

Transparent Digital Nudging and Consumer Loyalty: The Serial Mediating Role of Perceived Autonomy and Trust in Indonesian Digital Platforms

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ABSTRACT

This study analyzes the effect of transparent digital nudging on digital consumer loyalty through perceived autonomy and consumer trust on digital platforms in Indonesia. An explanatory quantitative study was conducted on 400 digital consumers using SEM-PLS. The analysis results show that transparent digital nudging has a significant effect on perceived autonomy with a large effect size (f^2 0.375), and perceived autonomy subsequently strengthens consumer trust with a small effect size (f^2 0.100). Consumer trust was found to be the strongest predictor of loyalty with a large effect size (f^2 0.742), while nudging and autonomy do not directly affect loyalty. Serial mediation testing was proven significant with a moderate mediation effect (v 0.092). These results confirm that long-term digital consumer loyalty is formed through trust-based relational mechanisms, not through instant digital design interventions. This study expands the relationship marketing literature by positioning digital choice architecture design as a consumer relationship management practice.

ABSTRAK

Penelitian ini menganalisis pengaruh transparent digital nudging terhadap loyalitas konsumen digital melalui perceived autonomy dan consumer trust pada platform digital di Indonesia. Studi kuantitatif eksplanatori dilakukan terhadap 400 konsumen digital menggunakan SEM-PLS. Hasil analisis menunjukkan bahwa transparent digital nudging berpengaruh signifikan terhadap perceived autonomy dengan ukuran efek besar (f^2 0.375), dan perceived autonomy selanjutnya memperkuat consumer trust dengan ukuran efek rendah (f^2 0.100). Consumer trust ditemukan sebagai prediktor terkuat bagi loyalitas dengan ukuran efek besar (f^2 0.742), sedangkan nudging dan otonomi tidak memengaruhi loyalitas secara langsung. Pengujian mediasi serial terbukti signifikan dengan pengaruh mediasi sedang (v 0.092). Hasil ini mengonfirmasi bahwa loyalitas konsumen digital jangka panjang terbentuk melalui mekanisme relasional berbasis kepercayaan, bukan melalui intervensi desain digital secara instan. Studi ini memperluas literatur relationship marketing dengan memposisikan desain arsitektur pilihan digital sebagai praktik manajemen hubungan konsumen.



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1. INTRODUCTION

The rapid development of the digital economy has changed the landscape and the way consumers make decisions. Digital platforms, e-commerce, social media, and various algorithmic system applications now not only provide information but also help shape economic behavior through design, features, and various digital choice architectures offered. This phenomenon drives the massive practice of digital nudging, which is the use of various design elements such as default options, framing, priming, social proof, and algorithmic recommendations to guide choices without eliminating the freedom to choose (Lemken et al., 2024; Mele et al., 2020; Panda & Binkley, 2025). From the perspective of behavioral economics, digital nudging is seen as an effort to help consumers make decisions

that are considered better while still maintaining the consumer's personal freedom (Cai, 2020; Jesse & Jannach, 2020; Kniess, 2021). However, in modern digital marketing practice, choice architecture is often exploited solely for commercial purposes, potentially reducing consumer autonomy through dark patterns, hidden settings, and manipulative defaults (Kozyreva et al., 2019). Behavioral experiments show that defaults and social influence can consistently guide online purchasing decisions across consumer characteristics (Ingendahl et al., 2020). Meanwhile, priming techniques can increase willingness to pay when the value of the product is unclear (Dennis et al., 2020). This indicates that digital interventions have significant economic power in their contribution to shaping consumer decisions, while also raising critical questions about freedom in making choices, consumer trust, and the sustainability of the consumer relationship with the platform.

Studies related to marketing and economic behaviour highlight that the main issue in digital nudging is not merely the effectiveness of persuasion, but also how the intervention is perceived by consumers in terms of transparency and autonomy. Studies on choice architecture show that the level of intrusiveness of a nudge is determined by the ease of opting out, affective pressure, and the transparency of the intervention's objectives (Lemken et al., 2024). Transparency is seen as a key mechanism in maintaining autonomy, because consumers are aware of the existence of nudges and the alternative choices available (Patricheev, 2025). Without transparency, nudging has the potential to trigger psychological reactance, which is resistance to external control efforts (Sunstein, 2017). In addition, the default effect can weaken over time or even cause backlash if consumers feel manipulated in their decision (De Haan & Linde, 2018; Gustavsson, 2016). Therefore, a new approach in digital marketing has begun to emphasize radical transparency and self-nudging, in other words, giving consumers control in managing their own digital environment (Kozyreva et al., 2019; Reijula & Hertwig, 2019). This argument places transparency not merely as an ethical issue, but also as an economic behavior variable that determines how consumers assess the legitimacy of digital marketing influence.

In the context of consumer–platform relationships, previous studies have shown that perceptions of autonomy and control are key psychological determinants in the formation of trust. Autonomy is understood as the subjective experience that decisions come from one's own will, especially in data- and algorithm-based environments in the digital space (Wertenbroch et al., 2020). The fulfillment of autonomy needs has been proven to increase cognitive, emotional, and behavioral engagement with digital platforms (Roy et al., 2023), which then contributes to brand trust and the quality of digital relationships (Hollebeek & Macky, 2019). Studies regarding social commerce affirm that privacy control as a form of autonomy increases trust, whereas privacy risks decrease it (Lin et al., 2019; X. Wang et al., 2019). Excessive reliance on AI-based systems can even decrease satisfaction when autonomy is perceived to be lost, so in turn, trust in technology is conditional on transparency and control from consumers (Saputra et al., 2022; Trang & Thang, 2025). In the context of behavioral economics, autonomy functions as a psychological mechanism that directly links the design of technology and consumers' relational evaluation of the platform.

Besides autonomy, the relationship marketing literature places trust as a main factor in shaping consumer loyalty. Commitment–trust theory explains that long-term

relationships are formed through trust and commitment from consumers, thereby reducing the uncertainty of economic exchanges (Apostolopoulos et al., 2023; Badrinarayanan & Ramachandran, 2024; Tjizumaue, 2023; Zhang et al., 2016). Empirical studies of digital marketing show that trust is the strongest predictor of brand loyalty, repurchase intention, and also electronic word-of-mouth (Ginting et al., 2022; R. E. Hidayat et al., 2021; Muharam et al., 2021; Ramadhani et al., 2025; Rowi et al., 2024). In the digital platform ecosystem, trust often acts as a mediator between digital experience and consumer loyalty (Ashiq & Hussain, 2023; Cardoso et al., 2022; Guerreiro & Pacheco, 2021; Kurniadi & Rana, 2023; Ozdemir et al., 2020). The relationship is also seen in social media marketing, where the quality of customer relationships mediates marketing activities towards loyalty (Alimuddin et al., 2023; Ibrahim & Aljarah, 2021).

