“Blockchain affordances and trust pathways to purchase intention and loyalty in e-commerce: Evidence from Vietnam”

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BLOCKCHAIN AFFORDANCES AND TRUST PATHWAYS TO PURCHASE INTENTION AND LOYALTY IN E-COMMERCE: EVIDENCE FROM VIETNAM

Abstract

Trust remains an important issue in consumer adoption of e-commerce, particularly in contexts characterized by information asymmetry and perceived online transaction risk. This study examines how perceived blockchain-enabled affordances, including transparency, security, decentralization, and control, are associated with consumer trust and how trust relates to purchase intention and loyalty, while testing the moderating role of blockchain literacy. Data were collected through a purposive online survey of Vietnamese e-commerce users between March and June 2025. The questionnaire was administered using Google Forms and distributed through e-commerce-related groups, blockchain-related communities, university networks, and social media platforms. After screening incomplete and low-quality responses, 427 valid questionnaires from respondents with prior experience of blockchain-enabled applications were retained for analysis using PLS-SEM. The results show that transparency ($\beta = 0.29$, $p < 0.001$) and security ($\beta = 0.25$, $p < 0.001$) are positively associated with consumer trust, followed by decentralization ($\beta = 0.17$, $p = 0.001$) and perceived control ($\beta = 0.14$, $p = 0.011$). Moderation tests indicate that blockchain literacy strengthens the effects of transparency ($\beta = 0.11$, $p = 0.005$) and security ($\beta = 0.09$, $p = 0.024$) on trust. The model explains meaningful variance in trust ($R^2 = 0.61$), purchase intention ($R^2 = 0.57$), and loyalty ($R^2 = 0.53$). These findings suggest that blockchain may contribute to consumer trust in e-commerce when transparency and security are made visible, understandable, and relevant to consumers through platform design and communication.

Keywords blockchain, trust, transparency, security, literacy

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INTRODUCTION

Trust remains a binding constraint on value creation in e-commerce because exchange occurs under persistent uncertainty. In digital markets, physical distance, information asymmetry, and limited interpersonal accountability elevate perceived risk, making consumers' decisions depend heavily on whether the platform environment is viewed as credible and dependable (Gefen et al., 2003; Pavlou, 2003). Accordingly, trust functions not only as a psychological prerequisite for initiating transactions but also as a strategic condition for sustaining purchase intention and relationship continuity in competitive online settings (Bricci et al., 2015; Hajli, 2015).

Blockchain technology has been promoted as an infrastructural response to this trust deficit. By enabling transparent, tamper-resistant records and distributed verification, blockchain is often assumed to embed verifiability into the architecture of transactions and information exchange, shifting assurance from third-party reliance to assurance-by-design (Casino et al., 2019; Wang et al., 2018). From a marketing standpoint, this promise is consequential because credibility can

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increasingly be generated through platform governance mechanisms rather than relying exclusively on brand reputation or external guarantees. In this study, blockchain-enabled e-commerce refers to online commerce settings in which blockchain-related functions, such as transaction verification, product traceability, authenticity checking, secure payment records, or distributed data validation, are embedded into platform operations or consumer-facing services. Thus, the term does not imply that the entire e-commerce platform is fully decentralized, but rather that selected blockchain-based mechanisms are used to support transparency, security, verification, and consumer trust.

Vietnam provides a relevant context for examining this issue because e-commerce has expanded rapidly alongside increasing digital payment adoption, yet concerns about online fraud, product authenticity, personal data protection, and platform credibility remain salient among consumers. At the same time, blockchain-related applications in payments, traceability, digital wallets, and product verification are becoming more visible, while consumers' understanding of blockchain remains uneven. This combination of fast-growing e-commerce, persistent trust concerns, and heterogeneous blockchain literacy makes Vietnam an appropriate emerging-market setting for investigating how blockchain-enabled cues are interpreted as trust signals.

However, a central scientific problem remains unresolved: the existence of blockchain-based mechanisms does not automatically translate into consumer trust or observable behavioral change. Technical assurances become market-relevant only when consumers perceive, interpret, and value them as credible signals during decision-making; otherwise, blockchain may operate as background infrastructure with limited impact on consumer responses (Duan & Zhu, 2025; Hajli et al., 2017). This creates a marketing-focused gap: explaining under what conditions blockchain-enabled cues function as trust signals and how such signals convert into purchase-related outcomes.

A related difficulty is conceptual fragmentation in how blockchain-enabled cues are typically discussed. Prior work often isolates specific attributes, such as transparency, security, decentralization, and user control, and examines them separately, whereas real purchase judgments are usually formed holistically from multiple cues simultaneously (Jiang et al., 2023; Ma et al., 2024). As a result, it remains challenging to explain how trust emerges as an overall evaluation from a bundle of blockchain-enabled cues and how that trust then operates as a pathway to downstream consumer outcomes.

The effectiveness of blockchain-enabled cues likely varies across consumers because interpretation depends on knowledge and comprehension of what the technology implies. Differences in blockchain literacy may therefore shape whether the same cues are recognized as credible, whether uncertainty is actually reduced, and why consumer responses diverge, an issue that is particularly relevant in Vietnam, where digital commerce usage is widespread but consumer familiarity with blockchain-enabled mechanisms is still developing and unevenly distributed (Ferreira da Silva & Moro, 2021; Roopnarain & Mwapwele, 2025). Collectively, these challenges indicate that the scientific problem is not whether blockchain can technically support trustworthy transactions, but how and under what market-relevant conditions blockchain-enabled affordances become effective trust signals and translate into consequential consumer behaviors.

1. LITERATURE REVIEW AND HYPOTHESES

Trust plays a central role in e-commerce because consumers often make purchase decisions under conditions of uncertainty, incomplete information, and limited direct verification. In such environments, consumers must rely on signals that help them assess whether a platform is credible, reliable, and fair. Blockchain has increasingly been discussed as a trust-enabling infrastructure in digital commerce because its architecture supports transparent, tamper-resistant, and verifiable records, thereby reducing information asymmetry

and transaction uncertainty, two conditions that commonly undermine trust in online exchange (Casino et al., 2019; Zheng et al., 2017). From an innovative marketing perspective, this shifts the basis of trust formation from reliance solely on institutional guarantees or third-party intermediaries toward technology-embedded assurance mechanisms that are implemented through platform design and governance (Toufaily & Zalan, 2024).

