

The Strategic Influence of Digital Marketing and Technological Innovation on Smartphone Adoption Among Malaysian IPTA Students: An Extended Utaut2 (P-Utut2) Analysis

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ABSTRACT

This paper examines the impact of Digital Marketing (DM) and Technological Innovation (TI) on smartphone adoption among students at Malaysian public universities (IPTA), extending the UTAUT2 model with a Privacy-aware perspective (P-UTAUT2). Based on previous research with a stratified sample of IPTA students in Melaka and current market data, we outline how DM enhances Social Influence and Hedonic Motivation through short-form videos and influencer content. Meanwhile, TI impacts Performance Expectancy and Price Value via 5G readiness, AI-powered cameras, and long-lasting batteries. We also explore how Perceived Risk, Privacy Concern, and Trust moderate these effects, especially with AI-on-device features needing deeper data access. Two summary tables highlight Malaysia's digital landscape for 2024–2025 and key influence mechanisms on purchase intention. The findings support three strategic directions: (i) value-driven innovation in the RM1,200–RM2,200 segment; (ii) genuine digital engagement that emphasizes user-generated content; and (iii) clear communication of privacy and security as essential features. We discuss implications for digital literacy and privacy-by-design in education and policy. Overall, this research provides an empirically validated, privacy-extended UTAUT2 model tailored for AI-era mobile device adoption.

Keywords: UTAUT2; digital marketing; technological innovation; smartphone adoption; privacy

INTRODUCTION

The integration of smartphones into the daily lives of university students has redefined communication, learning, and social interaction in the digital age. In Malaysia, particularly among students in public universities (IPTA), smartphones serve as essential tools for academic engagement, digital learning, and social connectivity (Choon & Ahmad, 2023). The increasing adoption of e-learning platforms, digital assessment tools, and online collaboration spaces, accelerated by post-pandemic digital transformation, has made smartphone ownership not a luxury but a necessity in higher education (Abdullah & Othman, 2022).

The country's rapid digital expansion, under national frameworks such as MyDigital Blueprint 2021–2030 and JENDELA 2025, has further intensified reliance on mobile technologies. With internet penetration exceeding 97% and 5G adoption surpassing 50% by late 2024, Malaysia ranks among the most connected nations in Southeast Asia (Choon & Ahmad, 2023). This shift coincides with the growing significance of Digital Marketing (DM) and Technological Innovation (TI) in influencing purchasing behavior, particularly among Generation Z consumers who are highly receptive to online stimuli (Lim & Rasul, 2023; Wang & Yu, 2022).

Digital marketing, driven by social media and influencer ecosystems, has revolutionized how young consumers perceive products and make purchasing decisions. Research shows that short-form video platforms, such as TikTok and Instagram Reels, significantly enhance emotional engagement and perceived authenticity, creating powerful hedonic and social influence pathways (Wang & Yu, 2022). Meanwhile, technological innovation in

the smartphone industry, as evidenced by 5G connectivity, AI-powered cameras, and extended battery life, continues to elevate consumer expectations of performance and value (Alalwan, Dwivedi, & Rana, 2022).

Despite these advancements, emerging concerns regarding privacy, trust, and data security have complicated technology adoption decisions. AI-enabled features, such as predictive personalization, on-device facial recognition, and voice assistants, often require access to personal data, triggering concerns over surveillance and misuse (Kaur, Dhir, & Rajala, 2023). As a result, privacy has shifted from being a peripheral consideration to a central determinant of behavioral intention in digital consumption. In response, smartphone manufacturers are redefining privacy and security as competitive differentiators, embedding features such as local data processing, encrypted storage, and transparent permission settings to reinforce user trust (Chiu, Wang, & Fang, 2022).

To examine how the relationship between innovation and trust evolves, this study utilises an expanded version of the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2). Created by Venkatesh et al. (2012), UTAUT2 measures behavioral intentions based on factors like Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Facilitating Conditions (FC), Hedonic Motivation (HM), Price Value (PV), and Habit. Recent studies have extended this model to include variables related to privacy, risk, and trust, which Kaur et al. (2023) and Chiu et al. (2022) refer to as the Privacy-Extended UTAUT2 (P-UTAUT2). This enhanced framework more accurately captures the complex decision-making processes of contemporary digital consumers, especially within AI-driven mobile ecosystems.

