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Analysis of the Technology Acceptance Model (TAM) in the Acceptance of Smartboards in Elementary Schools

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Abstract

The use of Smartboards in primary school learning has become an essential part of digital transformation in Indonesian education. However, the success of this implementation strongly depends on user acceptance. This study aims to analyze the factors influencing Smartboard acceptance using the Technology Acceptance Model (TAM), which includes Perceived Usefulness (PU), Attitude Toward Using (ATU), and Intention to Use (IU). A quantitative explanatory correlational design was employed, involving primary school teachers in West Jakarta who have used Smartboards in classroom instruction. Data were analyzed using Structural Equation Modeling (SEM). The findings indicate that all indicators of PU, ATU, and IU demonstrate valid and reliable loading factor values. Structurally, PU has a positive and significant effect on IU, and ATU also shows a significant positive influence on IU. These results highlight that perceived usefulness and positive attitudes are the primary determinants shaping teachers' intention to use Smartboard technology. The study implies that enhancing digital competencies, providing structured Smartboard training, and ensuring technical support are crucial to optimizing the implementation of Smartboard-based learning.

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Introduction

The rapid evolution of digital technology has fundamentally reshaped instructional practices in elementary schools, particularly through the integration of smartboards as interactive learning tools. These devices are designed to enhance instructional delivery by providing visually enriched and dynamic teaching materials that stimulate stronger student engagement. As global education systems progressively adopt 21st-century skills frameworks, smartboards are positioned as essential instruments for fostering creativity, collaboration, critical thinking, and digital literacy. Their capabilities allow teachers to create immersive learning experiences that promote conceptual clarity and facilitate active participation among young learners. Consequently, the presence of smartboards in elementary classrooms reflects a broader movement toward digital transformation in education.

Numerous previous studies have employed the Technology Acceptance Model (TAM) as a theoretical framework to examine technology adoption in educational settings. This model emphasizes two core constructs, namely Perceived Usefulness and Perceived Ease of Use, which influence users' attitudes, behavioral intentions, and actual system use. Prior research generally indicates that these two constructs significantly affect the acceptance and utilization of educational technologies.

Nevertheless, a critical review of the existing literature reveals several limitations that indicate the presence of a research gap. First, most TAM-based studies in education have predominantly focused on secondary and higher education contexts, such as the use of e-learning platforms, learning management systems, or other digital learning applications. Empirical studies specifically examining smartboard acceptance at the elementary school level remain relatively scarce. This gap is noteworthy, as users at the elementary level exhibit distinct characteristics in terms of pedagogical approaches, cognitive development, and technological competence compared to learners and educators in higher educational levels. Second, previous studies have largely been conducted in developed countries or urban educational environments with well-established technological infrastructure. These contexts do not fully represent the conditions of elementary schools in developing countries such as Indonesia, where disparities in technological resources, teachers' digital literacy, and institutional support remain prevalent. Consequently, the findings of earlier studies may not be directly generalizable to the Indonesian elementary school context. Third, existing research tends to emphasize the technical and functional aspects of technology adoption, particularly perceived ease of use and perceived usefulness, without sufficiently addressing the pedagogical and contextual dimensions of elementary education. Factors such as teachers' pedagogical readiness, the suitability of smartboards for the learning characteristics of young students, and the integration of smartboards into the elementary school curriculum have received limited scholarly attention.

Based on these considerations, it can be concluded that a significant research gap exists in studies investigating smartboard acceptance in elementary schools through the Technology Acceptance Model framework. Therefore, the present study is essential to comprehensively examine the factors influencing teachers' acceptance and actual use of smartboards in the context of Indonesian elementary education. The findings of this study are expected to contribute theoretically to the extension of TAM in elementary education and practically to informing educational policy and the effective integration of smartboards as instructional media.