However, consumer trust is not generated by technical capability alone. For blockchain-based mechanisms to matter in marketing contexts, consumers must perceive these technological characteristics as meaningful cues that signal honesty, procedural integrity, and resistance to opportunistic manipulation. A consumer-centered perspective therefore emphasizes perceived blockchain affordances, that is, the assurances and capabilities consumers believe the platform provides during information search, evaluation, and transaction execution (Duan & Zhu, 2025). In blockchain-enabled commerce, four affordances are particularly relevant to trust formation: transparency, security, decentralization, and perceived control.

Perceived transparency refers to the extent to which transaction- and product-related information is visible, traceable, and verifiable. When consumers perceive that relevant information can be audited and tracked, they are more likely to evaluate the platform as open, honest, and procedurally fair, which reduces ambiguity and strengthens trust (Hina et al., 2025; Jiang et al., 2023). Perceived security reflects beliefs that the system adequately protects authentication, privacy, and transaction integrity. Security cues reduce consumers' sense of vulnerability to fraud, misuse, or unauthorized access and therefore serve as psychological assurances of system reliability (Guntara et al., 2023; Kim et al., 2008). Perceived decentralization concerns the degree to which verification and control are distributed rather than concentrated in a single authority. When consumers perceive less unilateral control by one actor, they may infer lower opportunism risk and greater procedural integrity, which can enhance trust in the platform (Truong et al., 2021). Perceived control, in turn, captures the extent to which consumers feel empowered to manage personal data and transaction-related decisions. A stronger sense of control can reduce psychological discomfort associated with digital dependence and can reinforce confidence in the exchange environment (Ma et al., 2024; Wathieu et al., 2002).

Beyond its antecedents, trust is also a key mechanism linking platform characteristics to consumer behavioral outcomes. In online markets, trust refers to consumers' confidence in a platform's reliability, integrity, and credibility under conditions where direct monitoring and enforcement are constrained (Pavlou, 2003; Singh et al., 2024). A substantial body of research suggests that trust reduces perceived risk and uncertainty, facilitates transactional readiness, and supports more stable expectations about future interactions. As a result, trust is consistently associated with higher purchase intention and stronger loyalty in digital commerce settings (Hajli, 2015; Pasaribu et al., 2022). Consumers who trust a platform more strongly are more willing to transact and more likely to remain committed over time.

In addition to its role in trust formation, perceived control may also exert a direct influence on purchase intention. Consumers' intention to purchase is shaped not only by whether the platform is trustworthy but also by whether they feel able to manage the transaction process, data-sharing conditions, and related decisions. When users perceive greater autonomy and control, they may experience less friction, lower decision anxiety, and stronger readiness to complete a purchase, even beyond their overall trust evaluation (Ma et al., 2024; Wathieu et al., 2002).

Trust may further operate as a mediating mechanism through which blockchain-enabled affordances influence consumer purchase intention. Transparency, security, and decentralization can be interpreted as platform assurances that reduce uncertainty and foster confidence; stronger confidence then increases consumers' willingness to purchase. This logic is consistent with prior research in e-commerce and digital exchange that treats trust as a central mechanism translating platform characteristics into consumer responses (Hajli, 2015; Pavlou, 2003).

Finally, the effectiveness of blockchain-enabled cues may depend on whether consumers are able to understand and interpret them. Blockchain

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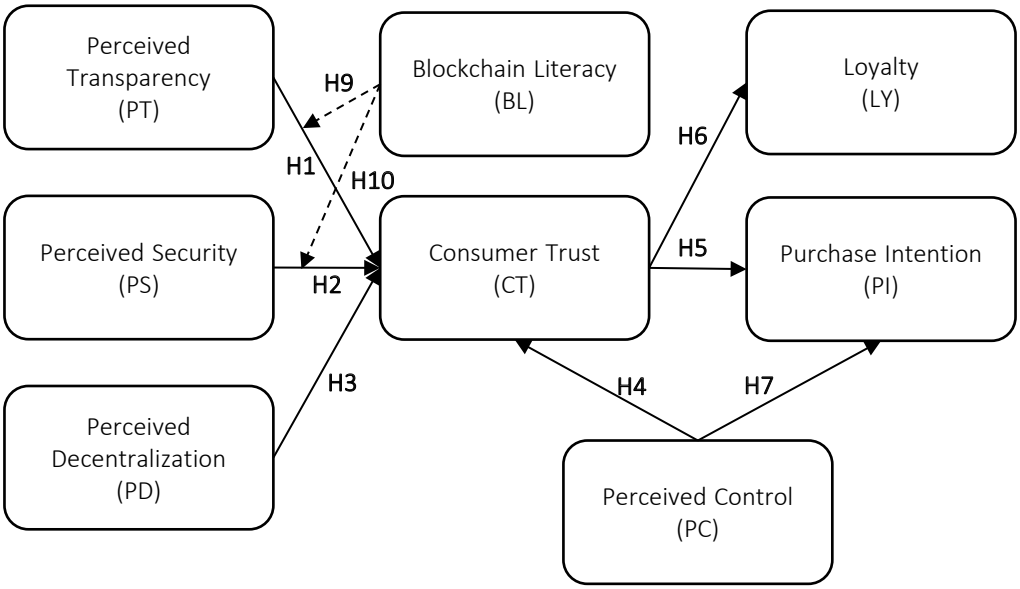

Figure 1. Research model and hypotheses

literacy, defined as consumers' understanding of blockchain mechanisms and their implications, can shape whether transparency and security cues are recognized as credible assurances and whether they effectively reduce uncertainty (Ferreira da Silva & Moro, 2021; Roopnarain & Mwapwele, 2025). Consumers with higher blockchain literacy are more likely to understand the significance of traceability, immutability, and transaction integrity, and are therefore more likely to translate transparency and security signals into stronger trust judgments. By contrast, lower literacy may weaken these relationships because the same cues may appear abstract, technical, or insufficiently meaningful (Norbu et al., 2024, 2025).

Overall, prior research suggests that blockchain can support trust formation in e-commerce by enhancing transparency, security, decentralization, and consumer control. Nevertheless, the literature remains somewhat fragmented because these affordances are often examined separately rather than as an integrated set of trust-building cues linked to downstream consumer outcomes. Besides, limited attention has been paid to the role of blockchain literacy as a boundary condition shaping how consumers interpret blockchain-based assurances.

