

Understanding Customer Engagement in Pakistan's E-Commerce Industry through AI-Driven Personalization and AI-Powered Chatbots: A Moderated Serial Mediation Approach

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Present study examines the impact of AI-driven personalization and AI-powered chatbots on customer engagement within Pakistan e-commerce sector using a moderated serial mediation platform. Representation on the stimulus-organism response model, technology acceptance model and expectation confirmation theory, the research investigates how satisfaction and trust sequentially mediate the relationship between AI technologies and engagement, while digital competence and privacy concerns act as moderators. A quantitative, cross sectional design was employed, with data collected from 270 online customers and analyzed using SmartPLS. Findings reveal that both personalization and chatbots significantly enhance engagement directly and indirectly through satisfaction and trust. Digital competence strengthens this relationship, whereas privacy concerns weaken the effect of personalization. The study provides empirical evidence from an emerging market, offering theoretical contributions and practical insights for businesses aiming to optimizing AI-driven customer engagement strategies.

1. Introduction

Globally the rapid advancements in the digital technologies undergo substantial revolution through artificial intelligence (AI). The AI revolutionized the customer engagements particularly AI-driven personalization and AI-powered chatbots becomes necessary tool to improve customer engagement and provide personalized services (Huang and Rust 2021). AI-driven personalization allowed traders to investigate consumer data and provide product endorsement and contents. This customized approach substantially improved the relevance and meaningful communication for the customer engagement. Studies suggested that customized promotions have great influence on costumer engagement (Bleier & Eisenbasis 2015). The AI-powered chatbot evolved as an important factor to provide service strategy to e-costumer. They improve the efficiency by providing the real-time support and offer 24-hour assistant which contribute consumer satisfaction and trustworthiness (Luo et al., 2019). Moreover, in personalized recommendations, relevance of communication improves and help customers discover products according to their interests and needs. Prior finding has indicated that personalization positively influences customer satisfaction, purchase intentions, and customer engagement by creating meaningful and interactive shopping practices (Grewal et al., 2021). Besides, digital experiences strengthen emotional attachment and long-term relationships between customers and online platforms. Features like chatbot i.e., prompt response and information quality influence the consumer engagement and satisfaction. However, Pakistan businesses rapidly adopting the AI and transforming into e-markets, smartphone users, e-payments and increasing internet access has enhanced the e-shopping platforms but the use of AI technologies to engage the costumers within their specific contents is deficient.

Distinguish, the Customer engagement is an important and modern factor in e-commerce platform (Dwivedi et al. 2023). In the Previous studies have reported that chatbot responsiveness and interactive communication significantly influence customer trust, engagement and most important satisfaction (Adam et al., 2021). Consequently, businesses increasingly rely on chatbot technologies to improve customer experiences and strengthen customer relationships. Moreover, client engagement has become one of the most important constructs in the modern e-commerce ecosystem. To engage them, interact with online platforms and spend more time browsing so that, recommend products to others and this develop loyalty toward e-commerce brands (Brodie et al., 2011). Hence, administrations increasingly focus on AI technologies to enhance customer engagement and maintain competitive advantage in digital shops. Role in growing AI technologies, has also attracted substantial academic attention, particularly regarding their influence on customer satisfaction. Meanwhile, Pakistan e-commerce industry has experienced rapid growth due to increasing internet penetration and digital payment. Platforms like Daraz and other digital marketplaces have transformed consumer purchasing behavior in Pakistan. However, despite the increasing use of AI technologies, customers in Pakistan continue to express concerns regarding privacy, trust, and the effective use of AI-driven systems (Dwivedi et al., 2023). Differences in digital competence among consumers may also influence how individuals interact with AI technologies and perceive their usefulness. Although previous studies have investigated the impact of AI technologies on customer behavior, most studies have focused on developed

economies and examined AI-driven personalization and chatbots separately. Limited research has integrated both technologies within a single framework while simultaneously examining the mediating roles of customer satisfaction and customer trust along with the moderating effects of digital competence and privacy concerns. Therefore, this study attempts to examine the impact of AI-driven personalization and AI-powered chatbots on customer engagement in Pakistan's e-commerce sector through a moderated serial mediation framework.