Despite the increasing availability of smartboards in Indonesian schools, their adoption is often hindered by several non-technical factors that extend beyond the mere provision of equipment. Central to this issue are user-centered dimensions such as perceived usefulness, perceived ease of use, comfort, and readiness to adopt technology. Teachers and students may possess varying degrees of familiarity with digital tools, which can affect their confidence and willingness to employ smartboards consistently. These challenges highlight that successful educational technology implementation requires not only infrastructure but also comprehensive support mechanisms that enhance user competence and motivation. Therefore, analyzing these acceptance factors becomes critical in understanding the actual utilization of smartboards in elementary learning environments.

A substantial body of research employing the Technology Acceptance Model (TAM) has demonstrated its robustness in predicting the adoption of various educational technologies, including e-learning platforms and game-based instructional tools. Studies consistently emphasize that perceived usefulness and perceived ease of use shape users' attitudes and behavioral intentions toward continuous engagement with learning systems. Additional constructs, such as user satisfaction and information quality, further strengthen the explanatory power of TAM in

understanding digital adoption behavior. These findings collectively suggest that TAM is an appropriate theoretical framework for assessing the acceptance of smartboards in elementary schools, particularly in digital education initiatives across diverse contexts.

The Indonesian government's commitment to promoting adaptive learning technologies is evident through the provision of smartboards to primary schools, aiming to enhance teaching effectiveness and learning efficiency. National and international studies reveal that interactive whiteboards yield multiple benefits, including improved classroom management, heightened learner motivation, and enriched pedagogical practices. Research further indicates that teachers' positive perceptions of smartboards—especially regarding usability and instructional value—contribute significantly to their consistent adoption. Moreover, smartboards have been found to strengthen learning outcomes, encourage differentiated instruction, and support digital-based assessment strategies. Collectively, these findings underscore the pedagogical potential of smartboards when integrated effectively.

Although smartboards have become more prevalent in Indonesian elementary schools, there remains a research gap regarding their acceptance at the user level. Most existing studies focus primarily on technical features or classroom demonstrations rather than on the psychological and behavioral aspects of user acceptance. Several previous studies on the Technology Acceleration Model state that this study illustrates that TAM has been able to explain the factors that predict the use of e-learning among users on the Edtech Startup platform, especially in supporting the learning process carried out. (Aripradono et al., 2023). The results of the study showed that perceived ease of use, perceived usefulness, and user satisfaction significantly influenced the intention to continue using the Canvas LMS. (Simaremare et al., 2024). Additionally, limited empirical attention has been directed toward examining how smartboard adoption relates to learning quality, particularly within early-grade education (Beldad & Hegner, 2018).. Studies linking TAM variables—specifically perceived usefulness and perceived ease of use—to measurable improvements in learning performance are still scarce. This lack of comprehensive inquiry calls for a deeper exploration of how acceptance factors influence the effectiveness of smartboard-based instruction. The results of the study stated that the adoption of technology by teachers in business education in Surakarta (Nur Rahmi Akbarini, 2024). Research with TAM (Sulaiman et al., 2023) shows that information quality is significantly correlated with Perceived Usefulness and Perceived Ease of Use.

Given the gaps in prior research, it is essential to examine the contribution of smartboard acceptance to the enhancement of elementary students' learning experiences. (Ndwandwe et al., 2024). Research Result (Belabcir, 2025) showed that Moroccan English as a Foreign Language (EFL) teachers working in the field of Foreign Language Education (EH) have positive perceptions towards the use of Interactive Whiteboards (IWB) in terms of Ease of Use, Usability, and User Acceptance. The use of interactive whiteboards improves teachers' skills in the classroom in the learning process (Zhao et al., 2024). Research (Sefriani et al., 2022) Understanding acceptance not only clarifies how users interact with technology but also informs the development of strategies to optimize digital device utilization. By focusing on schools in Jakarta, where technology integration is relatively advanced, this study aims to generate empirical insights relevant to broader national implementation efforts. Research (Fitroti et al., 2025) Such analysis is particularly valuable for educational stakeholders—including teachers, administrators, and policymakers—as they seek to maximize the pedagogical benefits of smartboards and make informed decisions regarding future technological investments.. Research Result (Susanto et al., 2025) shows that the use of Smartboard as an interactive medium in history learning significantly improves students' Historical Thinking Skills (HTS). Research (Sholihah et al., 2025) shows that the use of smartboard media has a significant impact on improving learning outcomes in Pancasila education, especially in the