Based on the above review, this study aims to examine how perceived blockchain affordances, namely transparency, security, decentralization, and perceived control, shape consumer trust and subsequent behavioral outcomes in e-commerce. Specifically, the study investigates the effects of trust on purchase intention and loyalty, tests the mediating role of trust in the relationships between selected blockchain affordances and purchase intention, and examines whether blockchain literacy strengthens the trust-building effects of transparency and security.

Drawing on the preceding literature, the following hypotheses are proposed:

H1: Perceived transparency positively influences consumer trust.

H2: Perceived security positively influences consumer trust.

H3: Perceived decentralization positively influences consumer trust.

H4: Perceived control positively influences consumer trust.

H5: Consumer trust positively influences purchase intention.

H6: Consumer trust positively influences consumer loyalty.

H7: Perceived control positively influences purchase intention.

H8: Consumer trust mediates the relationships between transparency, security, decentralization, and purchase intention.

H9: Blockchain literacy positively moderates the transparency-trust relationship.

H10: Blockchain literacy positively moderates the security-trust relationship.

Figure 1 presents the conceptual model of the study. The model proposes that perceived blockchain affordances, including transparency, security, decentralization, and perceived control, influence consumer trust, which in turn affects purchase intention and loyalty. Besides, perceived control is expected to have a direct effect on purchase intention, while blockchain literacy is proposed to strengthen the effects of transparency and security on trust.

2. METHODOLOGY

This study employed a quantitative, cross-sectional survey design to examine how perceived blockchain-enabled affordances influence consumer trust and, in turn, shape purchase intention and loyalty in e-commerce, while also testing the moderating role of blockchain literacy. A survey approach was appropriate because the study focused on consumers' perceptions, evaluations, and behavioral intentions in digital commerce, which are best captured through standardized self-reported measures. The proposed model was analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM), as this approach is well suited to prediction-oriented research involving multiple latent constructs as well as mediation and moderation effects.

The study was conducted in Vietnam between March and June 2025. Vietnam represents a relevant emerging-market context in which e-commerce adoption has expanded rapidly, while consumers' digital competencies and familiarity with blockchain-related mechanisms remain heterogeneous. This context is therefore appropriate for examining how blockchain-enabled cues are interpreted as trust signals and how blockchain literacy shapes trust formation in online commerce.

The target population consisted of adult e-commerce users in Vietnam. A purposive sampling strategy was used to recruit respondents who were capable of meaningfully evaluating blockchain-enabled cues in e-commerce settings. To be eligible, respondents had to be at least 18 years old and have recent experience purchasing products or services online. The questionnaire was administered online using Google Forms, and the survey link was distributed through relevant consumer communities and networks, including e-commerce groups, blockchain-related communities, university networks, and social platforms. 480 responses were collected. After data screening and cleaning, including the removal of incomplete submissions and low-quality responses such as patterned answering, 427 valid questionnaires were retained for the final analysis.

Data collection followed a structured procedure to enhance clarity and measurement quality. First, the measurement items were adapted from prior validated studies on blockchain-enabled commerce, trust, and consumer behavior and were contextualized to the Vietnamese e-commerce setting. Second, the questionnaire was reviewed by domain experts to assess clarity, content validity, and contextual appropriateness, and minor wording adjustments were made where necessary. Third, a pilot test involving 50 respondents was conducted to evaluate survey flow, comprehensibility, and face validity, after which minor revisions were implemented. Finally, the main survey was launched, monitored throughout the data collection period, and cleaned prior to statistical analysis.

All constructs were operationalized as multi-item reflective measures adapted from established scales and tailored to the blockchain-enabled e-commerce context. All items were assessed using a seven-point Likert scale ranging from 1 ("strongly disagree") to 7 ("strongly agree"). Perceived blockchain-enabled affordances were modeled through four constructs: perceived transparency, perceived security, perceived decentralization, and perceived control. Perceived transparency captured the extent to which transaction- and product-related information was visible, traceable, and verifiable. Perceived security reflected consumers' beliefs that the platform protected privacy, au-

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thentication, and transaction integrity. Perceived decentralization represented perceptions of distributed verification and reduced reliance on centralized intermediaries. Perceived control referred to the degree to which consumers felt empowered to manage personal data and transaction-related decisions. Consumer trust measured respondents' confidence in the reliability, integrity, and credibility of blockchain-enabled e-commerce systems. Behavioral outcomes were represented by purchase intention, referring to willingness to transact in the future, and loyalty, referring to attitudinal commitment and intention to continue engaging with the platform. Blockchain literacy captured respondents' understanding of blockchain concepts and implications and was modeled as a moderator of the relationships between perceived transparency and consumer trust, and between perceived security and consumer trust.

Item selection followed three principles: conceptual fit with the construct definitions used in this study, prior empirical use with acceptable psychometric properties, and suitability for adaptation to a blockchain-enabled e-commerce context. Specifically, perceived transparency items were adapted from traceability and information transparency research in digital commerce (Jiang et al., 2023; Luukela-Tandon et al., 2021). Perceived security items were adapted from well-established online transaction security and privacy assurance scales in e-commerce (Kim et al., 2008; Pavlou, 2003). Perceived decentralization items were adapted from blockchain governance and decentralization perception studies (Truong et al., 2021; Zheng et al., 2017). Perceived control items were drawn from consumer control, empowerment, and privacy-control research (Kim et al., 2008; Wathieu et al., 2002)). Consumer trust items were adapted from validated e-commerce trust scales (e.g., (Gefen et al., 2003; McKnight et al., 2002; Pavlou, 2003). Purchase intention and loyalty items were adapted from established consumer behavior and relationship marketing measures commonly used in online commerce research (Oliver, 1999; Zeithaml et al., 1996). Blockchain literacy items were adapted from studies on technology literacy and blockchain understanding that capture consumers' perceived knowledge of blockchain concepts and implications (Ferreira da Silva & Moro, 2021; Roopnarain & Mwapwele, 2025). To fit the blockchain-enabled e-commerce context, minor wording adjustments were introduced while preserving conceptual equivalence. For example, general references to a "website" were replaced with "blockchain-enabled e-commerce platform," and selected items explicitly referred to the verifiability of transaction or product information through blockchain.

