

PAPER

Mobile-AI Learning Adoption and Sustainable User Engagement: Managing the Effects of Perceived Value and Digital Literacy in Emerging Asian Countries

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ABSTRACT

Artificial intelligence (AI) is reshaping mobile learning (m-learning) by facilitating personalized, adaptive, and interactive educational experiences. Despite these advancements, maintaining learner engagement remains a significant challenge in emerging economies. This study examines the impact of AI-enabled mobile learning experiences on learner trust and engagement, with particular attention to the mediating role of perceived value and the moderating effect of digital literacy. A quantitative research design was adopted, and data were obtained from 486 mobile learning users in Indonesia, India, and Malaysia. The proposed model was evaluated using Partial Least Squares Structural Equation Modelling (PLS-SEM). The results show that AI-enabled mobile learning experiences greatly increase learner trust ($\beta = 0.35$, $t = 6.12$, $p < 0.001$). Perceived value has an even stronger positive impact on trust ($\beta = 0.41$, $t = 7.45$, $p < 0.001$). Trust is the main factor driving learner engagement ($\beta = 0.58$, $t = 12.89$, $p < 0.001$), underscoring its importance in keeping learners engaged in AI-supported environments. Digital literacy also makes the link between trust and engagement stronger ($\beta = 0.11$, $t = 2.35$, $p < 0.05$). This means that learners with better digital skills are more likely to turn trust into an ongoing learning activity. This study advances the field of mobile learning by integrating technological, cognitive, and behavioral factors into a comprehensive AI-enabled learning framework.

KEYWORDS

mobile learning, artificial intelligence (AI), user trust, perceived value, digital literacy, learner engagement

1 INTRODUCTION

Artificial intelligence (AI) is fundamentally transforming business operations, consumer engagement, and value delivery across industries in the digital economy [1].

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In the retail sector, especially within emerging markets, the integration of AI technologies into customer service [1], marketing, logistics, and decision-making processes has driven substantial change [2]. AI capabilities such as machine learning, natural language processing, and predictive analytics enable retailers to enhance customer experience (CX), streamline operations, and achieve sustainable competitive advantages [3]. As retailing becomes more digitalized, understanding the role of AI in building customer confidence and shaping experience presents a critical challenge for managers, marketers, and policymakers [2]. The adoption of AI technologies has enabled the deployment of smart systems that learn from customer interactions, predict behavior, and personalize services in real time [4]. AI applications including chatbots, recommendation engines, visual search, voice assistants, and sentiment analysis tools are now widespread in modern retail environments [5]. These technologies improve customer interactions by delivering rapid, seamless, and personalized experiences, thereby increasing customer satisfaction [6–7]. Nevertheless, the perceived reduction in human interaction may affect customer trust and acceptance of AI-driven services [8].

The opportunities and challenges of AI in shaping CX are especially evident in emerging markets across the globe especially in Asia, India, Malaysia, Indonesia, Pakistan where digital infrastructure is expanding rapidly yet unevenly [9]. In these regions, mobile technology is dominant, as consumers often bypass traditional desktop internet in favor of mobile-first access [10]. As a result, AI-driven services must be optimized for low data consumption and compatibility with entry-level smartphones to effectively reach lower-income populations [11]. Consumers in these markets display varied attitudes toward privacy and personalization; some prioritize convenience over concerns about data sharing, particularly where digital literacy is still developing [12]. Therefore, trust becomes a highly sensitive and influential factor in the effectiveness of AI implementation. The connection between AI-driven CX and trust is thus both timely and essential for advancing research and practice in rapidly growing, mobile-centric emerging retail markets [13].

In emerging economics countries, where digital ecosystems are primarily mobile-first, consumers are generally receptive to AI due to its convenience and efficiency. However, their trust depends largely on perceptions of data protection and algorithmic fairness. This concern is especially acute among low-income groups, who may be first-time internet users and are more susceptible to information misuse [14]. Consequently, companies must pursue not only financial objectives but also invest in building trust through culturally appropriate ethical governance and transparent communication. Additionally, CX enabled by mobile applications, electronic payments, and last-mile delivery systems have become critical competitive differentiators in these markets. There is a lack of comprehensive understanding regarding how different types of AI, such as conversational agents and recommendation systems, affect various dimensions of trust, including emotional and cognitive trust. This study goes beyond general discussion by providing a focused, data-driven look at how AI-powered CX builds trust and encourages engagement in emerging markets. The main goal is to explain how AI-CX drives business results, especially by highlighting the key role of customer trust and the influence of contextual factors. The study aims to measure how AI-CX directly affects customer trust and to show that trust is a key link between AI-driven interactions and stronger customer engagement; lastly to find

out how digital literacy helps, while cultural uncertainty avoidance makes this process harder.