material on recognizing the formulators of Pancasila for grade 2 students at Al-Islam Pengkol Elementary School. Research (Nurkhofifah, 2022) shows that the use of smartboard media can significantly improve students' reading comprehension skills. Research (Rahayu, 2024) stated that the use of SmartBoard Interactive increases student engagement, increases learning motivation, and facilitates better understanding of concepts. Research (Winayu, 2024) stated that this had an impact on the quality of learning carried out at SMPIT Mutiara Cendekia.

The integration of TAM into the investigation of smartboard use presents substantial theoretical significance, as it enables a systematic assessment of how users interpret technological attributes and translate these perceptions into behavioral intentions. Practically, the findings hold implications for professional development programs, digital pedagogy design, and infrastructure planning in schools. If high acceptance levels are shown to correlate with improved technology effectiveness, stakeholders can tailor their interventions toward enhancing users' perceptions of usefulness and ease of use. This approach aligns with contemporary educational policy trends that emphasize capacity building, pedagogical innovation, and evidence-based decision-making.

Although the Technology Acceptance Model (TAM) has been widely used in research on educational technology adoption, particularly in e-learning and Learning Management Systems (LMS), studies applying TAM to Smartboard use in elementary schools are still limited. Most previous research focuses on secondary and higher education levels and on individual learning technologies, thus not fully representing the characteristics of learning in elementary schools. Furthermore, TAM research generally emphasizes aspects of intention and technology use, without directly linking them to learning quality. To date, there has been little empirical research examining Smartboard acceptance by elementary school teachers and its impact on learning quality, particularly in the context of elementary schools in West Jakarta. Therefore, this study is novel in integrating TAM with learning quality in Smartboard use in Indonesian elementary schools.

In response to the identified research gap, this study seeks to evaluate the extent to which the acceptance of smartboards influences the quality of learning among elementary school students. By examining acceptance constructs within TAM, this research is expected to provide a comprehensive understanding of the relationship between digital technology adoption and educational outcomes in Indonesia. The insights generated will not only contribute to scholarly discourse but also inform practical recommendations for improving smartboard implementation at the school level. Ultimately, the study aspires to support national efforts in advancing digital education and ensuring that smartboard integration yields meaningful and sustainable improvements in student learning.

Methods

This study employed a quantitative research design with an explanatory correlational orientation to analyze the causal relationships among Technology Acceptance Model (TAM) constructs in the context of smartboard utilization in elementary schools. The research focused on determining how Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Attitude Toward Using (ATU), Behavioral Intention (BI), and Actual Usage (AU) contribute to learning effectiveness and student learning outcomes. The population consisted of elementary school teachers in West Jakarta, and the sample was selected through stratified random sampling or purposive sampling by targeting schools that had implemented smartboard technology. Data collection was conducted using a structured questionnaire with items measured on a five-point Likert scale to capture variations in respondents' perceptions.

The sampling method used was multistage random sampling. Multistage random sampling is a sampling technique conducted on a population that has stratified and clustered

characteristics. The total population was 337 people. Then, the calculation was carried out using the Slovin formula as follows:

$$n = \frac{N}{1 + N \cdot e^2}$$
$$n = \frac{337}{1 + 337(0{,}05)^2}$$
$$n = \frac{337}{1 + 337(0{,}0025)}$$
$$n = \frac{337}{1 + 0{,}8425}$$
$$n = \frac{337}{1{,}8425}$$
$$n = 182{,}9 \approx 183$$