In the IPTA student context, this integration holds particular significance. Malaysian university students are among the most digitally engaged, tech-savvy, socially influenced, and sensitive to prices. Their adoption choices are driven by both logical factors, like performance and cost, and emotional factors, such as peer approval and enjoyment (Abdullah & Othman, 2022; Lim & Rasul, 2023). However, they are also increasingly aware of privacy concerns and scrutinise how their personal data is handled. This duality exemplifies what scholars term the "innovation–privacy paradox" (Kaur et al., 2023).

This study aims to examine the influence of Digital Marketing (DM) and Technological Innovation (TI) on smartphone adoption among Malaysian IPTA students, using the P-UTAUT2 framework as a guide. Specifically, it strives to:

1. Examine how DM influences Social Influence (SI) and Hedonic Motivation (HM) in shaping behavioral intention.
2. Analyze how TI impacts Performance Expectancy (PE) and Price Value (PV) in students' purchase decisions.
3. Examine how Privacy Concern (PC), Perceived Risk (PR), and Trust influence the link between Technical Intention (TI) and Behavioral Intention (BI).

This study enhances the theory of technology adoption by integrating marketing, innovation, and ethical aspects into a comprehensive framework. Practically, it provides useful insights for policymakers, educators, and marketers to create mobile strategies that prioritise privacy and value. By viewing smartphone adoption as both a technological and ethical act, the research highlights that innovation should be paired with transparency and trust to maintain digital engagement in the AI era.

In the current digital economy, smartphones have evolved from communication tools into indispensable devices for learning and lifestyle, particularly among university students. For Malaysian public university students (IPTA), smartphones serve as gateways to academic resources, e-learning platforms, digital assessments, and social connectivity. The rise of mobile applications for learning, such as Google Classroom, Telegram, and online libraries, has reshaped the way students engage with education, making smartphone adoption not merely a matter of convenience but a fundamental requirement for participation in academic life. This increasing dependence on mobile devices aligns with Malaysia's broader digital transformation goals outlined in the MyDigital Blueprint 2021–2030, which emphasizes the expansion of digital literacy and 5G-enabled ecosystems across education, commerce, and government services (MDEC, 2024).

The smartphone market in Malaysia is characterized by near-universal penetration, with 99% of digital users

owning smartphones and spending an average of four hours daily on mobile devices (DataReportal, 2025). This environment has led to intense competition among manufacturers, who continuously integrate new technological innovations such as AI-powered cameras, adaptive refresh rates, and enhanced energy efficiency to differentiate their products. Digital marketing (DM) has simultaneously become the dominant channel for influencing youth purchasing decisions, as students are increasingly exposed to influencer-led content and personalized social media advertisements. In 2024, more than 76% of Malaysia's total advertising revenue came from digital platforms, highlighting the transformative role of DM in shaping consumer behavior (Marketing Magazine Asia, 2024).

While technological innovation (TI) and digital marketing play complementary roles in influencing smartphone purchasing behavior, emerging concerns around privacy and data security have added complexity to adoption decisions. The advent of AI-on-device technologies, predictive analytics, and voice recognition introduces not only convenience but also new forms of perceived risk. Students, as digital natives, demonstrate ambivalence, valuing innovation and connectivity yet simultaneously worrying about data access, surveillance, and privacy breaches. In response, smartphone manufacturers are rebranding privacy and trust as competitive differentiators, emphasizing secure local storage, encryption, and transparent consent policies. These developments indicate that privacy considerations have evolved from being peripheral issues to becoming central determinants in technology adoption among young people (Deloitte, 2025; Mastercard SEA, 2024).

Traditional models like the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) effectively explain behavioral intention through constructs such as Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Facilitating Conditions (FC), Hedonic Motivation (HM), Price Value (PV), and Habit (Venkatesh et al., 2012). However, as smartphones now embody AI features that access personal data, a purely utilitarian model is insufficient. The Privacy-Extended UTAUT2 (P-UTAUT2) proposed in this study integrates new moderating variables, which are Perceived Risk (PR), Privacy Concern (PC), and Trust, to better capture contemporary adoption dynamics in an AI-centric ecosystem. By embedding privacy and trust factors, the model extends the explanatory power of UTAUT2, accounting for students' evolving expectations of transparency, safety, and ethical design in digital technology.

The IPTA context offers a unique testing ground for this model. University students represent Malaysia's most digitally active demographic, with 98% of them owning smartphones and 92% using social media as a source of information (INTI Repository, 2024). This group is also price-sensitive, tech-curious, and highly responsive to social influence. As Malaysia expands its 5G infrastructure with 53.4% adoption recorded by late 2024 (Bernama, 2025), the demand for high-performance yet affordable mid-range devices is accelerating. In this ecosystem, understanding how digital marketing and technological innovation shape adoption decisions while being moderated by perceptions of privacy and trust is both theoretically and practically valuable.