2 LITERATURE REVIEW

2.1 Artificial intelligence-enabled customer experience, perceived value, and customer trust

Although literature has established a relationship between AI-enabled CX and customer trust, the underlying mechanisms remain insufficiently explored [13]. Core dimensions of AI-enhanced CX, including customization, responsiveness, and usability, are strongly associated with trust because they demonstrate system competence and reduce consumer uncertainty. Accurate predictions and seamless outcomes from AI systems indicate operational excellence, thereby fostering cognitive trust, defined as the logical belief in system reliability [14]. Nevertheless, the direct link between AI functionality and trust is increasingly considered inadequate. Recent studies indicate that perceived value is a key psychological driver in this relationship. AI should surpass functional efficacy, shifting the interaction from a transactional exchange to a valued relationship [7].

Perceived value, encompassing functional, emotional, and social dimensions, underpins a customer's willingness to accept AI-driven decisions [12]. Value-for-money considerations and social benefits are particularly salient in emerging markets, where consumers tend to be pragmatic and cost-conscious [15]. Consequently, even highly personalized or responsive AI services may fail to build trust unless they are perceived as delivering superior value relative to their cost, whether measured in money, data, or effort. Accordingly, the following hypotheses are proposed:

H1: AI-enabled CX has a significant positive effect on Customer Trust

H2: Perceived Value has a significant positive effect on Customer Trust

2.2 Customer trust and customer engagement

Customer trust constitutes a fundamental psychological prerequisite for meaningful interaction, distinguishing between satisfactory service encounters and active, voluntary participation in value creation [14]. According to social exchange theory, trust reduces perceived risk and uncertainty, thereby fostering the relational security required for customers to invest resources such as time, emotional effort, and social capital in brand relationships that extend beyond transactional exchanges [15]. This investment is reflected in engagement, which involves heightened cognitive, emotional, and behavioral involvement with the brand [16]. Trust enables customers to transition from passive recipients of value to active partners who co-create, provide constructive feedback, and advocate for the brand within their social networks [17]. The trust-engagement relationship is especially evident in virtual environments characterized by minimal human intervention [18]. Therefore, trust serves as a causal force that enables a broad spectrum of engagement behaviors critical for long-term competitive advantage.

H3: Customer Trust has a significant positive effect on customer engagement.

2.3 Contextual factor (Digital literacy)

A comprehensive understanding of the relationship between customer trust and engagement requires consideration of contextual factors, particularly digital literacy, which is vital in digital environments [13]. Digital literacy refers to the skills necessary to navigate and operate safely within digital spaces [14]. It acts as an enabling factor that influences how customers process and respond to AI-based services. Individuals with higher digital literacy are better able to understand algorithmic functions, evaluate data privacy implications, and resolve minor technical issues, thereby reducing the perceived complexity of AI interactions [17]. This competence fosters a sense of control and empowerment, enabling customers to better recognize the value of AI and accurately interpret signals of company reliability [19]. As a result, digital literacy is conceptualized not only as a prerequisite for access but also as a significant facilitator that enhances the conversion of trust into action [20]. Digital literacy functions as a moderating factor, resulting in significant variations in CX [21]. Among digitally literate customers, trust is more likely to lead to deep engagement, as these individuals possess the skills and confidence to participate in co-creative AI experiences, such as customizing algorithmic suggestions or using advanced self-service features [22].

H4: The relationship between customer trust and customer engagement is moderated by the contextual factor (Digital literacy).

