs not only enriches the predictive power of the model but also provides nuanced insights into the behavioral intentions and actual system use. One of the most consistently relevant and effective external variables is perceived trust. In the study by [53] on e-wallet adoption, trust was found to significantly influence both perceived usefulness and user satisfaction, confirming its central role in user decision-making in digital financial technologies.

Another highly influential variable is system quality, particularly in platform-based applications. [47] integrated dimensions such as *functionality*, *aesthetics*, and *expressiveness* as external constructs and demonstrated that these variables had a strong impact on perceived ease of use and subsequently on user satisfaction. Their study used PLS-SEM to validate the strength and direction of these relationships, confirming the importance of interface and design-related features. Perceived enjoyment also appears frequently as a relevant external construct. In the context of gamified learning platforms.[48] Service quality further complicates this relationship, emerging as a prominent external factor influencing user satisfaction. Various studies demonstrate that system quality, information quality, and service quality correlate with user satisfaction, thus supporting the notion that enhancing these qualities can lead to improved overall user satisfaction. [49] Explored the influence of service quality within an educational platform ("Zedemy") and found a significant relationship between service quality and user satisfaction, mediated by performance expectancy and facilitating conditions within an integrated UTAUT-TAM framework.

In addition, technological self-efficacy has gained traction as a strong predictor of user satisfaction. As shown by [50] users with higher self-efficacy are more likely to perceive the system as easy to use, which positively influences both perceived usefulness and satisfaction. The use of PLS-SEM in these studies supports the robustness of such relationships and allows for comprehensive model validation. In summary, the most effective external variables that have consistently demonstrated significant impact on user satisfaction in TAM-PLS-SEM studies include trust, system quality, perceived enjoyment, service quality, and technological self-efficacy. These constructs help bridge the gap between system interaction and subjective satisfaction, thereby enhancing both theoretical and practical understanding of user acceptance in various technology contexts.

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Table 5 External Variables on User Satisfaction in TAM (PLS-SEM)

Study	Methodology	PEOU atau PU	User Satisfaction	N Sampel
[12]	PPLS-SEM	YES	NO	230
[13]	PPLS-SEM	YES	NO	178
[14]	PPLS-SEM	YES	NO	296
[15]	PPLS-SEM	YES	NO	375
[16]	SEM + PLS-SEM	YES	NO	301
[17]	PLS-SEM +	YES	NO	225
[18]	TAM + SEM-PLS	YES	NO	100
[19]	PLS-SEM	YES	NO	369
[20]	PLS-SEM	YES	YES	238
[21]	PLS-SEM + CFA	YES	NO	290
[22]	FsQCA	YES	NO	325
[23]	SEM-PLS + TAM	YES	NO	200
[24]	SEM-PLS + TAM	YES	NO	574
[25]	TAM + SEM-PLS	YES	NO	500
[26]	CB-SEM+ PLS- SEM	YES	NO	859
[27]	PLS-SEM	YES	NO	456
[28]	PLS-SEM + TAM	YES	YES	504
[29]	PLS-SEM + TAM	YES	NO	398
[30]	PLS-SEM + CFA	YES	NO	1432
[31]	PLS-SEM + CFA	YES	NO	156
[32]	TAM + PLS-SEM	YES	NO	588
[33]	SEM-PLS + UTAUT	YES	NO	181
[34]	TAM + PLS-SEM	YES	YES	276
[35]	PLS-SEM	YES	YES	375
[36]	TAM + PLS-SEM	YES	NO	480
[37]	PLS-SEM	NO	NO	-
[38]	PLS-SEM	YES	NO	105
[4]	PLS-SEM + TAM	YES	NO	645
[39]	TAM + PLS-SEM	YES	NO	248
[40]	TAM + PLS-SEM	YES	NO	241
[41]	TAM + PLS-SEM	YES	NO	400
[42]	TAM + PLS-SEM	YES	YES	135
[43]	TAM + PLS-SEM	YES	NO	-
[44]	TAM + PLS-SEM	YES	YES	-

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Study	Methodology	PEOU atau PU	User Satisfaction	N Sampel
[45]	PLS-SEM	YES	YES	414
[46]	UTAUT + PLS-SEM	YES	NO	180

Table 5 The summarized literature table highlights a selection of relevant and up-to-date studies aimed at examining how the core TAM variables—*Perceived Ease of Use* (PEOU) and *Perceived Usefulness* (PU)—have been used to explain user acceptance behavior. Additionally, the presence of extended variables such as *User Satisfaction* is also explored in several studies. In general, all reviewed studies include either PEOU, PU, or both, affirming the consistency and validity of TAM in explaining technology adoption across different contexts. A number of studies also incorporate *User Satisfaction* as a complementary variable to further assess the success of technology implementation, such as those conducted by [51].

The dominant analytical technique employed across these studies is PLS-SEM, either used independently or in combination with other approaches such as *Confirmatory Factor Analysis* (CFA), *Fuzzy-set Qualitative Comparative Analysis* (FsQCA), and *Covariance-Based SEM* (CB-SEM). PLS-SEM is deemed particularly suitable for analyzing complex and exploratory models like TAM, as emphasized by [27]. This method allows for the examination of latent variable relationships with varying sample sizes and without strict assumptions of data normality. Sample sizes in the reviewed studies range from 100 to over 1400 respondents, reflecting the diversity in research contexts, including geographic regions, technological domains, and organizational settings. Such variation enhances the generalizability and replicability of the TAM framework. Studies such as [51]. Demonstrate that integrating *User Satisfaction* into the TAM framework provides valuable insights, particularly in post-adoption phases. Likewise, research by [34] and [51] underscores the significance of satisfaction in sustaining continued use of technology. In summary, the literature review supports the use of TAM in conjunction with PLS-SEM as a robust and valid methodological combination to measure users' technology acceptance in various digital transformation contexts.