In line with the self-determination perspective in consumer behaviour, autonomy is directly related to intrinsic motivation and long-term loyalty. Autonomy promotes consumption behavior that is more persistent, voluntary, and based on self-values (Taljaard & Sonnenberg, 2019). In the context of e-commerce, the needs for autonomy, competence, and relatedness mediate purchase continuity and consumer engagement (Chen et al., 2019). Other research shows that perceived autonomy increases trust, satisfaction, as well as long-term usage intentions in AI-based services (Han & Ko, 2025), while autonomy experience increases engagement and loyalty to digital destinations (Xiong & Zhang, 2024). Empowerment and psychological ownership are even able to strengthen emotional attachment and brand loyalty (Kumar & Nayak, 2019; Shukla et al., 2023). Thus, autonomy is not merely an ethical factor, but rather a behavioral economic mechanism that strengthens the value relationship between consumers and digital platforms.

Studies regarding ethical persuasion emphasize that transparency serves as a signal of honesty that strengthens trust in modern digital marketing. Transparency related to the use of data, personalization algorithms, sponsorships, and pricing increases trust and reduces privacy concerns (Ahmed et al., 2025; M. Hidayat et al., 2025; Joshi, 2025; O'Higgins & Fatorachian, 2025). Regarding influencer marketing, sponsorship disclosure can indeed reduce short-term engagement but increase long-term attitudes toward the brand through enhanced credibility (Lou, 2021; Nguyen et al., 2025; Sands et al., 2022). Research on algorithmic transparency also shows that fairness, explainability, and accountability increase trust and platform loyalty (Shin, 2020; Wang et al., 2022; Hassan et al., 2025; Aldboush & Ferdous, 2023; Filho, 2025). This, indirectly, indicates that marketing strategies based on behavioral economics will only achieve sustainability if accompanied by clear and understandable transparency practices for consumers.

Although the literature on digital nudging has grown rapidly, existing research mostly still focuses on three domains. First, it focuses on the influence of the effectiveness of nudging on short-term decisions such as purchase intention (Utami et al., 2025; Wu, 2025). Second, studies generally focus on testing direct relationships so that nudging can generate engagement and long-term retention (Kabir et al., 2025; Panwar et al., 2025). Without an explanation of the relational mechanism that underlies the formation of long-term customer loyalty. Third, research that tends to focus on positioning nudging as an interactive technology system in increasing customer lifetime value (Kozyreva et al., 2019; T. Singh, 2024). Not as a relational practice that can influence the user experience of digital

platforms. Among these three tendencies, there is a theoretical gap regarding how digital budgeting transparency shapes perceptions of autonomy, how autonomy subsequently builds trust, and how this sequence in a sequential pathway produces digital consumer loyalty.

This research is important to conduct in the context of Indonesia as one of the rapidly growing digital markets in Southeast Asia, with a high level of online platform adoption as well (Google et al., 2023). The digital landscape in Indonesia has unique characteristics dominated by major platforms such as Shopee, Tokopedia, TikTok Shop, and Lazada. In this competitive ecosystem, Indonesian consumers are vulnerable to exposure from highly aggressive digital choice architectures, ranging from personalized algorithmic recommendation systems, scarcity manipulation through flash sales, voucher incentives, to notification-based interventions. On the other hand, the level of digital literacy, sensitivity to transparency, and dynamics of trust towards a platform differ compared to the context of developed countries. Therefore, this research provides empirical boundary domains for testing digital nudging and relationship marketing. This study does not merely replicate established relationship or behavioral economics but positions transparent digital nudging as a relational practice within a digital ecosystem. Unlike previous studies that tend to place nudging as a direct persuasive stimulus, this research proposes that digital loyalty is formed through a gradual relational mechanism pathway that positions autonomy and trust as a chain process. This study integrates perspectives from behavioral economics, ethical digital marketing, and relationship marketing by positioning transparency as the stimulus, autonomy and trust as psychological organisms, and loyalty as the behavioral response within the stimulus–organism–response framework (Lim et al., 2024; Luo et al., 2025; Sohaib et al., 2022). This approach expands the domain of relationship marketing in the context of digital platform ecosystems.

Thus, the research problem in this study can be formulated as follows: how does transparent digital nudging affect consumers' perceived autonomy on digital platforms; how does perceived autonomy shape consumer trust; whether digital nudging and autonomy directly influence consumer loyalty; and whether consumer trust serves as the main mediating mechanism in the formation of digital loyalty. This study also questions whether the relationship between nudging and loyalty occurs through a serial mediation pathway of autonomy and trust as an economic behavior mechanism that explains the formation of long-term consumer relationships with digital platforms. Unlike manipulative nudging (dark patterns) that secretly steer consumer choices solely for commercial gain, transparent digital nudging in this study refers to digital choice architectures that guide consumer decisions through open, understandable, and non-coercive design features, while maintaining user awareness, alternative choices, and freedom of choice. Through this approach, this study is expected to provide three main theoretical contributions. First, this study shifts the focus of digital nudging research from short-term behavioral influence to long-term relational outcomes, namely consumer loyalty. Second, this study explains that transparent digital nudging does not directly create loyalty, but rather works through a serial psychological mechanism within the Stimulus–Organism–Response (S-O-R) framework: on the path of transparent nudging (Stimulus) towards perceived autonomy and consumer trust (Organism) leading to consumer loyalty (Response). Third, this study

expands the scope of relationship marketing by positioning digital interface design as part of customer relationship management, not merely in digital advancement.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 Transparent Digital Nudging and Perceived Autonomy

Digital nudging is a strategy based on behavioral economics that utilizes digital interface design such as default options, framing, algorithmic recommendations, and social cues to influence user decisions without limiting freedom of choice (Lemken et al., 2024; Mele et al., 2020; Panda & Binkley, 2025). This intervention aims to help individuals make better decisions while maintaining formal freedom of choice (Cai, 2020; Jesse & Jannach, 2020; Kniess, 2021). However, the literature also highlights that non-transparent digital choice architectures (dark patterns) can reduce autonomy because users do not fully understand how their choices are being guided (Gumbert, 2019; Kozyreva et al., 2019). Therefore, transparency becomes a key element in maintaining autonomy preservation in digital nudging. Transparency allows users to understand the purpose of the nudge, the alternative choices, as well as the system mechanisms working behind the decision (Lemken et al., 2024; Patricheev, 2025). When users are aware of the presence of digital interventions openly, perceptions of control and agency increase, thereby reducing intrusiveness and the potential for psychological reactance (Sunstein, 2017). Studies on recommender systems also show that ease of opting out and user control increase the perception of freedom of choice (Panda & Binkley, 2025; Vermeulen, 2022). Within the SOR framework, transparent digital nudging acts as an external stimulus that shapes internal psychological evaluations in the form of perceived autonomy. Based on this argument, the hypothesis is formulated. H1: Transparent Digital Nudging has a positive effect on Perceived Autonomy.