Current advancement of artificial intelligence technologies has significantly transformed the e-commerce industry by enabling businesses to deliver personalized services. AI-driven personalization and powered chatbots are increasingly adopted by e-commerce platforms to improve customer communication, functioning efficiency and most important customer engagement. It also allows businesses to analyze customer preference and, browsing and purchasing behavior in order to provide customized recommendations and personalized content (Huang and Rust 2021; Grewal et al., 2021; Bleier and Eisenbeiss 2015). Likewise, chatbots provide real-time assistance and 24-hour customer support, which contribute to improved service quality and customer satisfaction (Luo et al., 2019). In Pakistan the use of AI in e-commerce is increasing but there is a research gap that how AI-driven personalization and AI-powered chatbots collectively influenced the customer engagement. Moreover, clients may perceive AI systems as impersonal particularly when digital competence levels are low (Venkatesh et al., 2003). Prior studies suggest that AI-driven personalization and chatbot technologies positively influence trust of customer satisfaction and engagement (Adam et al., 2021; Dwivedi et al., 2023), however, experiential findings remain inconsistent across different contexts and populations. Although some studies report strong positive effects of AI technologies on customer experiences and purchase behavior, other studies highlight customer resistance, privacy concerns, and trust-related issues associated with AI adoption (Chatterjee et al., 2021). Various studies emphasis on personalization and chatbot individually and did not focus on their combined influences. Furthermore, studies lacking the moderated serial mediation models to conceptualize the complex interaction between AI technology, consumer thinking and engagement outcomes. While AI-driven personalization and AI-powered chatbots can enhance customer experiences, many consumers still express concerns regarding data privacy, trust, and the reliability of AI-based systems (Bleier & Eisenbeiss 2015). Prior studies primarily focused on developed countries, whereas limited empirical evidence is available regarding how AI technologies influence customer engagement in emerging economies such as Pakistan. Therefore, there is a need to investigate the mechanisms through which AI technologies influence customer engagement in Pakistan's e-commerce sector.

There are many literatures but several critical gaps remain undiscovered. The fragmented AI research (Huang and Rust 2021) examine personalization or chatbots independently rather than integrating them within a unified framework. Moreover, Molinillo et al., 2022 research on the lack of serial mediation models rarely explores the sequential relationship between trust and satisfaction, restrictive understanding of customer decision processes. Likewise, Venkatesh et al., 2012 limited focus on moderation effects of variables such as digital competence and privacy concerns are often ignored, although their significant influence on technology adoption. Ahmed et al., 2024 showed limited empirical evidence

from developing economies like Pakistan in which technological, economic and cultural factors differ significantly from developed markets, as it is the emerging market context. Previously, studies have focused mainly on the direct effects of AI technologies on customer behavior while providing limited understanding of the psychological processes through which these technologies influence customer engagement (Yun and Park 2022; Brodie et al., 2011). Precisely, inadequate attention has been given to the mediating roles of customer satisfaction and customer trust within AI-driven e-commerce surroundings. Although client trust is considered essential determinants of engagement and loyalty but have very limited studies have examined these variables simultaneously within a framework of serial mediation. Moreover, Aguirre et al., 2015 suggested DC can also strengthen purchaser ability to effectively interact with AI technologies. However, a privacy concerns may weaken trust and reduce positive responses toward personalized services. Current studies have largely ignored the combined influence of these moderating variables despite their increasing relevance in DC. One more major research gap exists in terms of geographical and contextual limitations where maximum researcher are related to AI technologies and customer engagement in developed economies like, the United States, European countries and China (Dwivedi et al., 2023). Moderately, incomplete evidence is available from developing countries, like Pakistan in which e-commerce adoption is rapidly increasing but concerns regarding trust, technological literacy, and privacy, where AI acceptance remain highly significant. However, Pakistan provides a unique context for examining AI technologies due to its rapidly growing digital economy and increasing dependence on online shopping platforms.

1.1 Research objectives

To evaluate the impact of AI-driven personalization on customer engagement in Pakistani business the present study objectives are:

- To study the role of AI-powered chatbots in improving customer satisfaction and engagements.
- To investigate the moderating role of privacy and trust.
- To examine a moderated serial mediation model exhibiting customer engagement.

1.2 Research questions

- Does AI-driven personalization increase customer engagement?
- To enhance customer experience, what role do AI-powered chatbot play?
- Do Satisfaction, trust, and perceived usefulness mediate the relationship?
- Does privacy concern moderate the success of AI-technologies?
- How does the combined effect explicate customer engagement?

1.3 Significance of the study

This investigation was designed to understand the AI in businesses by combining personalization and chatbot technologies within integrated moderated serial mediation context. Moreover, this study delivers actionable knowledge for Pakistani online businesses to improve customer engagement using AI. The importance of the privacy of user information, transparency and ethical usage also be highlighted. Also this study extends the application of SOR, TAM and ECT.