3.2. Discussion

Based on the results of a systematic review of 36 selected articles, it is clear that including external variables into the Technology Acceptance Model (TAM) through Partial Least Squares Structural Equation Modeling (PLS-SEM) enhances the model's explanatory strength, particularly regarding user satisfaction. Since user satisfaction is a fundamental indicator of technology effectiveness across numerous digital platforms, it becomes important to determine which external constructs are most useful and impactful. Yet, it should be mentioned that there is debate over how consistently these variables impact different platforms. To make

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sense of why these variables are important across different frameworks, they need to be examined across different technological ecosystems.

Research conducted in the context of the influence of technology acceptance [52]. The contextual factors influencing technology acceptance are extensive and complex, with numerous external variables emerging as key determinants in enhancing the depth of acceptance. One core aspect is the integration of qualitative insights into established models such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT).

The rapid development of telemedicine has significantly transformed healthcare services, leveraging technological advancements to enhance medical consultations and treatment through the Halodoc app [53]. Using a quantitative approach with PLS-SEM data analysis, this study integrates the UTAUT 2 Model with the Delone & McLean Model. The research findings indicate that out of eight hypotheses, seven were supported, with Effort Expectancy on User Satisfaction being the only hypothesis rejected. These findings highlight that User Satisfaction significantly influences Behavioral Intention, emphasizing the importance of enhancing user experience to increase telemedicine adoption.

Other researchers have noted that the primary role of TAM in the acceptance of educational technology indicates that external influences, including social and institutional contexts, are crucial in shaping user experiences and satisfaction levels [54]. There are several theoretical approaches that stand out in the context of education, including the Innovation Diffusion Theory (IDT), the Unified Theory of Acceptance and Use of Technology (UTAUT), and the Motivation Model (MM). Research shows that the Technology Acceptance Model (TAM) is the most influential model and leading scientific paradigm in investigating technology acceptance in the field of education**.** With the aim of enhancing their predictive validity, these models have been expanded in various empirical studies with additional predictive factors, such as self-efficacy, subjective norms, perceived enjoyment, playfulness, anxiety, social influence, system quality, and facilitating conditions. Research indicates that e-learning is the most common and valid delivery mode, followed by m-learning, learning management systems (LMS), personal learning environments (PLE), and massive open online courses (MOOCs), along with supporting technologies used in education such as social media platforms, teaching assistant robots, simulators, and virtual reality (VR) and augmented reality (AR) technologies. To enhance explanatory power, recent developments in the acceptance and adoption of educational technology have suggested the need to integrate TAM and UTAUT with other adoption and post-adoption theories and models, along with established approaches from other fields.

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Findings from these studies indicate that user satisfaction in the acceptance of educational technology is highly dependent on various external factors. The interaction between perceptions of ease of use, perceived usefulness, self-confidence, and social norms plays a role in shaping users' attitudes toward technology, which ultimately influences their behavior and level of satisfaction in the educational environment. As in the research conducted by [55] Information and Communication Technology (ICT) is emerging as a promising paradigm for creating profound changes in the digitization of education. For the practical implications of the proposed research model, four groups of students, each consisting of 300 people or two programming courses: C++ and Java, were analyzed in two consecutive academic sessions in a controlled environment for theory classes and laboratories. A series of statistical analyses were conducted and evaluated with hypothetical relationships to measure the desired outcomes. This model measures the impact on the following constructs: student interest, motivation, understanding, satisfaction, attention and interaction in class, attendance, grade improvement, and perception of pedagogical effects. The results show positive effects for the research questions and identified hypotheses, helping students in their knowledge, understanding, and programming and debugging skills.

4. CONCLUSION

This study demonstrates that the adoption of external factors for TAM (Technology Acceptance Model) technology is capable of adding value to models for explaining and predicting user satisfaction when analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). These findings are relevant for technology researchers and policymakers aiming to enhance technology adoption and user experience. The five most relevant and consistent external constructs identified in this study include trust, quality system, emotional well-being, service quality, and technology-driven self-efficacy. Concern for safety (trust) not only has high predictive power in digital payment systems and e-commerce, but it is also highly valued by user experience. Platform developers can enhance customer satisfaction by focusing on security and reliability, which are elements that directly contribute to user satisfaction. System quality, encompassing functionality and aesthetics, is crucial in influencing usability and user satisfaction, particularly on technology-based platforms. In gamified and educational environments, the feelings experienced—the words used—can quickly become mediating variables linking user ease and user satisfaction.

Service quality, which is particularly important in educational platforms, can enhance user satisfaction when users receive supportive and responsive assistance. Technological self-efficacy, which plays a significant role in systems requiring autonomy and certain user capabilities, indicates that users who are more self-efficacious actively report higher levels of satisfaction. However, this study has

p-ISSN: 2656-5935 http://journal-isi.org/index.php/isi e-ISSN: 2656-4882

limitations in its theoretical framework. Therefore, while these findings are relevant to platform developers, policymakers, and practitioners involved in enhancing technology adoption, they may not be applicable to other sectors not included in this review. Furthermore, due to the limited sample size and the possibility that the sample may not be representative of the entire population, the validity of the findings may be compromised. Future research may want to focus on how these external variables behave in different sectors or among different populations. Additionally, longitudinal studies may provide deeper insights into how technology adoption evolves over time.

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