2.2 Perceived Autonomy and Consumer Trust

Perceived autonomy is seen as a fundamental psychological need in Self-Determination Theory that affects intrinsic motivation, satisfaction, and the long-term relationship of consumers with digital platforms (Chen et al., 2019; Taljaard & Sonnenberg, 2019). In the context of an increasingly automated digital market, autonomy becomes an important factor because decisions are often mediated by algorithms and artificial intelligence (Wertenbroch et al., 2020). Research shows that when consumers feel they have control over personal data and interaction choices, the level of trust in the platform increases significantly (Lin et al., 2019; Saputra et al., 2022; X. Wang et al., 2019). Autonomy satisfaction also increases cognitive and emotional engagement, which in turn strengthens brand trust in an interactive digital environment (Hollebeek & Macky, 2019; Roy et al., 2023). Conversely, excessive reliance on AI systems without transparency can lower satisfaction and weaken trust (Trang & Thang, 2025). The concept of empowerment in social commerce shows that user control increases the quality of relationships and sustained trust (Irshad et

al., 2020; Tana et al., 2024). The mechanism of psychological ownership that emerges when users have personal control has also been shown to increase trust in technology and digital platforms (Hu et al., 2025). Perceived autonomy functions as an internal psychological condition that strengthens consumers' confidence in the integrity and good intentions of the platform. Based on the literature, the hypothesis is formulated. H2: Perceived Autonomy has a positive effect on Consumer Trust.

2.3 Transparent Digital Nudging and Consumer Trust

Transparency in digital marketing practices is considered a signal of ethics, honesty, and accountability that reinforces the perception of a company's credibility (M. Hidayat et al., 2025; Joshi, 2025). Transparency regarding data usage, personalization algorithms, and persuasive purposes helps consumers understand the decision-making process, thereby increasing trust (O'Higgins & Fatorachian, 2025). Studies on advertising disclosure show that transparency reduces perceptions of manipulation and increases long-term persuasion acceptance (Nguyen et al., 2025; Sands et al., 2022). Algorithmic transparency also increases perceived fairness and explainability, which directly strengthens trust in digital systems (Filho, 2025; Shin, 2020). In the context of the platform economy, platform transparency is even positioned as a key prerequisite for the formation of loyalty through trust formation mechanisms (Ahmed et al., 2025; Aldboush & Ferdous, 2023; Hassan et al., 2025). Transparency turns nudging from hidden manipulation into ethical persuasion that can be accepted by consumers (Lou, 2021; Shekhar, 2024). Transparent digital nudging not only preserves autonomy but also functions as a trust signal in consumer-platform relationships. Based on this argument, the hypothesis is formulated. H3: Transparent Digital Nudging has a positive effect on Consumer Trust.

2.4 Consumer Trust and Consumer Loyalty

Relationship marketing places trust as the main foundation of long-term relationships between companies and customers (Badrinarayanan & Ramachandran, 2024; Tjizumaue, 2023). Commitment-Trust Theory explains that trust reduces transaction uncertainty and encourages the sustainability of exchange relationships (Apostolopoulos et al., 2023; Zhang et al., 2016). Various studies on digital marketing indicate trust as the strongest predictor of loyalty, repurchase intention, and electronic word-of-mouth (Ginting et al., 2022; R. E. Hidayat et al., 2021; Muharam et al., 2021; Ngo et al., 2025). In the context of social media marketing, the quality of customer relationships based on trust can consistently mediate marketing activities toward brand loyalty (Alimuddin et al., 2023; Ibrahim & Aljarah, 2021). Systematic studies also confirm that trust and commitment are the core of relationship quality that can encourage customer retention as well as advocacy behavior (Albérico & A., 2023; Rosário & Casaca, 2025). In the high-risk digital platform environment, trust becomes a determining mechanism that encourages the sustainable use of the medium (Al-Adwan et al., 2022). Thus, the higher the consumer's trust in a digital platform, the stronger the

loyalty that is formed. Therefore, the hypothesis is formulated. H4: Consumer Trust has a positive effect on Consumer Loyalty.

2.5 Perceived Autonomy and Consumer Loyalty

Autonomy not only can influence trust but also has a direct relationship with loyalty through consumers' intrinsic motivation. Self-Determination Theory explains that consumer behavior originating from one's own will can result in high engagement and persistence (Taljaard & Sonnenberg, 2019). In e-commerce, autonomy along with competence and relatedness can mediate sustainable purchasing as well as continuous platform usage (Chen et al., 2019). Previous studies on AI services have shown that perceived autonomy increases engagement, satisfaction, and long-term loyalty (Han & Ko, 2025). Autonomy experience in digital tourism application platforms also increases engagement, which then strengthens loyalty intention (Xiong & Zhang, 2024). Consumers who feel a sense of agency tend to build emotional relationships and identification with a brand (Hardcastle et al., 2025). Psychological empowerment in digital brand communities has also been shown to increase community commitment and brand loyalty (Shukla et al., 2023). Thus, it is understood that autonomy becomes an important motivational mechanism in the formation of digital consumer loyalty. Based on this, the hypothesis is formulated. H5: Perceived Autonomy has a positive effect on Consumer Loyalty.

2.6 Transparent Digital Nudging and Consumer Loyalty

Digital nudging is increasingly used as a behavior-based marketing strategy to increase customer engagement and retention (Utami et al., 2025; Wu, 2025). Various mechanisms such as default options, personalized notifications, and gamification can shape usage habits and increase platform stickiness (Panwar et al., 2025; Riegger et al., 2022). Empirical studies show that nudging increases purchase intention, which in turn drives purchasing decisions (Utami et al., 2025). The conceptualization of smart nudge marketing emphasizes that data-based personalization can increase customer lifetime value through retention and repeat behavior (Eboseremen et al., 2022; Kabir et al., 2025). However, long-term effectiveness highly depends on ethical and transparent design because manipulative practices can damage trust and loyalty (Kozyreva et al., 2019; V. Singh et al., 2024). Transparent digital nudging allows behavioral influence to remain effective without sacrificing long-term relationships with consumers. Therefore, transparent nudging is predicted to have a direct effect on loyalty. Thus, the hypothesis is formulated. H6: Transparent Digital Nudging has a positive effect on Consumer Loyalty.

2.7 The Role of Perceived Autonomy Mediation

Within the S-O-R framework, digital nudging acts as a stimulus that shapes internal psychological evaluations before producing behavioral responses. Transparency enhances the perception of autonomy, which then strengthens trust through a sense of control and

empowerment (Lemken et al., 2024; Wertenbroch et al., 2020). Research shows that autonomy satisfaction increases engagement and relational trust on digital platforms (Roy et al., 2023). The mechanisms of psychological ownership and empowerment also explain how user agency mediates the formation of trust (Hu et al., 2025; Irshad et al., 2020). Thus, autonomy functions as a key psychological pathway that explains how transparent digital nudging generates trust. Therefore, the hypothesis is formulated. H7: Perceived Autonomy mediates the relationship between Transparent Digital Nudging and Consumer Trust.