Table 2 summarizes the characteristics of the respondents. Of the 427 valid participants, 60.2% were female (n = 257) and 39.8% were male (n

Table 1. Measurement scales, sources, and item counts

Construct	Abbrev.	No. of items	Key source(s)	Rationale for selection and adaptation
Perceived transparency	PT	4	Jiang et al. (2023), Luukela-Tandon et al. (2021)	Captures verifiability and traceability as core blockchain transparency cues; wording adapted to blockchain-enabled transaction and product records.
Perceived security	PS	4	Kim et al. (2008), Pavlou (2003)	Widely validated in e-commerce; reflects privacy, authentication, and transaction integrity perceptions; adapted to blockchain security cues.
Perceived decentralization	PD	3	Truong et al. (2021), Zheng et al. (2017)	Represents perceived distributed verification and reduced intermediary reliance; adapted to consumer-level perceptions.
Perceived control	PC	3	Kim et al. (2012), Wathieu et al. (2002)	Measures autonomy and control over data and decisions; adapted to platform data and transaction control settings.
Consumer trust	CT	4	Gefen et al. (2003), McKnight et al. (2002)	Established e-commerce trust measures aligned with integrity and reliability beliefs.
Purchase intention	PI	3	Pavlou (2003), Zeithaml et al. (1996)	Standard intention items for online purchase adapted to the blockchain-enabled platform context.
Loyalty	LY	3	Oliver (1999), Zeithaml et al. (1996)	Captures continuance, repurchase, and recommendation intentions in digital commerce settings.
Blockchain literacy	BL	4	Ferreira da Silva and Moro (2021), Roopnarain and Mwapwele (2025)	Captures consumer understanding of blockchain concepts and implications; used to model heterogeneity in interpreting trust cues.

Table 2. Respondent profile (n = 427)

Characteristics	Category	n	%
Gender	Male	170	39.8
	Female	257	60.2
Age (years)	18-24	168	39.3
	25-34	167	39.1
	35-44	66	15.5
	45 and above	26	6.1
Education	High school or below	64	15.0
	College/University	287	67.2
	Postgraduate	76	17.8
Monthly income (VND)	< 10 million	139	32.6
	10-20 million	171	40.0
	> 20 million	117	27.4
E-commerce purchase frequency	< 1 time/month	52	12.2
	1-3 times/month	201	47.1
	≥ 1 time/week	174	40.7
Years of online shopping	< 1 year	41	9.6
	1-3 years	143	33.5
	> 3 years	243	56.9
Primary blockchain-related experience	Blockchain payment/digital wallet	207	48.5
	Traceability/authenticity verification	122	28.6
	NFT-related verification/usage	44	10.3
	Other/unsure	54	12.6
Residence (Vietnam)	Ho Chi Minh City	154	36.1
	Hanoi	92	21.5
	Other major cities	121	28.3
	Other provinces	60	14.1

= 170). The sample was primarily composed of young and early-middle-age consumers, with 39.3% aged 18-24 (n = 168), 39.1% aged 25-34 (n = 167), 15.5% aged 35-44 (n = 66), and 6.1% aged 45 and above (n = 26). In terms of education, 67.2% held a college or university degree (n = 287), 17.8% had postgraduate education (n = 76), and 15.0% reported high school education or below (n = 64). Regarding monthly income, 32.6% earned under 10 million VND (n = 139), 40.0% earned 10-20 million VND (n = 171), and 27.4% earned above 20 million VND (n = 117). In terms of e-commerce activity, 40.7% reported purchasing online at least once per week (n = 174), 47.1% purchased one to three times per month (n = 201), and 12.2% purchased less than once per month (n = 52). Most respondents had substantial online shopping experience, with 56.9% reporting more than three years of experience (n = 243), 33.5% reporting one to three years (n = 143), and 9.6% reporting less than one year (n = 41). With respect to blockchain-related experience, 48.5% reported experience with blockchain payment or digital wallets (n = 207), 28.6% with traceability or authenticity verification (n = 122), 10.3% with NFT-related verification or usage (n = 44), and 12.6% reported other experience or were unsure (n = 54). Geographically, respondents were concentrated in major urban areas, including Ho Chi Minh City (36.1%, n = 154) and Hanoi (21.5%, n = 92), while 28.3% resided in other major cities (n = 121) and 14.1% in other provinces (n = 60).

Data analysis was conducted using SmartPLS 4.0 following a two-step approach. First, the measurement model was assessed in terms of internal consistency reliability, convergent validity, and discriminant validity using Cronbach's Alpha, composite reliability, Average Variance Extracted (AVE), the Fornell-Larcker criterion, and the Heterotrait-Monotrait ratio (HTMT). Second, the structural model was evaluated by estimating path coefficients and their significance using bootstrapping with 5,000 resamples. The explanatory power of the model was assessed using R2 values for endogenous constructs.

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Additional diagnostic indicators, including Variance Inflation Factors (VIF), effect sizes (f2), predictive relevance (Q2), the Standardized Root Mean Square Residual (SRMR), and the normed fit index (NFI), were used where appropriate to evaluate model adequacy. Mediation was examined through bootstrapped indirect effects of blockchain-related affordances on purchase intention via consumer trust. Moderation was tested by constructing interaction terms between blockchain literacy and perceived transparency, as well as between blockchain literacy and perceived security, in predicting consumer trust.

Participation in the study was voluntary and anonymous. Before accessing the questionnaire, respondents were provided with an information sheet describing the purpose of the study, confidentiality safeguards, data usage, and their right to withdraw at any time without penalty. Electronic informed consent was obtained through a mandatory consent checkbox prior to survey completion. No personally identifiable information was collected, and all results were analyzed and reported in aggregate form. No incentives were provided to participants. The dataset used in this manuscript was collected specifically for the present study and has not been used as the primary empirical basis for other publications.

3. RESULTS

3.1. Measurement model evaluation

Reliability and convergent validity were supported for all constructs. As shown in Table 3, all indicator loadings exceeded the recommended threshold of 0.70, Cronbach's Alpha values ranged from 0.83 to 0.92, and Composite Reliability (CR) values ranged from 0.89 to 0.94. Average Variance Extracted (AVE) values were between 0.68 and 0.79, exceeding the 0.50 benchmark and confirming adequate convergent validity.

Discriminant validity was also established. The Fornell-Larcker criterion indicated that the square root of each construct's AVE (diagonal values) exceeded its correlations with other constructs (Table 4). Besides, all HTMT ratios were below 0.85, confirming satisfactory discriminant validity. Cross-loading inspection showed that each indicator loaded highest on its intended construct, indicating robust psychometric properties.