n= number of sample
N= population size
e= margin of error

The analytical technique employed Structural Equation Modeling (SEM), allowing for simultaneous testing of the theoretical model and verification of causal hypotheses linking the latent variables. The analytical process began with the development of an initial structural model, identifying exogenous and endogenous variables and specifying measurement models that represent latent constructs. In this model, Computer Self-Efficacy (CSE) was hypothesized to influence Perceived Ease of Use, while both CSE and PEOU were expected to affect Perceived Usefulness. Subsequently, Attitude Toward Using was modeled as a function of Perceived Usefulness and Perceived Ease of Use, whereas Behavioral Intention was influenced by Attitude Toward Using and Perceived Usefulness. Actual Usage was positioned as the behavioral outcome influenced by Behavioral Intention. Model identification procedures were conducted to prevent over-identification or under-identification, followed by iterative model estimation using different initial values to obtain stable coefficient estimates. The next stage involved evaluating model fit through goodness-of-fit indices and performing model respecification where necessary to refine structural paths and ensure theoretical coherence. Descriptive and inferential statistical analyses were also conducted to support SEM results by summarizing respondent characteristics and assessing variable distributions. Through this systematic process, the methodology ensured rigorous assessment of technology acceptance factors and their empirical impact on smartboard-based learning implementation.

Results and discussion

The data analysis applied in this study incorporates both descriptive and inferential statistical techniques to ensure a comprehensive examination of the research variables and their empirical relationships. Descriptive statistics were used to summarize frequency distributions, central tendency measures, and data dispersion related to respondent characteristics and variable indicators. The measures of central tendency included mean, median, and mode, while dispersion was assessed through minimum, maximum, standard deviation, variance, kurtosis, and skewness. To test the theoretical framework, the study employed the Structural Equation Modeling (SEM) approach, which follows five sequential stages consisting of model specification, identification, estimation, fit evaluation, and respecification. The primary objective of the inferential analysis was to examine the effect of Intention to Use (IU) on Actual Use (AU) in the adoption of smartboard technology. Within the structural model, IU functions as an exogenous construct directly influencing AU as an endogenous behavioral outcome.

Based on research that has been conducted on a population of 183 teachers in West Jakarta who have obtained smartboards and use smartboards in schools to support learning.

Table 1. Respondents' Responses

Variabel	Score
CSE	49,18
PU	68,99%
PEOU	63,52%
ATU	54,64%
IU	45,45%
AU	40,71%

Source: Research Data

The following table shows that the model is a good fit to the data, namely:

Table 2. Compatibility Test

Statistical test	Model Value	Cut off	Summary
GFI	0,82	2,9	Marginal fit
NFI	0,81	2,3	Marginal fit
CFI	0,84	2,3	Marginal fit
IFI	0,85	2,3	Marginal fit
RMSEA	0,07	2.3	Good fit
RMR	0,041	2,9	Good fit

Source: Research Data

Based on the tests carried out, the following results were obtained:

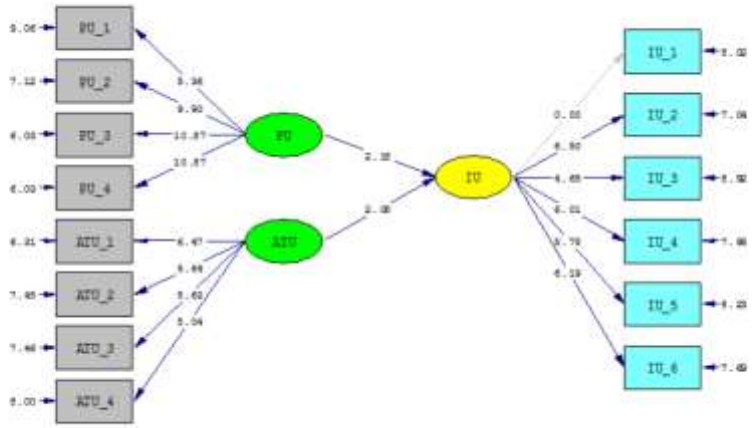

Figure 1: Research result

The structural model analysis demonstrates that all constructs within the Technology Acceptance Model (TAM)—Perceived Usefulness (PU), Attitude Toward Using (ATU), and Intention to Use (IU)—exhibit significant and theoretically consistent relationships. The results of the outer model analysis further confirm that every indicator associated with each variable achieved loading factor values exceeding the established threshold, indicating high reliability and validity in representing their respective constructs. These findings reinforce the robustness of the measurement model and ensure that the variables accurately capture user perceptions regarding smartboard adoption. The alignment between empirical results and TAM theory suggests that the conceptual framework operates effectively within the context of elementary school technology