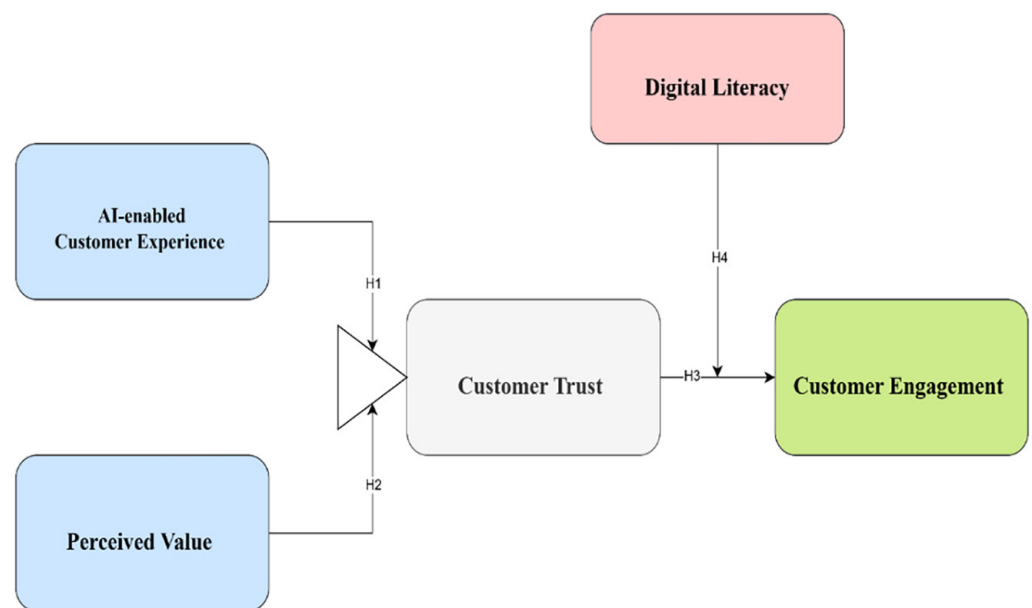


Fig. 1. Conceptual framework

3 METHODOLOGY

3.1 Research design

A quantitative, cross-sectional research design grounded in a positivist paradigm was employed to objectively examine and test predefined hypotheses regarding the

relationships among latent constructs. AI-enabled CX, perceived value, customer trust, customer engagement, and the contextual variable of digital literacy.

3.2 Population and sampling

The target population consisted of adult consumers residing in major urban centres in Indonesia, India, and Malaysia who had engaged with an AI-based retail service, such as a chatbot or recommendation system, within the preceding three months. Purposive sampling yielded 486 valid responses.

3.3 Instrumentation

A structured questionnaire served as the data collection instrument, were constructed using a five-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The AI-enabled CX scale, adapted from Hollebeek & Macky [12] captured personalization, responsiveness, and ease of use. The Perceived Value scale, adapted from Oliveira Santini et al., [11] included four dimensions of quality, emotional, price, and social. Customer Trust incorporating cognitive and affective dimensions, was adopted from Moodley & Sookhdeo [13]. Customer Engagement was assessed from Hasan & Othman [2]. The Digital Literacy scale was integrated from Rodríguez-de-Dios et al., [14].

3.4 Data collection

Data collection occurred over a three-month period (February to April 2025) using online surveys administered through Google Forms. Surveys were distributed through social media platforms, retail loyalty program mailing lists, and AI service providers to maximize reach among eligible respondents. Informed consent was obtained from all participants, and both anonymity and confidentiality were maintained in compliance with institutional ethical guidelines.

3.5 Data analysis techniques

We analysed the data using SPSS 28 and SmartPLS 4. SPSS was used for descriptive statistics and reliability checks, while PLS-SEM was used to assess the measurement and structural models. To check reliability and validity, we used Cronbach's alpha, AVE, the Fornell-Larcker criterion, and HTMT. We tested the significance of the paths with bootstrapping using 5,000 resamples. We also used multi-group analysis (MGA) to examine how digital literacy and cultural uncertainty avoidance moderated the results.

4 RESULTS AND DISCUSSION

4.1 Descriptive statistics

Table 1 displays a data set characterized by relatively high means across all constructs, ranging from mean $M = 3.78$ (Digital Literacy) to $M = 4.10$ (Customer

Engagement), indicating that respondents generally held positive perceptions of the constructs. The low standard deviations demonstrate that responses were closely clustered around the mean, reflecting a high degree of consensus among participants. Skewness and kurtosis values for all constructs fall within the acceptable range of ± 2 , indicating approximate normality and supporting the application of parametric inferential statistical tests, such as structural equation modelling (SEM). The elevated mean for Customer Engagement suggests that effective AI-based experiences may be associated with increased customer loyalty and advocacy in emerging markets.