2.8 The Role of Mediation in Consumer Trust

Relationship marketing literature consistently shows trust as the main mediator between customer experience and loyalty (Ashiq & Hussain, 2023; Cardoso et al., 2022). Digital transparency increases trust, and trust in turn drives loyalty as well as continued use (Ahmed et al., 2025; M. Hidayat et al., 2025; R. Wang et al., 2022). Research in e-commerce and social commerce confirms that loyalty rarely forms directly without going through trust first (Guerreiro & Pacheco, 2021; Kurniadi & Rana, 2023). Therefore, trust functions as a relational mechanism that transforms marketing stimuli into long-term commitment. Based on this argument, the hypothesis is formulated. H8: Consumer Trust mediates the relationship between Transparent Digital Nudging and Consumer Loyalty.

2.9 Mediation of perceived autonomy serial and consumer trust

Transparent digital nudging increases perceived autonomy through transparency and user control (Lemken et al., 2024). Autonomy then strengthens trust because consumers feel respected and not manipulated (Roy et al., 2023; X. Wang et al., 2019). Furthermore, trust becomes the main relational mechanism that generates long-term loyalty (Rosário & Casaca, 2025). This chain pathway aligns with the S-O-R model where digital design stimuli affect internal psychological states before producing loyalty behavioral responses. Modern digital marketing research also shows that the success of long-term nudging depends on a combination of autonomy preservation and trust formation (Panwar et al., 2025; V. Singh et al., 2024). Therefore, the relationship between transparent digital nudging and consumer loyalty is predicted to occur through the serial mediation process of autonomy and trust. Hence, the hypothesis is formulated. H9: Transparent Digital Nudging increases Consumer Loyalty through the mediation of Perceived Autonomy and Consumer Trust.

The research framework is presented in Figure 1, illustrating the causal relationships between variables, the effect of Transparent Digital Nudging on Perceived Autonomy, Consumer Trust, and Consumer Loyalty, both directly and through mediation mechanisms.

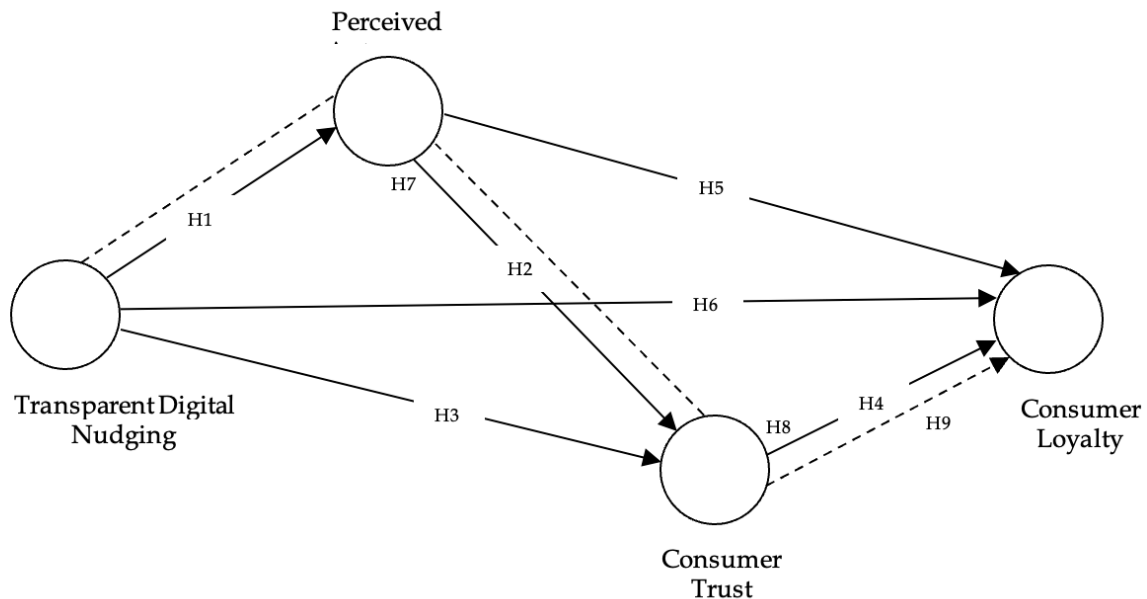


Figure 1 *Research Framework*

3. RESEARCH METHOD

This study uses a quantitative approach with an explanatory research type aimed at explaining the causal relationships between transparent digital nudging, perceived autonomy, consumer trust, and consumer loyalty on digital platforms in Indonesia. The explanatory approach was chosen because this research is oriented towards testing a theoretical model based on economic behavior as well as evaluating cause-and-effect relationships between latent constructs in the context of digital marketing and online consumer behavior. The research population is all consumers who have made online purchases in the last three months, so the respondents represent active users of digital platforms as is common practice in digital consumer behavior research based on cross-sectional surveys (Nurjannah Dewi et al., 2021; Siagian et al., 2022; Xiong & Zhang, 2024).

The research sample consisted of 400 respondents, a number considered adequate for Partial Least Squares-based Structural Equation Modeling (SEM-PLS) analysis, given that this method is suitable for predictive research with complex models and many causal relationships. (Becker et al., 2022; M Sarstedt et al., 2020, 2022). The sampling technique used purposive sampling with the criteria that respondents have made online purchases in the last three months and are willing to voluntarily fill out the research questionnaire through an online survey, which is spread on social media and digital communities in Indonesia. To enhance the internal validity of the study, the demographic characteristics of the respondents such as gender, age, region of residence, education level, online shopping intensity, and platforms used are presented in the respondent profile section; this is done

to provide an overview of the research sample context. Demographic variables are not included as control variables in the structural model, as the study focuses on testing the relationships among the main constructs. Next, Harman's single factor test was carried out to detect common method bias, and the first component explained 39.6% of the total variance, below the recommended 50% threshold (Kock, 2021). Respondent characteristics can be seen in Table 1.