integration. Consequently, the statistical evidence supports the conclusion that the structural model adequately represents the dynamics of technology acceptance, thereby providing a strong foundation for deeper interpretation of how smartboard utilization is shaped by cognitive evaluations and attitudinal responses among users.

The analysis of indicator loadings reveals that each variable in the model demonstrates strong explanatory power regarding user perceptions of smartboard technology. For the Perceived Usefulness (PU) variable, indicators PU_1 through PU_4 generated loading factor values ranging from 6.03 to 9.06, signifying that users consistently perceive smartboards as beneficial for enhancing learning activities. Similarly, the indicators associated with Attitude Toward Using (ATU) show values between 6.31 and 8.00, indicating that positive emotional and cognitive evaluations are closely tied to users' comfort, enthusiasm, and willingness to integrate the technology into daily teaching. Meanwhile, the Intention to Use (IU) variable includes six indicators with loading factors from 7.04 to 8.92, demonstrating that a strong intention to use smartboards emerges from mental readiness and personal commitment. These results collectively confirm that usefulness perception, attitude formation, and usage intention are interconnected determinants that reinforce each other in shaping user acceptance.

The inner model analysis provides further evidence that technology acceptance is strongly influenced by perceptions of usefulness and attitudes toward smartboard usage. Perceived Usefulness (PU) exhibits a positive and significant impact on Intention to Use (IU), with a path coefficient of 2.18, indicating that the more teachers believe smartboards enhance their instructional effectiveness, the stronger their intention to adopt them. Additionally, Attitude Toward Using (ATU) also demonstrates a significant positive effect on IU, with a coefficient of 2.08, showing that favorable emotional and cognitive orientations toward the technology elevate a user's willingness to engage with it. These relationships align with the core principles of the Technology Acceptance Model, which posits that perceived usefulness and attitudes are central predictors of behavioral intention. Therefore, the findings validate the theoretical assumptions and highlight the importance of fostering positive perceptions and supportive attitudes to maximize smartboard integration in elementary school learning environments.

Within the Technology Acceptance Model (TAM) framework, the relationship between Intention to Use (IU) and Actual Use (AU) is understood as a direct causal relationship, where user behavioral intention is the main predictor of actual technology use. Therefore, the mention of the analysis of the influence of IU on AU in the research title refers to the theoretical basis of TAM which places IU as the main determinant of teachers' Smartboard usage behavior. However, the research results presented focus more on testing the factors forming IU, especially Perceived Usefulness (PU) and Attitude Toward Using (ATU), while the presentation of numerical results and empirical discussion regarding the IU → AU path has not been explained in detail. Thus, the relationship between IU and AU in this study is more conceptual and theoretical, in accordance with the TAM model, rather than as an empirical finding discussed in depth. In the future, further research is recommended to present the results of the IU → AU path test explicitly, including the path coefficient and its significance level, so that the suitability between the title, objectives, and research results can be demonstrated more comprehensively.

Conlusion

The Structural Equation Modeling (SEM) results demonstrate that all constructs examined in this study—Perceived Usefulness (PU), Attitude Toward Using (ATU), and Intention to Use (IU)—exhibited significant relationships consistent with the assumptions of the Technology Acceptance Model (TAM). PU was found to have a positive and meaningful impact on IU, indicating that teachers who perceive Smartboards as beneficial for enhancing instructional effectiveness are more

inclined to integrate them into their teaching practices. Likewise, ATU showed a significant influence on IU, reinforcing the idea that favorable attitudes toward Smartboards substantially shape teachers' behavioral intentions. The high and valid loading factor values for all indicators further confirm that the constructs accurately represent the psychological aspects influencing Smartboard adoption. These findings collectively affirm that cognitive evaluations and attitudinal responses are crucial determinants in understanding the dynamics of Smartboard acceptance within elementary educational settings.