Table 1. Descriptive statistics for key constructs (N = 486)

Construct	Mean	Standard Deviation	Skewness	Kurtosis
Independent Variables				
AI-enabled CX	4.02	0.68	-0.85	1.12
Perceived Value	3.95	0.71	-0.72	0.89
Dependent Variables				
Customer Trust	3.88	0.75	-65.00%	0.54
Customer Engagement	4.1	0.66	-91.00%	1.45
Moderating Variable				
(Contextual variable) Digital Literacy	3.78	0.8		

Table 2 indicates that all bivariate correlations are positive and statistically significant at the 0.01 level. The relationships among variables are moderate to strong. Customer Trust and Customer Engagement exhibit the highest correlation ($r = 0.723$), providing initial evidence of a strong association between these key outcome variables. The independent variables AI-enabled CX ($r = 0.621$) and Perceived Value ($r = 0.647$) also demonstrate strong positive correlations with Customer Trust, suggesting they are important predictors. Digital literacy displays moderate but significant positive correlations with all other variables, underscoring its relevance within the model. The absence of very high correlations (above 0.85) among independent variables mitigates concerns regarding multicollinearity and supports their inclusion in subsequent structural equation modelling.

Table 2. Inter-correlations among study variables

Variable	1	2	3	4	5
1. AI-enabled CX	1				
2. Perceived Value	0.681**	1			
3. Customer Trust	0.621**	0.647**	1		
4. Customer Engagement	0.584**	0.609**	0.723**	1	
5. Digital Literacy	0.432**	0.398**	0.351**	0.385**	1

Note: ** $p < 0.01$.

4.2 Evaluation of the measurement model

The reliability and validity of the constructs were assessed using a measurement model in SmartPLS 4. Internal consistency was supported by Cronbach's alpha and composite reliability (CR) values, both exceeding the 0.7 threshold. Convergent validity was confirmed through average variance extracted (AVE), with all AVE values above 0.5. Discriminant validity was established using the Fornell-Larcker criterion and HTMT ratios, demonstrating that the constructs are empirically distinct.

Table 3. Measurement model assessment: Reliability and convergent validity

Construct	Dimensions	Cronbach's α	CR	AVE
AI-enabled Customer Experience		0.86	89%	0.64
	Personalization	0.83	86%	0.68
	Responsiveness	0.81	85%	0.65
	Ease of Use	0.85	87%	0.7
Perceived Value		0.88	91%	0.67
	Quality	0.84	87%	0.69
	Emotional	0.82	86%	0.67
	Price	0.8	84%	0.64
	Social	0.78	83%	0.62
Customer Trust		0.88	0.91	0.69
	Cognitive Trust	0.85	0.88	0.71
	Affective Trust	0.83	0.86	0.68
Customer Engagement		0.84	0.87	0.63
Digital Literacy		0.89	0.91	0.65
	Technological Literacy	0.82	0.85	0.66
	Personal Security Literacy	0.83	0.86	0.67
	Critical Literacy	0.81	0.84	0.65
	Device Security Literacy	0.82	0.85	0.66
	Information Literacy	0.8	0.83	0.62

Table 3 indicates that the measurement model demonstrates high reliability and convergent validity. Internal consistency is evident across all constructs and their respective dimensions, with both CR and Cronbach's alpha values consistently above 0.70. Furthermore, the AVE for each construct exceeds the recommended threshold of 0.50, suggesting that the measurement items explain more variance in the construct than measurement error. This strong evidence of reliability and validity supports the subsequent assessment of the structural model.

Figure 2 displays the measurement model for the present study, depicting the directional correlations between variables and their indicators, as well as the factor loadings that reflect internal consistency.