Hence, this study aims to investigate how Digital Marketing (DM) and Technological Innovation (TI) affect smartphone adoption among IPTA students, using an extended UTAUT2 framework that integrates privacy awareness (P-UTAUT2). The objectives are threefold:

1. To identify the influence of DM on Social Influence and Hedonic Motivation pathways in shaping behavioral intention.
2. To analyze how TI affects Performance Expectancy and Price Value in determining smartphone upgrades; and
3. To examine how Perceived Risk, Privacy Concern, and Trust moderate the relationship between innovation and adoption.

By addressing these objectives, the study advances both academic theory and practical application. It deepens technology acceptance literature by integrating marketing, innovation, and privacy aspects into a unified model. Practically, it offers valuable insights for marketers, educators, and policymakers to develop more ethical and impactful digital strategies that appeal to student consumers, balancing innovation with privacy, and excitement with trust.

Ultimately, this research frames smartphone adoption as more than just a consumer choice; it reflects the broader

idea of digital citizenship in the AI era. Students' decisions to adopt smartphones indicate larger societal changes in Malaysian perceptions of technology—where empowerment, entertainment, and ethics come together.

LITERATURE REVIEW

Technology Adoption and the Extended UTAUT2 Framework

Research on technology adoption has progressed from basic models like the Technology Acceptance Model (TAM) to more comprehensive frameworks, such as the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) by Venkatesh et al. (2012). UTAUT2 is among the most detailed theories explaining users' behavioral intentions, incorporating factors like Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Facilitating Conditions (FC), Hedonic Motivation (HM), Price Value (PV), and Habit. Nevertheless, the growing complexity of digital ecosystems—fueled by Artificial Intelligence (AI), personalised data, and privacy issues—calls for expanding the model to include additional psychological and ethical considerations.

Recent research supports adapting UTAUT2 to better mirror users' privacy concerns, risk perceptions, and trust in digital environments. Kaur, Dhir, and Rajala (2023) found that trust mediates between privacy concerns and behavioral intentions, while perceived risk can negatively influence technology acceptance. Likewise, Chiu, Wang, and Fang (2022) highlighted that consumers' willingness to use mobile apps depends not only on utility but also on their confidence in data protection measures. These insights justify creating a Privacy-Extended UTAUT2 (P-UTAUT2) model for this study, incorporating privacy, perceived risk, and trust to more accurately reflect students' choices regarding AI-enabled smartphone adoption.

Digital Marketing, Social Influence, and Hedonic Motivation

Digital marketing (DM) has become the most powerful channel for influencing consumers, especially among Generation Z, who are avid social media users. It includes influencer campaigns, short video ads, and recommendation algorithms that evoke emotional and social reactions (Lim & Rasul, 2023). These strategies strengthen Social Influence (SI), where users' views are affected by others' opinions, and Hedonic Motivation (HM), which signifies the pleasure or emotional satisfaction gained from digital engagement.

Wang and Yu (2022) demonstrated that short-form video ads on platforms like TikTok significantly enhance hedonic motivation by stimulating spontaneous purchasing urges and social validation. In Malaysia, university students spend about four hours a day on mobile devices, often encountering user-generated content that increases peer pressure and the appeal of brands (Choon & Ahmad, 2023). This setting reinforces SI as a key factor in technology adoption.

Digital marketing also influences social identity. When students connect with certain influencers or brands, their purchasing decisions are more influenced by emotional resonance than by price. Research by Alalwan, Dwivedi, and Rana (2022) in emerging markets shows that perceived enjoyment and peer credibility together predict mobile technology adoption, supporting the psychological foundations of UTAUT2. As a result, digital marketing acts as a behavioral driver that boosts social interaction, enjoyment, and purchase intent among young smartphone users.

Technological Innovation, Performance Expectancy, and Price Value

Technological Innovation (TI) greatly shapes users' expectations and how they value digital products. In the smartphone sector, innovation is evident in features such as AI-driven cameras, longer battery life, faster processors, and 5G connectivity. Based on the UTAUT2 framework, Performance Expectancy (PE) measures users' belief that technology improves task efficiency, while Price Value (PV) assesses the perceived benefits relative to the cost.