3.2. Structural model evaluation and hypothesis testing

After establishing measurement quality, the structural model was evaluated. The model explained 61% of the variance in consumer trust ($R^2 = 0.61$),

Table 3. Reliability and convergent validity of constructs

Construct	Cronbach's α	CR	AVE
Perceived Transparency (PT)	0.89	0.93	0.76
Perceived Security (PS)	0.88	0.91	0.72
Perceived Decentralization (PD)	0.83	0.89	0.68
Perceived Control (PC)	0.87	0.91	0.73
Consumer Trust (CT)	0.92	0.94	0.78
Purchase Intention (PI)	0.88	0.92	0.79
Loyalty (LY)	0.86	0.91	0.75
Blockchain Literacy (BL)	0.90	0.93	0.77

Table 4. Fornell-Larcker discriminant validity matrix (√AVE on diagonal)

Construct	PT	PS	PD	PC	CT	PI	LY	BL
PT	0.87							
PS	0.62	0.85						
PD	0.55	0.58	0.83					
PC	0.49	0.46	0.51	0.85				
CT	0.66	0.64	0.60	0.55	0.88			
PI	0.53	0.56	0.47	0.52	0.69	0.89		
LY	0.49	0.50	0.45	0.47	0.66	0.68	0.87	
BL	0.42	0.44	0.41	0.38	0.46	0.43	0.41	0.88

Table 5. Path coefficients and hypothesis testing results

Hypothesis	Path	β	t-value	p-value	Result
H1	PT → CT	0.29	6.02	< 0.001	Supported
H2	PS → CT	0.25	5.48	< 0.001	Supported
H3	PD → CT	0.17	3.85	0.001	Supported
H4	PC → CT	0.14	2.54	0.011	Supported
H5	CT → PI	0.47	9.21	< 0.001	Supported
H6	CT → LY	0.52	10.04	< 0.001	Supported
H7	PC → PI	0.18	3.15	0.002	Supported
H9	BL × PT → CT	0.11	2.84	0.005	Supported
H10	BL × PS → CT	0.09	2.26	0.024	Supported

57% in purchase intention ($R^2 = 0.57$), and 53% in loyalty ($R^2 = 0.53$), indicating strong explanatory power. Table 5 reports the direct effects and hypothesis testing results.

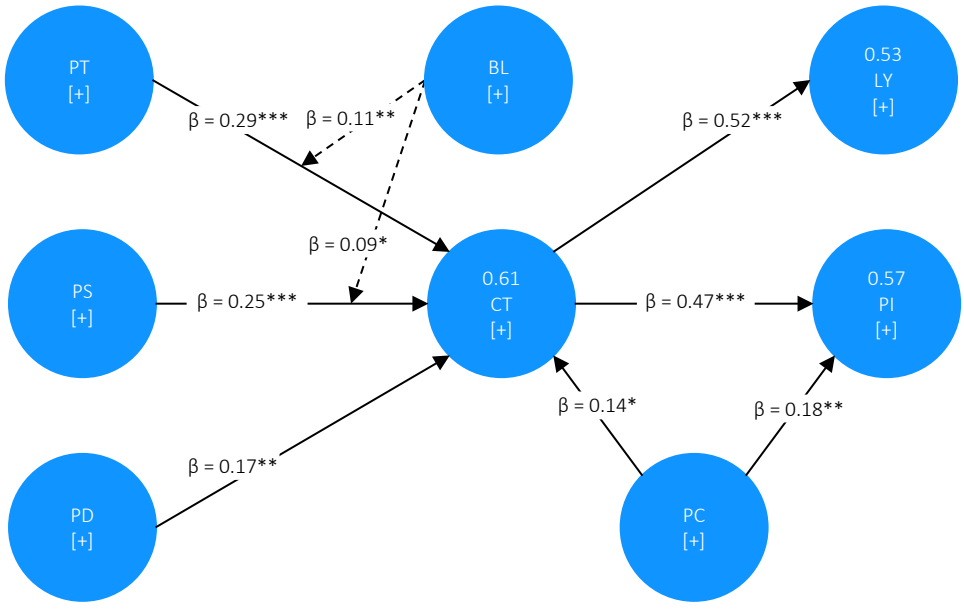
All hypothesized direct relationships were statistically significant and in the expected direction. Among the blockchain-enabled affordances, perceived transparency exhibited the strongest effect on trust (β = 0.29), followed by perceived security (β = 0.25). Perceived decentralization (β = 0.17) and perceived control (β = 0.14) also positively contributed to trust. Consumer trust strongly predicted both purchase intention (β = 0.47) and loyalty (β = 0.52). In addition, perceived control had a significant direct effect on purchase intention (β = 0.18), indicating that empowerment-related perceptions stimulate purchase motivation beyond the trust pathway.

Figure 2 presents the results of the structural model analysis. The figure displays the standardized path coefficients for the hypothesized relationships, including the moderating effects of blockchain literacy, as well as the explained variance (R^2) for consumer trust, purchase intention, and loyalty.

Figure 2. Results of the structural model estimated using PLS-SEM, showing the standardized path coefficients and the explained variance (R^2) of the endogenous constructs.

3.3. Mediation analysis

Mediation was assessed using bootstrapping with 5,000 resamples by examining direct, indirect, and total effects. As reported in Table 6, consumer trust significantly mediated the effects of trans-



Note: *p < 0.05; **p < 0.01; ***p < 0.001.

Figure 2. Structural model results

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Table 6. Mediation analysis results (bootstrapping, n = 427)

Hypothesis	Path	Direct effect (β)	t-value	p-value	Indirect effect via CT (β)	t-value	p-value	Total effect (β)	Mediation type
H8a	PT → PI	0.12	2.41	0.016	0.14	5.01	< 0.001	0.26	Partial
H8b	PS → PI	0.10	2.08	0.038	0.12	4.66	< 0.001	0.22	Partial
H8c	PD → PI	0.05	1.47	0.142 (ns)	0.08	3.45	0.001	0.13	Full
H8d	PC → PI	0.18	3.15	0.002	0.07	2.88	0.004	0.25	Partial

Note: PT = Perceived Transparency; PS = Perceived Security; PD = Perceived Decentralization; PC = Perceived Control; CT = Consumer Trust; PI = Purchase Intention.

parency, security, decentralization, and perceived control on purchase intention.

The results indicate partial mediation for transparency, security, and perceived control (significant direct and indirect effects), whereas decentralization exhibited full mediation (non-significant direct effect but significant indirect effect via trust). These findings confirm that trust is the primary mechanism through which blockchain-enabled cues translate into purchase intention, with some affordances (notably transparency, security, and control) also exerting additional direct effects.