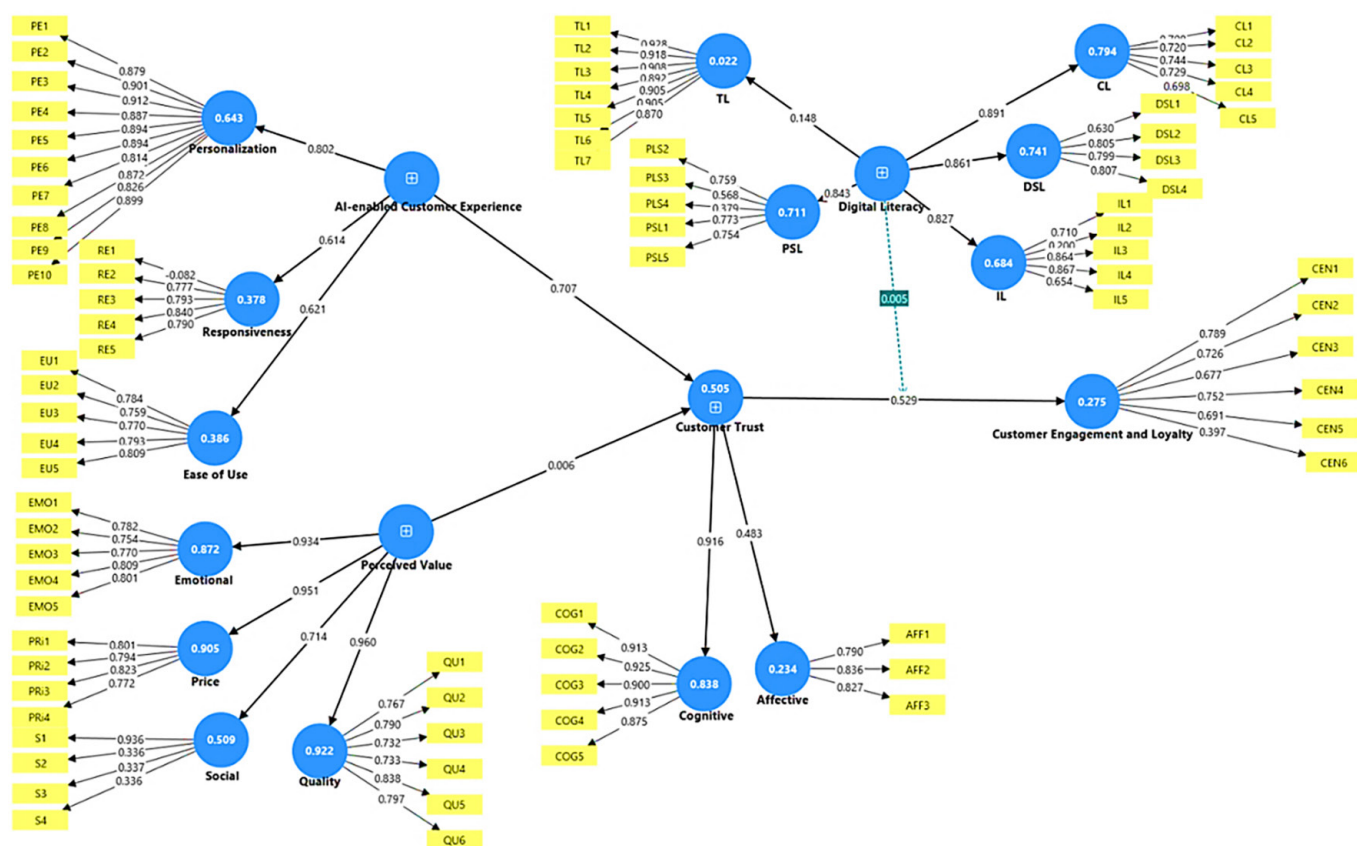


Fig. 2. Measurement model

Table 4. Discriminant validity assessment (Fornell-Larcker Criterion)

Construct	–1	–2	–3	–4	–5
1. AI-enabled CX	0.8				
2. Perceived Value	0.681	0.819			
3. Customer Trust	0.621	0.647	0.831		
4. Customer Engagement	0.584	0.609	0.723	0.794	
5. Digital Literacy	0.432	0.398	0.351	0.385	0.806

Table 4 confirms that all constructs in the study are empirically distinct. The Fornell-Larcker criterion establishes discriminant validity when the square root of the AVE for each construct (diagonal value) exceeds its highest correlation with any other construct (off-diagonal values). For instance, the square root of the AVE for Customer Trust (0.831) is greater than its correlations with AI-enabled CX (0.621), Perceived Value (0.647), and all other constructs.

4.3 Structural model analysis

The structural model was evaluated to identify hypothesized relationships and assess predictive power. This method extends beyond construct quantification by examining the theoretical causal pathways outlined in the research model.

SmartPLS was employed with 5,000 bootstrap resamples to analyse path coefficients (β), t-statistics, and p-values, thereby determining the strength of each relationship.

Table 5. Results of hypothesis testing

Hypothesis	Path	β Coefficient	t-Value	p-Value	Supported
H1	AI-enabled CX $\rightarrow$ Customer Trust	0.35	6.12	<0.001	Yes
H2	Perceived Value $\rightarrow$ Customer Trust	0.41	7.45	<0.001	Yes
H3	Customer Trust $\rightarrow$ Customer Engagement	0.58	12.89	<0.001	Yes
H4	Trust $\times$ Digital Literacy $\rightarrow$ Engagement	0.11	2.35	<0.05	Yes

The results in Table 5 indicate that all four hypotheses are supported. Both AI-enabled CX ($\beta = 0.35$, $p < 0.001$) and Perceived Value ($\beta = 0.41$, $p < 0.001$) are significant predictors of Customer Trust, collectively explaining 52% of its variance. Customer Trust has a strong and significant effect on Customer Engagement ($\beta = 0.58$, $p < 0.001$). Digital Literacy significantly moderates the relationship between Trust and Engagement ($\beta = 0.11$, $p < 0.05$), indicating that trust's influence on engagement is stronger among consumers with higher digital literacy. The model explains 47% of the variance in Customer Engagement, demonstrating substantial predictive capability.