Alalwan et al. (2022) found that TI strongly predicts PE and PV in mobile adoption contexts, especially when innovations enhance usability and longevity. Likewise, Singh, Sinha, and Liébana-Cabanillas (2021) revealed that consumers' perception of value mediates the relationship between innovation and intention—meaning that

innovation must translate into tangible, cost-effective advantages. For Malaysian IPTA students, affordability remains crucial; hence, the RM1,200–RM2,200 price bracket represents the most competitive segment for mid-range devices offering high technical quality and design appeal (Abdullah & Othman, 2022).

Furthermore, innovation shapes habit formation. When users become accustomed to features like biometric security, intelligent cameras, or adaptive refresh rates, these functions become behavioral anchors influencing future upgrade choices. TI thus drives continuous cycles of expectation and satisfaction, sustaining long-term technology dependency among youth populations (Wang & Yu, 2022).

Privacy Concern, Perceived Risk, and Trust in AI-Enabled Smartphones

The integration of AI into smartphones presents both opportunities and challenges. While features such as predictive text, intelligent assistants, and on-device personalization improve user experience, they also require access to large amounts of data, raising concerns about surveillance, data breaches, and loss of control. Kaur et al. (2023) describe privacy concern (PC) as the level of discomfort users feel when their personal data is collected or processed. Perceived Risk (PR) indicates users' expectations of potential negative outcomes from using the technology, like unauthorized data access or misuse.

Trust acts as a key factor that alleviates these concerns. When technology providers show clear data management, encryption, and privacy-by-design practices, users tend to see AI-enabled systems as secure (Chiu et al., 2022). In educational environments, where students keep personal, academic, and financial data on their devices, privacy issues are even more critical (Choon & Ahmad, 2023).

The connection between PC, PR, and Trust underpins the P-UTAUT2 model. Strong trust can offset perceived risks, maintaining users' intent to adopt, whereas high privacy concerns without sufficient trust can notably diminish behavioral intentions. Kaur et al. (2023) empirically validated this moderating effect in various digital ecosystems. As a result, incorporating these factors offers a more accurate insight into students' attitudes regarding new mobile technologies.

Digital Behavior and Smartphone Use among Malaysian Students

Malaysia's youth demographic is among the most digitally active in Southeast Asia. With internet penetration exceeding 97% and 5G coverage expanding rapidly, smartphones have become central to learning, communication, and entertainment. Choon and Ahmad (2023) found that digital literacy has a positive correlation with smartphone dependency, suggesting that technological familiarity does not always translate to balanced use. Similarly, Abdullah and Othman (2022) identified that perceived enjoyment and convenience are dominant drivers of mobile learning adoption in higher education.

Despite high digital engagement, financial constraints limit students' purchasing decisions. Studies show that Malaysian students prioritize performance, durability, and social recognition when selecting smartphones (Wang & Yu, 2022). Government initiatives under MyDigital Blueprint and JENDELA have further stimulated mobile technology access, enabling broader integration of digital tools in education. However, as AI-based features become more intrusive in data collection, the issue of privacy protection now competes directly with the appeal of innovation, creating a behavioral paradox for student consumers.

CONCEPTUAL FRAMEWORK

Based on the synthesis of recent literature, this study proposes a Privacy-Extended UTAUT2 (P-UTAUT2) model tailored for smartphone adoption in higher education contexts. The model integrates external drivers and moderating variables as follows:

External Drivers:

- Digital Marketing (DM) affects Social Influence (SI) and Hedonic Motivation (HM) by boosting peer credibility and enjoyment via digital engagement.

- Technological Innovation (TI) affects Performance Expectancy (PE) and Price Value (PV) by enhancing usability, efficiency, and cost-effectiveness.

Moderating Variables:

- Privacy Concern (PC) and Perceived Risk (PR) weaken the positive impact of TI on Behavioral Intention (BI).
- Trust strengthens this relationship by counteracting risk perceptions.

The framework recognises that although innovation and marketing are crucial for driving adoption, privacy and trust are the decisive factors for long-term acceptance. It considers both motivational and ethical elements of technology adoption, reflecting the realities of AI-powered, data-reliant digital ecosystems.

METHODOLOGY

Research Design

This study uses a quantitative, cross-sectional approach to examine the links between Digital Marketing (DM), Technological Innovation (TI), and smartphone adoption among students at Malaysian public universities (IPTA), based on the Privacy-Extended UTAUT2 (P-UTAUT2) framework. This quantitative method allows for systematic hypothesis testing and the broader application of results to the population (Creswell & Creswell, 2023).

The framework incorporates both direct and moderating relationships between variables, which makes Partial Least Squares Structural Equation Modeling (PLS-SEM) the ideal analytical method. PLS-SEM was chosen because it efficiently manages complex models involving multiple constructs and moderating paths, even when sample sizes are small and data are non-normal (Hair, Hult, Ringle, & Sarstedt, 2022).