3.4. Moderation analysis

Moderation was tested using interaction terms (PT × BL and PS × BL) and bootstrapping with 5,000 bootstrap resamples. Table 7 reports the moderation results, including effect sizes.

Both interaction effects were positive and significant, indicating that blockchain literacy strengthens the effects of perceived transparency and perceived security on consumer trust. Although the interaction effect sizes were small (f^2 = 0.02-0.03), the results demonstrate a meaningful boundary condition: consumers with higher blockchain literacy derive stronger trust benefits from transparency and security cues.

To further interpret the significant interaction effects, simple slope analysis was conducted and is presented in Figure 3. Figure 3A depicts the interaction between perceived transparency and blockchain literacy in predicting consumer trust, while Figure 3B presents the interaction between perceived security and blockchain literacy in predicting consumer trust.

3.5. Model fit and predictive power

Overall model quality indicators supported adequate fit and predictive capability. The standardized root mean square residual was SRMR = 0.041 (< 0.08) and the normed fit index was NFI = 0.91, indicating acceptable model fit. Predictive relevance assessed via blindfolding showed positive Q^2 values for all endogenous constructs (CT = 0.46; PI = 0.42; LY = 0.39), supporting strong predictive validity. Multicollinearity diagnostics indicated no concerns (VIF < 3). Effect size estimates (f^2) ranged from small to large across relationships, with transparency and security demonstrating comparatively stronger impacts on trust.

4. DISCUSSION AND IMPLICATIONS

This study provides empirical evidence on how blockchain-enabled affordances shape consumer trust and subsequent behavioral outcomes in e-commerce, and how blockchain literacy conditions this trust formation process. The findings align with the Stimulus-Organism-Response (SOR) paradigm, which explains how environmental/technological stimuli influence internal

Table 7. Moderation analysis results (bootstrapping, n = 427)

Hypothesis	interaction term	β	t-value	p-value	f^2 effect size	Result
H9	PT × BL → CT	0.11	2.84	0.005	0.03	Supported
H10	PS × BL → CT	0.09	2.26	0.024	0.02	Supported

Note: PT = Perceived Transparency; PS = Perceived Security; BL = Blockchain Literacy; CT = Consumer Trust.

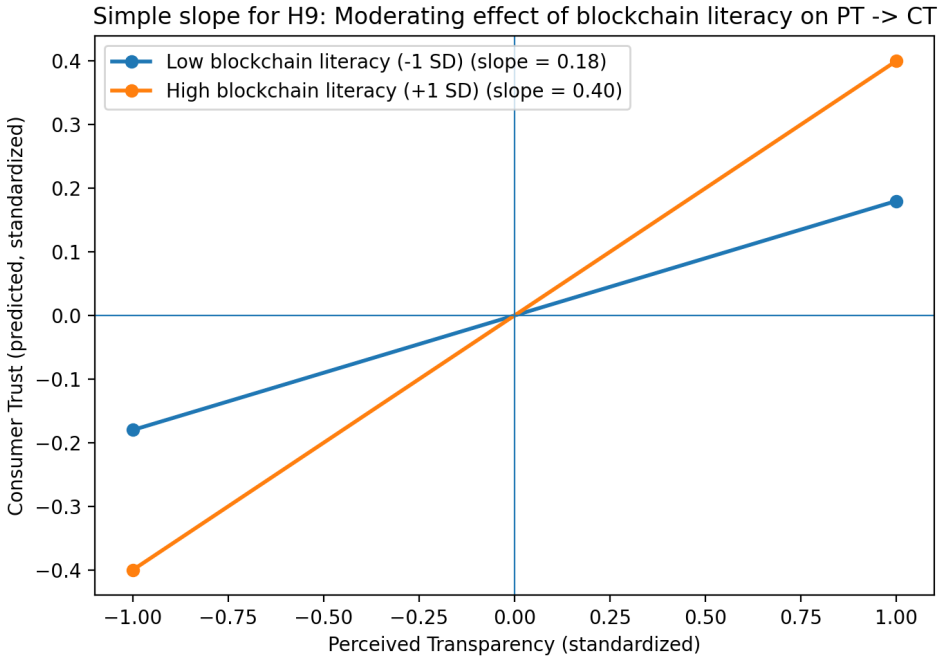

Figure 3A. Simple slope of the moderating effect of blockchain literacy on the relationship between perceived transparency and consumer trust

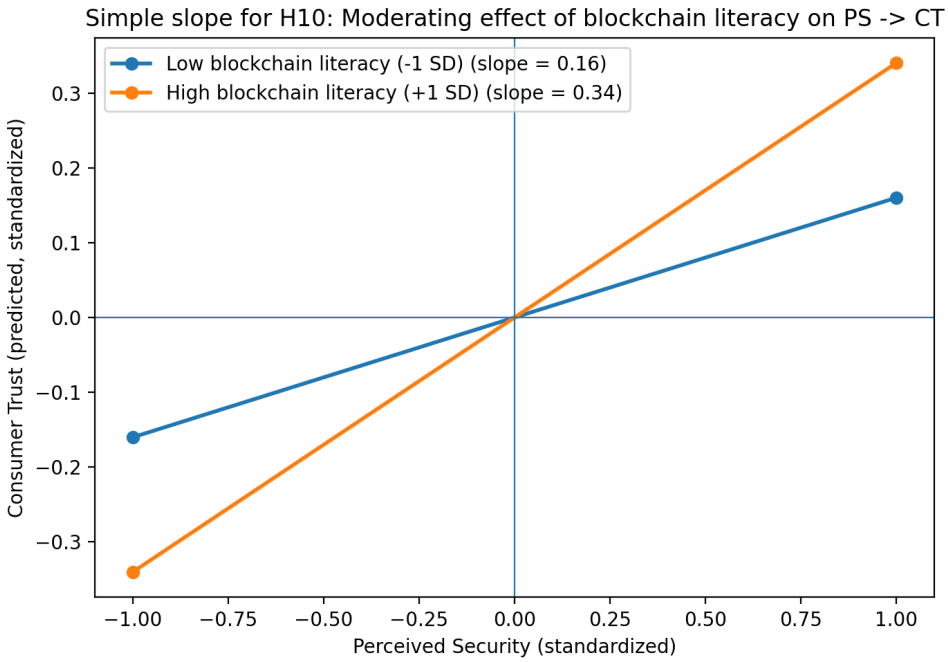

Figure 3B. Simple slope of the moderating effect of blockchain literacy on the relationship between perceived security and consumer trust

psychological states and then shape behavioral responses (Luukela-Tandon et al., 2021; Mehrabian & Russell, 1974). Consistent with contemporary views of technology-mediated trust, the results suggest that trust formation in digital commerce increasingly emerges from system cues rather than solely from interpersonal interaction or institutional assurances (Gefen et al., 2003; McKnight et al., 2002; Pavlou, 2003; Toufaily & Zalan, 2024). The model's explanatory power is also substantial

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(R^2 = 0.61 for trust; R^2 = 0.57 for purchase intention; R^2 = 0.53 for loyalty; $Q^2 > 0$ across endogenous constructs), indicating that the proposed mechanism captures meaningful variance in consumer responses within blockchain-enabled commerce (Hair et al., 2022; Henseler et al., 2015).