This study advances the literature by applying an empirically validated model to demonstrate how AI-based strategies foster customer loyalty in emerging markets. The findings reveal that both AI-driven CX and perceived value significantly drive trust, with perceived value ($\beta = -0.41$) exerting a somewhat greater effect. In pragmatic, cost-conscious environments, consumers develop trust not only through seamless AI functionality but also through explicit benefits that justify their investment of data and time. Trust serves as a critical catalyst for customer engagement and is the primary antecedent to large-scale customer involvement ($\beta = 0.58$). This directional relationship highlights the role of trust in converting satisfactory AI interactions into favorable behaviors, such as advocacy and repeat usage. Additionally, the substantial moderating effect of digital literacy ($\beta = 0.11$) provides a key segmentation insight: the transition from trust to active usage is more pronounced among digitally literate consumers, who possess the skills and confidence to maximize AI capabilities.

Consequently, for companies in high-growth markets, the strategic imperative is twofold: first, to develop AI services that are both effective and clearly communicate their value; and second, to support technological implementation by promoting digital literacy, thereby strengthening the trust-engagement relationship and optimizing returns on AI investments.

5 DISCUSSION

This study examines the role of AI in fostering sustainable customer relationships within the dynamic retail environments of emerging markets. The study presents a contextually nuanced model that contributes to the literature on AI in business. While the positive influence of AI-enabled CX on trust is consistent with global discourse [11], the finding that Perceived Value ($\beta = 0.41$) is a more significant determinant of trust than AI-enabled CX ($\beta = 0.35$) offers a novel insight in

these settings. In markets such as Indonesia, India, and Egypt, where cost and practicality are primary determinants of trust, technological sophistication alone does not suffice. Trust is established when AI provides tangible utility and economic benefits, thereby challenging technology-centric adoption models common in research from developed economies and placing the value proposition at the core of AI strategy. Furthermore, the study provides clear evidence of how trust translates into business performance, identifying it as the primary driver of customer engagement. The relationship between Customer Trust and Customer Engagement ($\beta = 0.58$) is both strong and significant, suggesting that in environments marked by high uncertainty, trust is essential for transforming satisfactory AI interactions into active loyalty, positive word of mouth, and frequent use.

A key contribution of this study is the identification of the significant moderating effect of digital literacy. Among digitally literate consumers, trust and engagement levels are notably higher ($\beta = 0.11$). This result not only recognizes the digital divide but also quantifies its impact on corporate performance. Contrary to literature suggesting that digital literacy impedes digital technology adoption [22], the findings indicate that digital literacy enhances post-adoption relationship quality [23]. As a result, the return on investment in AI is substantially greater among digitally literate groups. Digital literacy, therefore, emerges as a managerial asset, with customer education and capacity building serving as strategic resources for AI-driven customer relationship management. Collectively, these findings reframe the AI implementation paradigm from a technological focus to a socio-technological approach, emphasizing value-based design, trust-building, and digital empowerment to achieve sustainable competitive advantage in high-growth markets.

6 CONCLUSION

This paper extends the analysis of AI in business by shifting from a solely technological perspective to a nuanced socio-technical framework for effective AI implementation. The results indicate that attaining competitive advantage with AI depends not only on advanced algorithms but also on a strategic integration of value-based utility, trust-building mechanisms, and customer empowerment initiatives. Identifying value as a more significant predictor of trust than experience, and recognizing digital literacy as a catalyst for engagement, challenge undifferentiated, technology-centric approaches. The research suggests that organizations should focus on a human-centered approach. This includes considering cost-benefit analyses and digital maturity to help turn AI from a mere efficiency tool into a foundation for strong, lasting customer relationships in the 21st century. The study only included urban consumers in Indonesia, India, and Malaysia, so the results may not apply to rural areas. Future studies should use long-term methods to examine how AI service failures and people's reluctance to trust algorithms affect customer trust and engagement.

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