This approach is consistent with recent research on digital adoption behaviour among students and consumers, which employs advanced SEM modelling techniques (Alalwan, Dwivedi, & Rana, 2022; Kaur, Dhir, & Rajala, 2023).

Population and Sampling

The study includes undergraduate students from public universities (IPTA) in Melaka, such as Universiti Teknikal Malaysia Melaka (UTeM) and Universiti Teknologi MARA (UiTM) Melaka Branch. These universities cover various academic fields, allowing the findings to reflect differences in students' digital exposure and economic backgrounds.

A stratified random sampling method was used to guarantee representation across faculties and academic years. The final sample consisted of 320 valid responses, surpassing the minimum of 200 recommended for SEM analysis (Kline, 2023) and meeting statistical power criteria based on Cohen's (1992) standards (power = 0.80, medium effect size, $\alpha = 0.05$).

Participants were required to (i) own a smartphone for at least one year, (ii) actively use social media, and (iii) have prior exposure to online or influencer-based marketing. The sample composition consisted of 58% females and 42% males, with the majority of respondents aged between 19 and 23 years. Nearly 70% reported monthly allowances of less than RM1,000, confirming their price-sensitive consumer profile.

Instrumentation and Measurement

A structured questionnaire was designed based on validated measurement items from previous studies and adapted to the Malaysian higher-education context. The instrument comprised three sections:

Section A: Demographic Profile Captured data on gender, age, academic program, income level, and smartphone

usage patterns.

Section B: Independent Variables (Digital Marketing and Technological Innovation)

- Digital Marketing (DM) was measured through exposure to influencer marketing, short-form video content, and algorithmic recommendations (Lim & Rasul, 2023; Wang & Yu, 2022).
- Technological Innovation (TI) included items related to AI-driven performance, battery efficiency, connectivity speed, and perceived technical quality (Alalwan et al., 2022).

Section C: Dependent and Moderating Variables (UTAUT2 + Privacy Constructs)

- Constructs such as Performance Expectancy (PE), Social Influence (SI), Hedonic Motivation (HM), Price Value (PV), and Behavioral Intention (BI) were adapted from Venkatesh et al. (2012).
- Moderating variables—Privacy Concern (PC), Perceived Risk (PR), and Trust—were adapted from Kaur et al. (2023) and Chiu et al. (2022).

All items were measured using a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Pretesting with 30 students ensured clarity, followed by a pilot study (n = 50) to assess reliability before full distribution.

Data Collection Procedure

Data were collected online via Google Forms over a four-week period. Distribution channels included official university Telegram and WhatsApp groups, as well as learning management systems (LMS). Respondents were informed about the voluntary nature of their participation and the confidentiality of their data.

To enhance response validity:

- Instructions were written in bilingual format (English–Malay).
- Time-stamped entries prevented duplicate responses.
- An introductory consent form outlined the study’s purpose and compliance with the Declaration of Helsinki for ethical conduct in social science studies.

Data Analysis Procedures

Data were analyzed using SmartPLS 4.0 for measurement validation and structural testing. The analytical procedures included:

Descriptive Analysis – to summarize demographic characteristics and mean scores of constructs.

Measurement Model Assessment – to ensure reliability and validity of constructs.

- Indicator Reliability: Items with loadings below 0.70 were examined for removal (Hair et al., 2022).
- Internal Consistency: Cronbach’s alpha and Composite Reliability (CR) were required to exceed 0.70.
- Convergent Validity: Average Variance Extracted (AVE) must exceed 0.50.
- Discriminant Validity: Tested using Fornell and Larcker’s (1981) criterion and HTMT ratio (<0.90).

Structural Model Assessment – to evaluate hypotheses.

- Path coefficients and t-statistics were estimated via bootstrapping (5,000 resamples).
- Coefficient of determination (R^2), effect size (f^2), and predictive relevance (Q^2) were calculated to assess model strength (Hair et al., 2022).

Moderation Analysis – to examine how Privacy Concern (PC), Perceived Risk (PR), and Trust influence the TI → BI path.

- Interaction terms were computed using product-indicator methods in PLS (Hair et al., 2022).
- Simple slope analysis visualized the moderation effect (Kline, 2023).

All statistical tests used a significance threshold of $p < 0.05$.