A primary insight is that perceived transparency and perceived security are the strongest predictors of consumer trust (PT → CT: β = 0.29; PS → CT: β = 0.25). This pattern indicates that trust in blockchain-enabled commerce is anchored in verifiability and protection cues. From a signaling perspective, transparent and secure system features reduce information asymmetry and perceived risk, thereby strengthening credibility assessments (Pavlou, 2003; Spence, 1973). Transparency reduces uncertainty by enabling traceability and authenticity verification and supporting integrity and fairness perceptions (Hina et al., 2025; Jiang et al., 2023). Security functions as psychological assurance: perceived safeguards against fraud and privacy threats increase confidence in online exchanges (Guntara et al., 2023; Kim et al., 2008). Besides, blockchain's architectural properties (immutability, distributed verification) can be understood as institutional substitutes when they are visible and interpretable to consumers, thereby supporting technology-based trust formation (Casino et al., 2019; Duan & Zhu, 2025; Kshetri, 2018; Zheng et al., 2017).

The results also show that perceived decentralization and perceived control positively but more moderately influence trust (PD → CT: β = 0.17; PC → CT: β = 0.14). Decentralization may enhance procedural trust by reducing reliance on a single authority and limiting unilateral manipulation an important fairness cue in online marketplaces (Truong et al., 2021). Perceived control contributes through empowerment and autonomy: when consumers believe they can manage data and transaction decisions, perceived vulnerability declines and confidence rises, consistent with broader privacy/control research in digital environments (Hoffman et al., 1999; Kim et al., 2012; Ma et al., 2024; Wathieu et al., 2002). Collectively, these findings refine trust theory in e-commerce by indicating that different affordances contribute through distinct cognitive routes, with transparency and security serving as higher-salience trust triggers.

A third contribution is the confirmation that consumer trust is the central mechanism linking blockchain affordances to behavioral outcomes. Trust strongly predicts both purchase intention (CT → PI: β = 0.47) and loyalty (CT → LY: β = 0.52), consistent with established e-commerce trust research and relationship-marketing theory that positions trust as a driver of commitment and retention-related outcomes (Hajli, 2015; Morgan & Hunt, 1994; Pavlou, 2003; Singh et al., 2024). Mediation results provide a clearer mechanism-level account. Transparency and security show partial mediation, implying that these cues influence purchase intention both through trust and via additional direct pathways (e.g., reduced perceived risk/effort) (Duan & Zhu, 2025). Decentralization displays full mediation (direct effect ns; indirect effect via trust significant), suggesting decentralization affects purchase intention only insofar as it is converted into trust judgments. Perceived control exhibits partial mediation and a meaningful direct effect on purchase intention (PC → PI: β = 0.18), indicating that autonomy-related cues can stimulate purchase motivation beyond the trust pathway, consistent with decision-autonomy perspectives (Wathieu et al., 2002).

Finally, the study demonstrates that blockchain literacy is a significant boundary condition. Both interaction effects are positive and significant (BL × PT → CT: β = 0.11; BL × PS → CT: β = 0.09), indicating that consumers with higher literacy derive stronger trust benefits from transparency and security cues. This extends digital trust research by showing that interpretive competence shapes how consumers translate technical cues into psychological assurance (Ferreira da Silva & Moro, 2021; Roopnarain & Mwapwele, 2025). More broadly, the result resonates with the digital-skills literature: technology value is realized not only by system features but also by users' ability to understand and utilize them (Norbu et al., 2024, 2025; Van Dijk & Deursen, 2014). Although effect sizes are small, their significance indicates a meaningful amplification mechanism that is practically relevant for markets with uneven competencies.

Implications for practice and policy. First, because transparency has the strongest trust effect, platforms should make transparency visible and actionable through consumer-facing tools (e.g., traceability dashboards, authenticity indicators, ledger-

verified labels) that reduce cognitive burden and improve verifiability at the point of decision (Hina et al., 2025; Jiang et al., 2023). Second, security should be treated not only as a safeguard but also as a communicated value proposition, using clear disclosures about privacy protection and transaction integrity to reduce perceived risk and increase conversion likelihood (Kim et al., 2008; Pavlou, 2003). Third, platforms should translate decentralization and control into concrete empowerment benefits (e.g., consent-based sharing, understandable data-ownership settings) that strengthen autonomy perceptions (Hoffman et al., 1999; Kim et al., 2012; Ma et al., 2024). Fourth, given the moderating role of literacy, firms and regulators can improve trust returns by investing in consumer education and standardized disclosures to help users interpret transparency and security signals (Ferreira da Silva & Moro, 2021; Roopnarain & Mwapwele, 2025).

Limitations and future research. The cross-sectional design limits causal inference; longitudinal or experimental studies could better capture trust dynamics over time (Podsakoff et al., 2003). The Vietnam context supports emerging-market insights but may limit generalizability; multi-country comparisons could test boundary conditions across institutional environments. Self-reported measures may introduce bias; future work could triangulate surveys with behavioral/transactional data. Blockchain literacy could be unpacked into technical understanding, perceived explainability, and ethical awareness to identify which dimension most strongly shapes trust formation. Future studies could also examine hybrid ecosystems where blockchain interacts with AI or IoT, potentially creating new trust configurations that blend verifiability with personalization.

CONCLUSION

This study aimed to examine how perceived blockchain-enabled affordances (transparency, security, decentralization, and control) shape consumer trust and, in turn, drive purchase intention and loyalty in e-commerce, while assessing the moderating role of blockchain literacy in trust formation. The findings indicate that transparency and security are the strongest drivers of consumer trust, while decentralization and perceived control also contribute positively. Consumer trust, in turn, exerts a strong positive effect on both purchase intention and loyalty, confirming its central role in converting platform-level cues into transactional and relational outcomes. The mediation results further show that decentralization affects purchase intention only through trust, whereas transparency, security, and perceived control demonstrate both direct and trust-mediated effects. Besides, blockchain literacy strengthens the effects of transparency and security on trust, suggesting that trust-building returns are higher when consumers can interpret blockchain-related cues.