This study concludes that Smartboard acceptance in elementary school learning environments is strongly driven by teachers' perceptions of usefulness and their positive attitudes toward the technology. When teachers believe that Smartboards enhance the clarity, engagement, and effectiveness of instructional delivery, their willingness to adopt the technology intensifies. This psychological acceptance forms the foundation for successful integration of Smartboards into daily learning activities and contributes to the improvement of teaching quality. Positive attitudes further reinforce consistent usage, as teachers who feel comfortable, confident, and motivated are more likely to utilize Smartboards in creative and pedagogically meaningful ways. Therefore, the acceptance process extends beyond technical availability, depending heavily on internalized beliefs and emotional readiness. These insights highlight the essential role of teacher perceptions and attitudes in determining whether technology integration efforts achieve meaningful and sustainable outcomes in elementary school settings.

The findings of this study further reinforce and expand the applicability of the Technology Acceptance Model (TAM) within the context of Indonesian elementary school learning environments. Consistent with global research trends, the variables of Perceived Usefulness (PU) and Attitude Toward Using (ATU) remain dominant predictors of teachers' intentions to use instructional technology. These results confirm that the fundamental TAM structure remains relevant for evaluating the acceptance of interactive, multimedia-based tools such as Smartboards. Additionally, the study provides empirical evidence supporting the adaptability of TAM in assessing emerging digital learning technologies in diverse educational contexts. By validating teachers' cognitive and attitudinal factors as determinants of behavioral intention, this research contributes to the broader understanding of how technology acceptance mechanisms function in developing educational systems. Consequently, these findings offer valuable insights for policymakers, school administrators, and curriculum developers seeking to optimize Smartboard implementation and promote technology-based learning innovations. Although this study on smartboard acceptance in elementary schools using the Technology Acceptance Model (TAM) provides valuable insights into technology adoption in educational contexts, several limitations should be acknowledged. Recognizing these limitations is essential for guiding future research toward more comprehensive and robust findings. This study involved elementary school teachers from specific schools and regions; therefore, the findings may not fully represent the broader population of elementary schools. Variations in school characteristics, such as geographical location, institutional status, availability of technological infrastructure, and socio-economic background, may influence differences in the level of smartboard acceptance and utilization. Future studies should expand the research scope by involving a larger and more diverse sample across multiple regions. Multi-site or cross-regional studies are recommended to enhance the generalizability of findings and to provide a more representative understanding of smartboard acceptance in elementary education.

This study focuses primarily on teachers as the main users of smartboards, while students' perspectives are not extensively examined. Students' engagement and responses, however, play a critical role in determining the effectiveness of smartboard-supported instruction. Future studies should include students as additional research participants to obtain a more holistic perspective.

Furthermore, examining the relationship between teachers' technology acceptance and student engagement or learning outcomes would provide valuable pedagogical insights.

This study has several limitations that need to be considered. First, the sample size was limited to elementary school teachers in West Jakarta, so the results cannot be broadly generalized to elementary school contexts in other areas with different characteristics. This study only examined the perspectives of teachers as Smartboard users, without involving students as those who directly experience the impact of technology use in the learning process. The quantitative, questionnaire-based research approach still relies on respondents' subjective perceptions and does not fully reflect the actual practice of Smartboard use in the classroom. Furthermore, this research model only uses the core constructs of the Technology Acceptance Model (TAM) without incorporating other contextual and pedagogical factors, such as institutional support, teacher training, and pedagogical readiness. Therefore, future research is recommended to involve a broader and more diverse sample, integrate student perspectives, use a mixed methods approach, and expand the TAM model by adding contextual variables to gain a more comprehensive understanding of the acceptance and effectiveness of Smartboard use in elementary schools.

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