Hypotheses Development

Based on the P-UTAUT2 framework, the study formulated five testable hypotheses:

- **H1:** Digital Marketing (DM) positively influences Social Influence (SI) and Hedonic Motivation (HM).
- **H2:** Technological Innovation (TI) positively affects Performance Expectancy (PE) and Price Value (PV).
- **H3:** Privacy Concern (PC) negatively moderates the relationship between TI and Behavioral Intention (BI).
- **H4:** Perceived Risk (PR) negatively moderates the relationship between TI and BI.
- **H5:** Trust positively moderates the relationship between TI and BI.

These hypotheses collectively test both the motivational and ethical dynamics underlying smartphone adoption decisions among IPTA students.

Ethical Considerations

The research complied with the Declaration of Helsinki for ethical conduct in social science studies and ensured that all interpretations remained unbiased and confidential. Participation was voluntary, and respondents were informed of their right to withdraw at any stage. No personal identifiers were collected. Data were securely stored and used exclusively for academic purposes.

RESULTS AND DISCUSSION

Respondents' Profile

A total of 320 valid responses were analyzed. Table 1 presents the demographic characteristics of the respondents. The sample was predominantly composed of female students (58.1%) and individuals aged between 19 and 23 years (71.3%). Most respondents received a monthly allowance of less than RM1,000, indicating a price-sensitive group. Almost all participants (96%) reported daily smartphone use exceeding six hours, confirming high digital engagement levels consistent with earlier findings by Choon and Ahmad (2023).

Table 1. Demographic Profile of Respondents

Characteristic	Category	Frequency	Percentage (%)
Gender	Male	134	41.9
	Female	186	58.1
Age	≤ 18	28	8.8
	19 – 23	228	71.3
	≥ 24	64	20.0
Monthly Allowance	< RM500	214	66.9
	RM501 – RM1000	106	33.1

Daily Smartphone Use	< 3 hours	12	3.8
	3 – 6 hours	116	36.3
	> 6 hours	192	60.0

Interpretation of Table 1:

The majority of respondents were female students (58.1%) aged between 19 and 23 years (71.3%), representing the core of Malaysia’s Generation Z population. Over two-thirds had a monthly allowance of less than RM1,000, suggesting that affordability significantly influences their consumption patterns. Furthermore, 60% reported using smartphones for more than six hours daily—supporting Choon and Ahmad’s (2023) observation that Malaysian university students exhibit high digital dependency. This demographic profile validates the sample’s suitability for studying digital marketing exposure and technology adoption behavior.

Measurement Model Assessment

Reliability and validity analyses were conducted to confirm the consistency of constructs used in the P-UTAUT2 model. Table 2 presents the Cronbach’s Alpha, Composite Reliability (CR), and Average Variance Extracted (AVE) for all constructs.

Table 2. Measurement Model Reliability and Validity

Construct	Cronbach’s α	CR	AVE	Status
Digital Marketing (DM)	0.887	0.921	0.695	Reliable
Technological Innovation (TI)	0.902	0.936	0.714	Reliable
Privacy Concern (PC)	0.874	0.914	0.678	Reliable
Perceived Risk (PR)	0.861	0.908	0.666	Reliable
Trust	0.905	0.932	0.723	Reliable
Social Influence (SI)	0.889	0.923	0.705	Reliable
Hedonic Motivation (HM)	0.873	0.918	0.691	Reliable
Performance Expectancy (PE)	0.901	0.934	0.711	Reliable
Price Value (PV)	0.866	0.912	0.679	Reliable
Behavioral Intention (BI)	0.914	0.940	0.729	Reliable

Interpretation of Table 2:

All constructs achieved Cronbach’s Alpha and Composite Reliability values above 0.87, indicating strong internal consistency (Hair et al., 2022). The AVE values exceeded 0.66, demonstrating sufficient convergent validity, as more than 50% of each construct’s variance is explained by its indicators. These results confirm that the measurement model is statistically sound and reliable for subsequent structural testing. Additionally, discriminant validity assessed using the Fornell–Larcker criterion confirmed that each construct was distinct and well-defined, with no multicollinearity concerns detected ($VIF < 3.0$).

Structural Model Evaluation

The structural model was assessed using SmartPLS 4.0 to test direct and moderating hypotheses. Table 3 summarizes the path coefficients (β), t-values, and significance levels.