Overall, these results support the conclusion that blockchain creates marketing value primarily by operating as a trust infrastructure rather than merely as a technical upgrade. The effectiveness of this infrastructure depends on how convincingly platforms translate blockchain-enabled features into consumer-visible and consumer-understandable assurances. Practically, e-commerce firms should prioritize making transparency and security cues salient and interpretable at the point of decision and reinforce empowerment signals by linking perceived control to concrete customer benefits. Taken together, the study clarifies a coherent trust pathway through which blockchain-enabled design features can strengthen consumer confidence and support sustained engagement in e-commerce.

AUTHOR CONTRIBUTIONS

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APPENDIX A

Table A1. Summary of constructs and theoretical links

Construct	Definition (as conceptualized in this study)	Key theoretical source(s)	Expected role in model
Perceived Transparency	The degree to which blockchain-based transactions and product data are visible, traceable, and verifiable by consumers.	Hina et al. (2025), Jiang et al. (2023), Tandon et al. (2021)	Antecedent of consumer trust
Perceived Security	Consumers' belief that blockchain technology ensures privacy, authentication, and data protection.	Duan and Zhu (2025), Guntara et al. (2023), Judijanto et al. (2025)	Antecedent of consumer trust
Perceived Decentralization	The perception that control and verification are distributed across nodes, enhancing fairness and independence.	Ovezik et al. (2025), Singh et al. (2024), Truong et al. (2021)	Antecedent of consumer trust
Perceived Control	The extent to which users feel capable of managing their personal data, decisions, and participation in blockchain-enabled systems.	Ma et al. (2024), Wathieu et al. (2002)	Antecedent of consumer trust and purchase intention
Consumer Trust	A psychological state reflecting confidence in the reliability, honesty, and integrity of blockchain-enabled e-commerce systems.	Girimurugan et al. (2024), Singh et al. (2024)	Mediator between blockchain features and behavioral outcomes
Purchase Intention	Consumers' willingness to engage in future transactions on blockchain-enabled e-commerce platforms.	Pasaribu et al. (2022), M. Sattar and B. Sattar (2012)	Behavioral outcome
Loyalty	The degree of attitudinal commitment and behavioral consistency toward blockchain-enabled e-commerce.	M. Sattar and B. Sattar (2012), Singh et al. (2024)	Behavioral outcome
Blockchain Literacy	The consumer's understanding of blockchain concepts, functions, and implications for trust and security.	Ferreira da Silva and Moro (2021), Roopnarain and Mwapwele (2025)	Moderator of transparency → trust and security → trust relationships

APPENDIX B

Survey questionnaire items and measurement sources

Scale: 1 = strongly disagree … 7 = strongly agree.

Instruction to respondents: Please indicate your agreement with the statements below regarding your experience with blockchain-enabled e-commerce platforms.

PERCEIVED TRANSPARENCY (PT) (4 ITEMS)

- PT1. The platform provides transparent information about transactions and product-related records.
- PT2. I can trace the transaction/product information when needed through the platform's block-chain-enabled features.
- PT3. The information shown by the platform can be verified and is difficult to manipulate.
- PT4. The platform helps me confirm product authenticity and transaction history more reliably.

Source: Adapted from transparency/traceability research in digital commerce (Jiang et al., 2023; Luukela-Tandon et al., 2021).

PERCEIVED SECURITY (PS) (4 ITEMS)

- PS1. I feel that my transactions on this platform are secure.
- PS2. I believe this platform protects my personal and payment information.
- PS3. I believe it is difficult for unauthorized parties to tamper with transaction records on this platform.
- PS4. Overall, this platform provides strong security assurance for online purchasing.

Source: Adapted from e-commerce security/trust literature (Kim et al., 2008; Pavlou, 2003).

PERCEIVED DECENTRALIZATION (PD) (3 ITEMS)

- PD1. The platform's transaction verification does not depend on a single central authority.
- PD2. I believe transaction records are validated through distributed verification rather than a single intermediary.
- PD3. The platform reduces reliance on intermediaries by using blockchain-based verification.

Source: Adapted from blockchain decentralization and governance literature (Truong et al., 2021; Zheng et al., 2017).

PERCEIVED CONTROL (PC) (3 ITEMS)

- PC1. I feel that I can control how my data are used on this platform.
- PC2. I feel that I can manage my purchasing decisions and transaction preferences effectively on this platform.
- PC3. The platform provides options that allow me to decide what information to share and when.

Source: Adapted from consumer control/autonomy and privacy-control research (Kim et al., 2012; Wathieu et al., 2002).

CONSUMER TRUST (CT) (4 ITEMS)

- CT1. I trust this platform to be reliable for online transactions.
- CT2. I believe this platform is honest in its operations.
- CT3. I believe this platform keeps its promises and commitments to users.
- CT4. Overall, I trust this platform when making purchases online.

Source: Adapted from validated e-commerce trust scales (Gefen et al., 2003; McKnight et al., 2002; Pavlou, 2003).

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PURCHASE INTENTION (PI) (3 ITEMS)

- PI1. I intend to purchase products/services through this platform in the near future.
- PI2. I will likely use this platform for my future online purchases.
- PI3. If I need to buy online, this platform would be one of my first choices.

Source: Adapted from online purchase intention research (Pavlou, 2003; Zeithaml et al., 1996).

LOYALTY (LY) (3 ITEMS)

- LY1. I intend to continue using this platform regularly.
- LY2. I would recommend this platform to others.
- LY3. I would choose this platform over other alternatives when possible.

Source: Adapted from loyalty/repurchase intention measures (Oliver, 1999; Zeithaml et al., 1996).

BLOCKCHAIN LITERACY (BL) (4 ITEMS)

- BL1. I understand the basic principles of blockchain technology.
- BL2. I understand how blockchain can improve transparency and traceability in online commerce.
- BL3. I understand how blockchain can enhance security and reduce tampering in transactions.
- BL4. Overall, I consider myself knowledgeable about blockchain and its implications in e-commerce.

Source: Adapted from blockchain/digital literacy research (Ferreira da Silva & Moro, 2021; Roopnarain & Mwapwele, 2025).