Table 1 *Respondent Profile Demographics*

Respondent Characteristics		Criteria	Freq.	Perc.
Gender	Male		132	33,0%
	Female		268	67,0%
Ages	<20 years		103	25,8%
	21–25 years		118	29,5%
	26–30 years		50	12,5%
	31–35 years		58	14,5%
	36–40 years		24	6,0%
	>40 years		47	11,8%
Respondent's Domicile	Sumatera		176	44,0%
	Jawa		142	35,5%
	Sulawesi		46	11,5%
	Kalimantan		20	5,0%
	Bali & Nusa Tenggara		10	2,5%
	Maluku & Papua		6	1,5%
Educational Background	High School/Vocational School Equivalent		184	46,0%
	Diploma III		13	3,3%
	D4/Bachelor's Degree (S1)		137	34,3%
	Master's Degree (S2)		54	13,5%
	Doctorate (S3)		12	3,0%
Online Shopping Frequency (Last 3 Months)	1–2 time		105	26,3%
	3–5 time		163	40,8%
	6–10 time		61	15,3%
	More than 10 times		71	17,8%
Platform*	Shopee		357	89,3%
	Tokopedia		95	23,8%
	Tiktok Shop		47	11,8%
	Lazada		10	2,5%
	Bukalapak		6	1,5%
	Lainnya		9	2,3%

Note: 115 respondents use more than 1 platform

Furthermore, the questionnaire in this study did not limit respondents to only choosing or evaluating a single digital platform. The instrument provided flexibility for respondents to assess their experience on one or several main platforms they actively used in the past three months, with a total of 115 respondents evaluating more than one

shopping platform. These platform choices served as an indicator measurement by specifically referring to the platforms actively used. Through this approach, the loyalty construct measured in the model specifically refers to consumer loyalty to concrete digital platforms that are part of their active shopping behavior ecosystem, rather than loyalty to e-commerce activities in general. After cleaning the data from careless responses such as straight-lining, 400 valid samples were obtained and are ready to be analyzed using SEM-PLS.

The research instrument consists of a questionnaire designed based on indicators of each research variable with a five-point Likert scale to measure respondents' perceptions of latent constructs such as transparent digital nudging, autonomy, trust, and loyalty commonly used in digital consumer behavior research (Cheung et al., 2023; Hassan et al., 2025). All constructs in this study are modeled as first-order reflective constructs so that indicators are treated as reflections of the latent variable. Variable measurement adopts previous research, where a summary of the number of items and the source references used have been presented in Table 1 in the Appendix.

The data analysis method uses Structural Equation Modeling based on Partial Least Squares (SEM-PLS) because this method has a causal-predictive orientation suitable for marketing and economic behavior research that aims to explain as well as predict digital consumer loyalty (J. Hair et al., 2021a; Richter & Tudoran, 2024; M Sarstedt et al., 2022). In addition to these considerations, the use of SEM-PLS compared to covariance-based SEM (CB-SEM) is based on the use of research models with complex constructs while simultaneously testing serial mediation, in which PLS-SEM excels in predictive model estimation with more flexible data distribution assumptions. Moreover, this study not only tests the fit of an established theoretical model but also expands consumer behavior relationships in the context of the digital economy.

Data analysis in this study was carried out using SmartPLS software version 4.1.1.4. The analysis was conducted in two main stages, namely the evaluation of the measurement model (outer model) and the evaluation of the structural model (inner model). The outer model evaluation was carried out to assess the quality of the instrument through testing indicator reliability using outer loading values, internal consistency reliability through Cronbach's alpha and composite reliability, convergent validity through Average Variance Extracted (AVE), as well as discriminant validity using the Fornell-Larcker criterion, heterotrait-monotrait ratio (HTMT), and Cross-loadings as recommended in modern PLS-SEM best practices (Chinnaraju, 2025; J. Hair et al., 2021a; Henseler, Ringle, et al., 2016). Next, the inner model evaluation stage aims to test causal relationships between constructs through estimation of path coefficients using the bootstrapping procedure to obtain statistical significance and estimation of mediation effects through predictor effect sizes using f^2 and $\text{upsilon } v$, including serial mediation on the autonomy and trust paths (Nitzl et al., 2016; Sarstedt, et al., 2020). After that, the inner Variance Inflation Factor (VIF) values

and the explanatory power of the model were assessed through R², Q² predict, SRMR, and PLS predict to ensure the model's ability to predict digital consumer loyalty (Hair et al., 2021; Richter & Tudoran, 2024; Sarstedt, et al., 2020).

4. RESULT and DISCUSSION

4.1 Analysis Result

Measurement Model Analysis

Table 2 *Outer Loading, Cronbach's Alpha, Composite Reliability, and AVE*

Variables	Item	Outer loadings	Cronbach's alpha	Composite reliability	AVE
Transparent Digital Nudging	TDN1	0.822	0.919	0.934	0.640
	TDN2	0.846			
	TDN3	0.761			
	TDN4	0.777			
	TDN5	0.773			
	TDN6	0.812			
	TDN7	0.741			
	TDN8	0.861			
Perceived Autonomy	PA1	0.729	0.920	0.935	0.644
	PA2	0.802			
	PA3	0.833			
	PA4	0.839			
	PA5	0.820			
	PA6	0.832			
	PA7	0.799			
	PA8	0.756			
Consumer Trust	CT1	0.704	0.898	0.917	0.582
	CT2	0.784			
	CT3	0.799			
	CT4	0.789			
	CT5	0.757			
	CT6	0.797			
	CT7	0.734			
	CT8	0.732			
Consumer Loyalty	CL1	0.851	0.934	0.946	0.686
	CL2	0.855			
	CL3	0.870			
	CL4	0.826			
	CL5	0.843			
	CL6	0.756			
	CL7	0.842			
	CL8	0.778			

Source: Processed Data, 2026

The results of the measurement model evaluation indicate that all constructs have met the criteria for validity and reliability. All indicators have outer loading values above 0.70, thereby adequately representing the latent constructs. The Cronbach's alpha and composite reliability values for all variables are above 0.70, indicating very good internal consistency. All constructs also meet convergent validity with AVE exceeding 0.50. In other words, the measurement model is declared reliable and valid.

Table 3 *Fornell-Larcker*

	Consumer Loyalty	Consumer Trust	Perceived Autonomy	Transparent Digital Nudging
Consumer Loyalty	0.829			
Consumer Trust	0.736	0.763		
Perceived Autonomy	0.426	0.454	0.802	
Transparent Digital Nudging	0.410	0.421	0.522	0.800

Source: Processed Data, 2026.

Table 4 *HTMT*

	Consumer Loyalty	Consumer Trust	Perceived Autonomy
Consumer Loyalty			
Consumer Trust	0.790		
Perceived Autonomy	0.457	0.496	
Transparent Digital Nudging	0.441	0.455	0.564

Source: Processed Data, 2026.

The results of the discriminant validity test indicate that the model has met the required criteria. Based on the Fornell–Larcker criterion, the square root of the AVE values for each construct is higher than the correlations with other constructs, indicating that each variable has good discriminatory ability and can be distinguished from other constructs in the model. This result is also reinforced by the HTMT criterion, where all heterotrait–monotrait ratio values are below the 0.90 threshold. Overall, both tests confirm that each construct in this study is conceptually and empirically distinct, thus the measurement model meets discriminant validity.