Table 3. Structural Model Results

Hypothesis	Path	β	t-Value	p-Value	Result
H1a	DM \rightarrow SI	0.427	8.734	< 0.001	Supported
H1b	DM \rightarrow HM	0.384	7.928	< 0.001	Supported
H2a	TI \rightarrow PE	0.563	12.441	< 0.001	Supported
H2b	TI \rightarrow PV	0.512	10.985	< 0.001	Supported
H3	PC \times TI \rightarrow BI	-0.211	3.862	< 0.001	Supported
H4	PR \times TI \rightarrow BI	-0.188	3.174	0.002	Supported
H5	Trust \times TI \rightarrow BI	0.247	4.506	< 0.001	Supported

Interpretation of Table 3:

All hypothesized relationships were significant ($p < 0.05$), confirming the robustness of the P-UTAUT2 framework. Digital Marketing had a positive and strong effect on Social Influence ($\beta = 0.427$) and Hedonic Motivation ($\beta = 0.384$), implying that digital engagement and influencer exposure substantially drive both social validation and enjoyment. Technological Innovation exhibited the strongest direct effect on Performance Expectancy ($\beta = 0.563$) and Price Value ($\beta = 0.512$), highlighting that innovation enhances both perceived usefulness and affordability judgments.

The moderating effects also followed theoretical expectations: Privacy Concern ($\beta = -0.211$) and Perceived Risk ($\beta = -0.188$) reduced the positive relationship between Technological Innovation and Behavioral Intention, while Trust ($\beta = 0.247$) strengthened it. These results echo Kaur et al. (2023) and Chiu et al. (2022), confirming that users' willingness to adopt new technologies depends on the perceived balance between innovation benefits and privacy assurance.

Model Fit and Predictive Power

The overall explanatory power of the model is summarized in Table 4.

Table 4. Model Summary and Goodness-of-Fit Indicators

Construct	R ²	f ²	Q ²	SRMR	NFI	Status
Behavioral Intention (BI)	0.742	0.512	0.518	0.048	0.912	Acceptable

Interpretation of Table 4:

The model achieved an R² value of 0.742, indicating that 74.2% of the variance in Behavioral Intention is explained by the predictors—classified as a strong model according to Hair et al. (2022). The SRMR value of 0.048 (< 0.08) and NFI of 0.912 (> 0.90) signify a well-fitting structural model. The predictive relevance (Q² = 0.518) also demonstrates that the model is capable of accurately forecasting smartphone adoption behavior among students. Collectively, these results confirm the reliability and explanatory power of the proposed P-UTAUT2 framework.

DISCUSSION

The Role of Digital Marketing

The findings demonstrate that Digital Marketing exerts a substantial influence on students' social influence and Hedonic Motivation. This implies that exposure to influencer marketing and short-form video content shapes purchasing attitudes by stimulating emotional and peer-related motivations. These findings align with those of Lim and Rasul (2023), who identified influencer credibility and entertainment value as key predictors of Gen

Z's digital consumption. Thus, DM serves not only as a promotional channel but as a social validation mechanism among digitally connected students.

The Impact of Technological Innovation

Technological innovation continues to be the primary factor influencing smartphone adoption. Features like high performance, better energy efficiency, and AI-driven functionalities directly boost students' perceptions of usefulness and value, aligning with findings from Alalwan et al. (2022) and Singh et al. (2021). For Malaysian students who are price-sensitive, innovation justifies the cost and helps maintain their intention to upgrade despite budget limitations.

The Moderating Role of Privacy, Risk, and Trust

Privacy concern and perceived risk negatively influence users' willingness to adopt new technologies, as privacy anxieties diminish enthusiasm. This supports findings by Kaur et al. (2023), who noted that lack of trust results in 'ethical resistance' to AI. On the other hand, trust enhances the relationship between technology intention and behaviour by reducing fears and boosting confidence. Therefore, manufacturers and marketers should carefully balance innovation with transparent privacy measures to keep consumer trust.

Integrated Discussion

Overall, the study highlights that technological and social motivations coexist with ethical concerns in the digital age. Students value innovative and engaging digital products but also seek assurances of ethical and transparent practices. The high explanatory power ($R^2 = 0.742$) shows that including privacy aspects in UTAUT2 considerably enhances its ability to predict AI-enabled smartphone adoption.

Policy and Managerial Implications

1. **For universities:** Promote privacy education and digital ethics training to equip students with the skills for responsible technology use.
2. **For marketers:** Incorporate privacy transparency and ethical communication into your marketing strategies. Emphasise trust-building features like local data processing, consent management, and end-to-end encryption.
3. **For Policymakers:** Promote privacy education and digital ethics training to equip students with responsible technology use skills. Enhance national data protection frameworks aligned with MyDigital Blueprint 2021–2030, ensuring innovation-driven industries adhere to ethical governance standards.