Table 5 *Cross-loading*

	Consumer Loyalty	Consumer Trust	Perceived Autonomy	Transparent Digital Nudging
CL1	0.851	0.636	0.373	0.357
CL2	0.855	0.620	0.366	0.368
CL3	0.870	0.639	0.348	0.383
CL4	0.826	0.554	0.316	0.347
CL5	0.843	0.639	0.336	0.313
CL6	0.756	0.607	0.418	0.309
CL7	0.842	0.624	0.312	0.321
CL8	0.778	0.547	0.351	0.319
CT1	0.502	0.704	0.356	0.319

CT2	0.634	0.784	0.349	0.348
CT3	0.667	0.799	0.417	0.377
CT4	0.669	0.789	0.308	0.353
CT5	0.475	0.757	0.330	0.248
CT6	0.507	0.797	0.375	0.351
CT7	0.482	0.734	0.307	0.264
CT8	0.486	0.732	0.315	0.278
PA1	0.280	0.341	0.729	0.387
PA2	0.284	0.339	0.802	0.416
PA3	0.337	0.356	0.833	0.443
PA4	0.364	0.409	0.839	0.412
PA5	0.397	0.397	0.820	0.434
PA6	0.336	0.338	0.832	0.460
PA7	0.369	0.359	0.799	0.395
PA8	0.353	0.366	0.756	0.401
TDN1	0.321	0.379	0.498	0.822
TDN2	0.333	0.364	0.457	0.846
TDN3	0.378	0.315	0.352	0.761
TDN4	0.261	0.302	0.389	0.777
TDN5	0.251	0.293	0.364	0.773
TDN6	0.349	0.337	0.405	0.812
TDN7	0.372	0.305	0.380	0.741
TDN8	0.349	0.382	0.470	0.861

Source: Processed Data, 2026.

From the results of the cross-loading test, all indicators have the highest loading values on the constructs being measured compared to other constructs. The differences in loading values between constructs are also quite clear, indicating no signs of measurement overlap between latent variables. This finding confirms that each indicator is able to specifically explain the intended construct and that there is no problem of indicator discrimination. Thus, the measurement model meets discriminant validity, and all indicators are suitable to be retained for the subsequent structural model analysis.

Structural Model Analysis

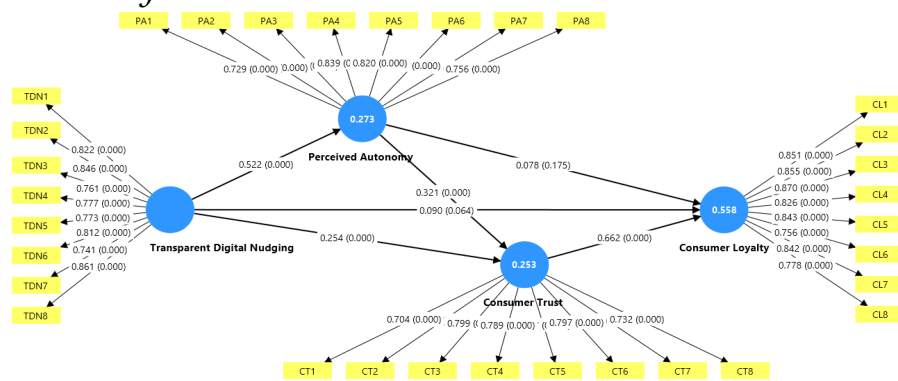


Figure 2 Bootstrapping Output

Table 6 Inner Model VIF

	Consumer Loyalty	Consumer Trust	Perceived Autonomy	Transparent Digital Nudging
Consumer Loyalty				
Consumer Trust	1.338			
Perceived Autonomy	1.513	1.375		
Transparent Digital Nudging	1.461	1.375	1.000	

Source: Processed Data, 2026.

The results of the inner VIF test show that all Variance Inflation Factor values range from 1.000 to 1.513, which are still below the threshold of 5.00. This means that the independent variables do not overlap and each is able to explain the endogenous variable independently. In other words, the structural model of this study is free from multicollinearity bias and can therefore proceed to testing causal relationships and hypothesis testing.

Table 7 Hypothesis Test

	Hypothesis	Path Coefficient	P values	95% Confidence Interval		F Square
				Lower	Upper	
Direct (effect size)	H1. Transparent Digital Nudging -> Perceived Autonomy	0.522	0.000	0.405	0.617	0.375
	H2. Perceived Autonomy -> Consumer Trust	0.321	0.000	0.205	0.440	0.100
	H3. Transparent Digital Nudging -> Consumer Trust	0.254	0.000	0.129	0.368	0.063
	H4. Consumer Trust -> Consumer Loyalty	0.662	0.000	0.578	0.734	0.742
	H5. Perceived Autonomy -> Consumer Loyalty	0.078	0.175	-0.033	0.191	0.009
	H6. Transparent Digital Nudging -> Consumer Loyalty	0.090	0.064	-0.008	0.184	0.013
	Hypothesis	Path Coefficient	P values	95% Confidence Interval		Upsilon (v)
				Lower	Upper	
Indirect (effect size mediation)	H7. Transparent Digital Nudging -> Perceived	0.168	0.000	0.101	0.245	0.207

Autonomy -> Consumer Trust					
H8. Transparent Digital Nudging -> Consumer Trust -> Consumer Loyalty	0.168	0.000	0.087	0.247	0.167
H9. Transparent Digital Nudging -> Perceived Autonomy -> Consumer Trust -> Consumer Loyalty	0.111	0.000	0.067	0.170	0.092

Source: Processed Data, 2026.

Table 8 Direct, Indirect, and Total Effects for Mediation Analysis

Relationship	Direct Effect	Indirect Effect	Total Effect	95% CI	Mediation Type
TDN -> PA -> CT	0.254 (p < 0.001)	0.168 (p < 0.001)	0.422	[0.101, 0.245]	Partial mediation
TDN -> CT -> CL	0.090 (p = 0.064)	0.168 (p < 0.001)	0.369	[0.087, 0.247]	Full mediation
TDN -> PA -> CT -> CL	0.090 (p = 0.064)	0.111 (p < 0.001)	0.369	[0.067, 0.170]	Full mediation

Source: Processed Data, 2026.