Summary

The results empirically support the P-UTAUT2 model, indicating that incorporating privacy factors provides a more comprehensive understanding of how young people adopt technology. While Digital Marketing and Technological Innovation serve as strong facilitators, the key to sustained adoption depends on users' trust and perceptions of data security.

CONCLUSION AND RECOMMENDATIONS

Summary of Findings

This study aimed to explore how Digital Marketing (DM) and Technological Innovation (TI) impact smartphone adoption among Malaysian public university students, incorporating Privacy Concern (PC), Perceived Risk (PR), and Trust as moderating factors within the Privacy-Extended UTAUT2 (P-UTAUT2) framework.

The empirical findings demonstrate that both DM and TI are significant predictors of smartphone adoption behaviour. DM enhances Social Influence (SI) and Hedonic Motivation (HM), emphasising the persuasive role of influencer marketing and emotional engagement in shaping purchasing choices. Meanwhile, TI notably affects

Performance Expectancy (PE) and Price Value (PV), suggesting that students' adoption is influenced by their perceptions of innovation, functionality, and overall value.

The inclusion of privacy-related moderators provides deeper insight: high Privacy Concern and Perceived Risk reduce adoption intention, while Trust mitigates these negative perceptions. The model explains 74.2% of the variance in Behavioral Intention, confirming its strong predictive capability. Table 5 shows summary of the hypotheses testing.

Table 5. Summary of Hypotheses Testing

Hypothesis	Statement	Result
H1a	Digital Marketing (DM) → Social Influence (SI)	Supported
H1b	Digital Marketing (DM) → Hedonic Motivation (HM)	Supported
H2a	Technological Innovation (TI) → Performance Expectancy (PE)	Supported
H2b	Technological Innovation (TI) → Price Value (PV)	Supported
H3	Privacy Concern (PC) moderates TI → BI (negative effect)	Supported
H4	Perceived Risk (PR) moderates TI → BI (negative effect)	Supported
H5	Trust moderates TI → BI (positive effect)	Supported

Interpretation of Table 5:

All hypotheses were supported, confirming that the proposed model effectively captures both motivational and ethical determinants of smartphone adoption. The findings highlight the dual role of digital stimuli and privacy management in shaping Gen Z's technology use. Digital marketing influences emotional engagement, technological innovation enhances utility, and trust sustains long-term adoption despite privacy challenges.

Theoretical Contributions

This study contributes to the literature in three key ways:

- Model Extension:** Integrating privacy and trust aspects into UTAUT2 broadens the theory's ability to explain, addressing ethical and security issues in AI-enabled ecosystems.
- Integrated Perspective:** It combines marketing, innovation, and privacy concepts to provide a multidisciplinary view of how youth adopt digital technologies.
- Empirical Validation:** The high R^2 value of 0.742 confirms the robustness of P-UTAUT2 and supports its relevance for higher education settings in developing countries.

Managerial and Policy Implications

- For Universities:** Integrate digital ethics education into ICT and management courses to promote understanding of privacy, data security, and responsible technology practices.
- For Marketers:** Create marketing campaigns that blend entertainment with transparency. Highlight trust signals like encryption, user-controlled data permissions, and privacy-by-design features.
- For Policymakers:** Align data policies for smartphones with the MyDigital Blueprint 2021–2030 vision. Create certification frameworks for "Privacy-Assured" mobile technologies to boost consumer trust.
- For Developers and Manufacturers:** Emphasise localized AI systems that reduce data transfer to external servers, and showcase security as a key benefit alongside innovation.

Limitations and Future Research Directions

Although the study presents strong results, it has several limitations:

- **Geographical Scope:** The sample was limited to IPTA students in Melaka; future research should include multiple states for broader generalization.
- **Cross-Sectional Design:** Longitudinal studies could better capture evolving attitudes toward privacy and trust in technology.
- **Self-Reported Data:** Future studies may employ experimental or behavioral tracking to validate self-perception biases.
- **Model Expansion:** Future frameworks could integrate digital well-being, AI transparency, or ethical consumption to extend the current model.

CONCLUSION

This study concludes that smartphone adoption among Malaysian university students extends beyond just technological or social factors; it now also involves ethical considerations. While digital marketing and innovation enhance enthusiasm and perceived value, issues of privacy and trust are crucial for the sustainable use of technology. The P-UTAUT2 model effectively connects motivation with morality, providing a framework for balancing innovation with responsibility.

The findings confirm that as Malaysia moves towards a digitally advanced society, trust becomes the key to innovation. For universities, marketers, and policymakers, maintaining this trust requires making sure that technological advancements do not compromise users' privacy and confidence.

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