The interpretation of the f^2 effect size refers to Hair et al. (2021) and Henseler, Hubona, et al. (2016), where 0.02 (small), 0.15 (medium), and 0.35 (large). Meanwhile, for mediation effect size, ν is used, as recommended by Cohen in Ogbeibu (2020), where 0.01 (low mediation effect), 0.075 (medium), and 0.175 (high). The hypothesis testing results show the research findings as follows:

H1 is accepted, the test results show that Transparent Digital Nudging has a positive and significant effect on Perceived Autonomy ($\beta = 0.522$, $p < 0.001$, and $CI = [0.405, 0.617]$) with a large effect size ($f^2 = 0.375$). These results prove that a digitally transparent choice architecture can significantly enhance consumers' sense of control and freedom of choice. H2 is accepted, where Perceived Autonomy has a positive significant effect on Consumer Trust ($\beta = 0.321$, $p < 0.001$, and $CI = [0.205, 0.440]$) with a small effect size ($f^2 = 0.100$). This finding confirms that users' perceived subjective autonomy contributes to fostering trust in digital platforms. H3 is accepted, Transparent Digital Nudging has a positive significant effect on Consumer Trust ($\beta = 0.254$, $p < 0.001$, and $CI = [0.129, 0.368]$) with a small effect size ($f^2 = 0.063$). Openness of information in interface design interventions has been proven to directly increase consumer confidence, with a small effect. And, H4 is accepted, indicating that Consumer Trust has a significant positive effect on Consumer Loyalty ($\beta = 0.662$, $p < 0.001$, and $CI = [0.578, 0.734]$) with a large effect size ($f^2 = 0.742$). Trust plays the role of the most dominant relational determinant in generating long-term consumer loyalty in the digital ecosystem.

Next, H5 was rejected, because Perceived Autonomy does not have a significant effect on Consumer Loyalty ($\beta = 0.078$, $p = 0.175$, and $CI = [-0.033, 0.191]$) with an effect size below the minimum threshold ($f^2 = 0.009$). This indicates that merely feeling free to choose does not automatically convert consumer attitudes into loyal behavior on a platform. Likewise, H6 was rejected, because the direct effect of Transparent Digital Nudging on Consumer Loyalty ($\beta = 0.090$, $p = 0.064$, and $CI = [-0.008, 0.184]$) has an insignificant effect size ($f^2 = 0.013$). This signifies that stimuli from transparent digital nudges cannot instantly induce loyalty without the presence of mediating psychological factors.

In the mediation effect, H7 is accepted, Perceived Autonomy mediates the relationship between Transparent Digital Nudging and Consumer Trust ($\beta = 0.168$, $p < 0.001$, and $CI = [0.101, 0.245]$) with a high mediation effect (upsilon = 0.207). This relationship falls into the category of partial mediation because the direct effect of nudging on consumer trust (H3) is also proven significant. Furthermore, H8 is accepted, where Consumer Trust mediates the relationship between Transparent Digital Nudging and Consumer Loyalty ($\beta = 0.168$, $p < 0.001$, and $CI = [0.087, 0.247]$) with a medium mediation effect (upsilon = 0.167). This relationship falls into the category of indirect-only mediation (full mediation), indicating that consumer trust acts as a conduit to transform the platform's digital nudging interventions into customer loyalty.

Finally, H9 was accepted, because significant serial mediation was found in the Transparent Digital Nudging path through Perceived Autonomy and Consumer Trust toward Consumer Loyalty with a medium mediation effect ($v=0.092$). This relationship falls into the category of indirect-only mediation (full serial mediation). The serial mediation path was proven significant, while the direct effect of nudging on loyalty (H6) was not significant. In other words, digital consumer loyalty emerges through a gradual psychological process, starting with increased perception of autonomy, then developing into trust, which in turn generates loyalty to the digital platform. The findings from this hypothesis test confirm the dominance of the full mediation mechanism, which indicates that consumer loyalty on digital platforms in Indonesia is built more through the process of trust formation rather than through the direct influence of digital nudging strategies.

Model Fit Evaluation

Table 9 *R2 and Q2 Predict*

	R-square	Q ² predict
Consumer Loyalty	0.558	0.158
Consumer Trust	0.253	0.167
Perceived Autonomy	0.273	0.262

Source: Processed Data, 2026.

Model fit evaluation shows that the structural model has good explanatory and predictive capabilities. The structural model evaluation in Table 9 shows the coefficient of determination (R^2) values for Consumer Loyalty of 0.558 (moderate), Perceived Autonomy

0.273 (moderate), and Consumer Trust 0.253 (moderate). Meanwhile, the predictive relevance of the model is confirmed to be good because all Q^2_{predict} values are above zero (> 0), with details of Perceived Autonomy at 0.262, Consumer Trust 0.167, and Consumer Loyalty 0.158. These values affirm that the structural model has adequate explanatory power and out-of-sample predictive relevance in explaining the variance of the constructs studied.

Table 10 SRMR

Estimated model	
SRMR	0.065

Source: Processed Data, 2026.

Evaluation through an SRMR value of 0.065 is below the threshold of 0.08, so the model is declared to have a good level of fit between the theoretical model and empirical data.

Table 11 PLS Predict

	PLS-SEM_RMSE	PLS-SEM_MAE	LM_RMSE	LM_MAE
CL1	0.768	0.573	0.783	0.588
CL2	0.752	0.557	0.760	0.571
CL3	0.752	0.572	0.758	0.581
CL4	0.796	0.611	0.797	0.610
CL5	0.815	0.601	0.834	0.620
CL6	0.812	0.632	0.819	0.640
CL7	0.781	0.583	0.791	0.603
CL8	0.820	0.620	0.831	0.636
CT1	0.735	0.591	0.747	0.598
CT2	0.789	0.592	0.815	0.610
CT3	0.707	0.550	0.724	0.562
CT4	0.733	0.559	0.752	0.569
CT5	0.812	0.618	0.820	0.635
CT6	0.778	0.590	0.790	0.605
CT7	0.817	0.603	0.836	0.620
CT8	0.717	0.571	0.730	0.582
PA1	0.837	0.627	0.778	0.595
PA2	0.848	0.644	0.803	0.594
PA3	0.789	0.569	0.783	0.570
PA4	0.851	0.634	0.790	0.572
PA5	0.877	0.668	0.808	0.589
PA6	0.846	0.650	0.802	0.582
PA7	0.787	0.621	0.775	0.609
PA8	0.780	0.611	0.726	0.555

Source: Processed Data, 2026.

The results of the PLS Predict evaluation indicate that the model has good predictive ability for the endogenous construct indicators. The predictive power test at the indicator

level in Table 11 was conducted by comparing the Root Mean Square Error (RMSE) values between the PLS-SEM model and the Linear Model (LM) as benchmarks. The test results show that the constructs Consumer Loyalty (CL1-CL8) and Consumer Trust (CT1-CT8) have high predictive power because all of their indicators produce PLS-SEM_RMSE values lower than the LM_RMSE values. In contrast, the predictive power of the Perceived Autonomy construct (PA1-PA8) is considered low predictive power, because all of its indicator PLS-SEM_RMSE values are higher than those of the LM version. Although the predictive power of autonomy is weaker, the overall model is still strongly justified because the two final constructs that are the main targets of the study (trust and loyalty) are proven to have high predictive accuracy.

4.2 Discussion

The study results indicate that transparent digital nudging has a positive and significant effect on perceived autonomy with a medium effect size. This finding suggests that transparent digital nudging is capable of shaping consumers' perception of autonomy within digital choice architectures. Research on digital nudging confirms that choice-based design interventions in digital spaces can influence users' decisions without eliminating freedom of choice (Cai, 2020; Jesse & Jannach, 2020; Kniess, 2021). In this context, transparency becomes a crucial mechanism in maintaining users' perception of freedom. When digital recommendations are delivered openly through clear information, the provision of alternative choices, and granting full control to users, nudging is perceived as a decision support instrument, rather than a form of manipulation. These results are consistent with Patricheev (2025) research which states that transparency can reduce the level of intrusiveness and increase informed choice for consumers.

The second hypothesis was accepted with a small to moderate effect size, indicating that perceived autonomy plays an important role in building consumer trust. This finding reinforces the argument that trust in the digital ecosystem develops through users' subjective experience of control over decision-making processes. In line with studies conducted by Wang et al. (2019) and Lin et al. (2019), when users feel in control of their digital choices and experiences, their level of trust in the platform will increase significantly. Furthermore, Roy et al. (2023) also emphasized that the fulfillment of autonomy needs can enhance emotional and cognitive engagement, which in turn develops into trust. The results of this study confirm that trust in the digital economy landscape is not merely the result of technological quality, but rather from the psychological experience of the users. Consumers trust a platform not merely because of the sophistication of its system, but because they feel they still hold control as decision-makers.

One of the most important findings in this study is the non-significant direct influence of perceived autonomy and transparent digital nudging on consumer loyalty. These results indicate that digital consumer loyalty cannot be formed instantly merely through interface design or the experience of autonomy. In fact, the rejection of these two hypotheses becomes the main analytical strength of this study. Digital consumers in Indonesia may feel

they have full freedom (autonomy) when navigating and consider the choice architecture presented to be fairly honest and transparent (nudging). However, freedom of choice alone does not automatically make them loyal to a single platform.

Loyalty is a relational outcome that is cumulative in nature, not merely a short-term behavioral response to interface design. Consumer characteristics in Indonesia indicate a very high level of multi-platform usage, where the majority of respondents use Shopee (89.3%) and Tokopedia (23.8%) interchangeably. Because consumers can easily switch applications, the perception of having the freedom to choose is no longer sufficient to lock in their loyalty. This loyalty is entirely controlled by the consumer trust factor, which in this study has been proven to be the strongest predictor with a path coefficient of 0.662.

In emerging markets like Indonesia, consumers face high uncertainty regarding data privacy security, delivery reliability, fraud risks, and the fairness of algorithmic recommendations. Therefore, transparent nudging strategies can only be converted into long-term loyalty if the platform succeeds in building consumer confidence that their digital ecosystem is honest, safe, and fair.

The literature on behavioral nudging also reinforces this argument by asserting that nudges generally influence behavior through intermediary psychological mechanisms, rather than serving as direct determinants of long-term loyalty (Utami et al., 2025; Wu, 2025). Loyalty is a relational construct whose development is determined by the accumulation of positive experiences and the level of user trust in the platform, not merely a mechanical response to digital design.

On the other hand, consumer trust has been proven to be the strongest predictor of consumer loyalty with a large effect size. The findings of this study are in line with the relationship marketing literature that places trust as the main foundation of loyalty (Ibrahim & Aljarah, 2021; Muharam et al., 2021; Zhang et al., 2016). Other studies in various digital contexts also show that trust acts as a mediator bridging the relationship between service quality, empowerment, and transparency with customer loyalty (Ashiq & Hussain, 2023; Cardoso et al., 2022; X. Wang et al., 2019). These findings provide empirical confirmation that digital nudging does not directly create loyalty, but must go through a process of trust mediation.

The acceptance of the serial mediation hypothesis (H9) demonstrates the phenomenon of full serial mediation. Digital consumer loyalty emerges through a gradual psychological process: the practice of transparency creates autonomy, autonomy satisfaction builds trust, and in turn, trust generates consumer loyalty. This finding is in line with previous digital nudging research which emphasizes that choice architecture works by altering users' internal psychological conditions, rather than through direct stimulation of loyalty (Kozyreva et al., 2019; Lemken et al., 2024; Mele et al., 2020).

Furthermore, this full mediation dominance confirms that digital loyalty is shaped by trust-based relational mechanisms, not merely by technological persuasion alone.

Relational marketing studies show that autonomy and empowerment will strengthen trust, which then becomes the main determinant in maintaining long-term relationships and customer loyalty (Irshad et al., 2020; Roy et al., 2023; X. Wang et al., 2019; Wertenbroch et al., 2020).

These findings broaden the perspective of relationship marketing by positioning digital consumers as active relational actors who respond to digital nudging practices. Digital platforms should not just be positioned as providers of interactive technology, but must act as relationship managers based on trust through transparency and granting autonomy to users. This study emphasizes that implementing platform strategies that are ethical, transparent, and respect user autonomy is an absolute prerequisite for creating sustainable loyalty in the digital economy era.

5. CONCLUSION, REMARKS & IMPLICATION

This study concludes that transparent digital nudging functions as a behavioral stimulus that does not directly shape consumer loyalty, but rather operates through gradual psychological mechanisms. Through the confirmation of a full serial mediation model, this study demonstrates that digital consumer loyalty is a long-term outcome entirely dependent on consumers' psychological evaluation of platform integrity and credibility. The coherent relational flow in this digital economy is shown to proceed sequentially: through transparent digital nudges, users' perceived autonomy is enhanced, that autonomy fosters consumer trust, and it is that trust that ultimately builds consumer loyalty. These findings expand the perspective of relationship marketing by positioning digital interface design practices as tools for humanistic and strategic consumer relationship management.

The implications of this research affirm that digital platform strategies in Indonesia need to shift focus from short-term technological persuasion toward building long-term relationships based on transparency and user control. Ethical and transparent nudging approaches have proven to be far more effective in securing sustained loyalty. In contrast, the implementation of manipulative design strategies (dark patterns) has a high potential to reduce perceptions of autonomy, massively degrade consumer trust, and ultimately harm customer retention within the digital ecosystem.

This study has limitations because it uses a cross-sectional design, so the dynamics of behavioral changes and shifts in consumer beliefs over time cannot yet be continuously recorded. In addition, the general scope of the sample of digital platform users in Indonesia limits the generalization of the findings to more specific digital industries. Future research is recommended to apply a longitudinal approach or experimental methods to capture consumers' real behavioral responses to design interventions directly. Subsequent research also needs to conduct comparative analyses across digital industry sectors as an effort to expand the accuracy and predictive relevance of digital nudging models.

STATEMENT OF USE OF GENERATIVE AI

In the preparation, the author utilized ChatGPT to assist with language editing and grammar correction during the manuscript preparation. ChatGPT was not used to develop research ideas, collect data, or interpret findings. The manuscript has been reviewed to ensure accuracy and compliance with standards, and the author is responsible for the content of the publication.

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