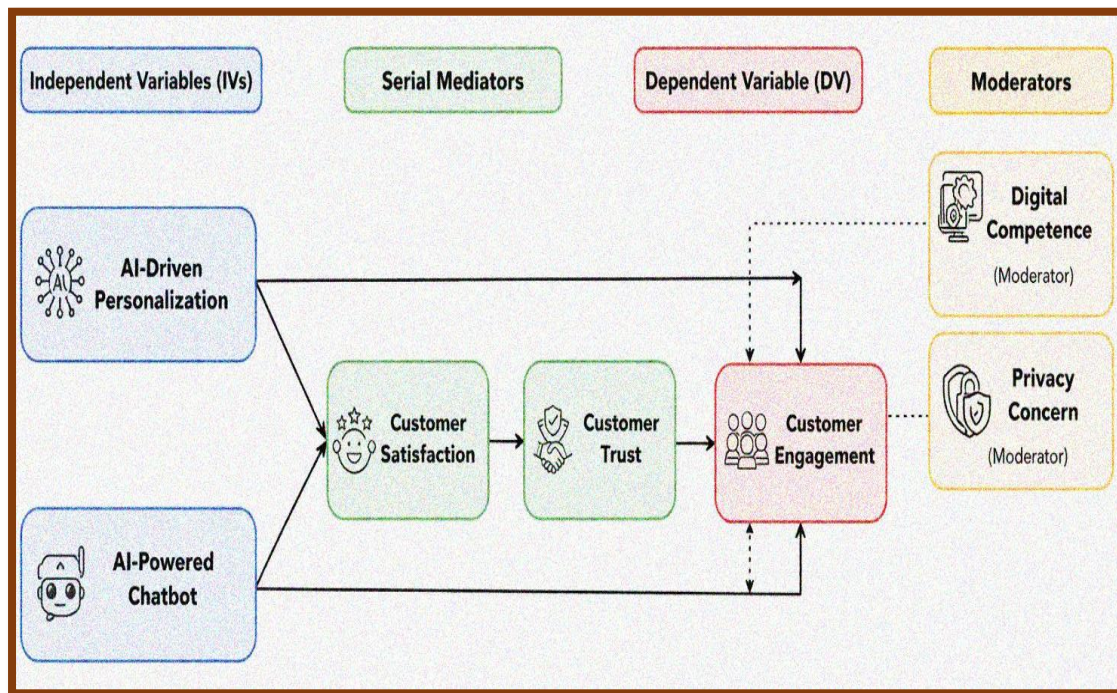


Figure No 1: Moderated serial mediation model: Impact of AI technologies on customer engagement

2. Literature Review

The customer engagement is a psychological state of interactive experience among customer and business products. It echoes emotional and behavioral investment in business product interaction (Hollebeek et al., 2014). Through continuous experiences, customer engagement resonant the interactive and profound relationship that develops over time (Bordie et al., 2011). Recent studies identified that AI as a key emerging tool of customer engagement along with e-commerce and customized products (Brodie et al., 2011). Customers which are more engaged, m considered as more profitable, loyal and mostly repurchase. Customer engagement is an important factor of performance and greater purchase tendency increased loyalty (Kumar and Pansari 2016). AI has emerged as dominant theme in consumer involvement, particularly in in online business research (Brodie et al. 2011). However, previous research focused on the developed markets which differ substantially with emerging countries like Pakistan. This creates a research gap to study the dynamics of consumer trust and e-commerce in emerging economies where socioeconomic and technological dynamics are different (Ameen et al., 2021).

AI driven personalization is an advance tool and machine learning technique to modify content, recommendations, and experience based on individual preferences (Grewal et al., 2021). This method is relevant and enable the businesses to improve overall consumer journey. AI personalization increases the relevance, reduce search efforts, better customer experience, and make emotional connection with the business model. Mehrabian and Russell (1974) reported that personalization influences the cognitive and emotional state which is mostly responsible for the customer engagement. AI-driven personalization enhances

consumer satisfaction which is significant factor of costumer engagement (Huang et al. 2021). Moreover, personalized recommendations reduce data redundancy, accelerate decision making and enhance customer retention (Bleier & Eisenbeiss, 2015). However, personalization in online market increase the data privacy issues, it simultaneously increases the concern regarding the misuse of the data (Martin & Murphy, 2017).

AI-powered chatbot transformed the customer support through instant and automated responses and increasingly used in online marketing to facilitate automated user sustenance. Chatbot provide uninterrupted assistant, process multiple queries at a time, and guide consumer by purchase decisions. It also improves the response time, data accuracy, and user satisfaction. Studies have shown that customer usually do not identify the differences in human and AI chats, in some cases users feel comfortable with these bots due to their non-discriminatory nature. Gnewuch et al. (2017) reported that these system work on natural language processing to promote human like interactions to enhance productivity. Moreover, Human and chatbot interactions and their associated characteristics are very important (Nguyen et al. 2022). Chatbot substantially improve the customer satisfaction by prompt response and consistent service quality (Luo et al., 2019). Chatbot is an important constituent of technology acceptance model because it is handy and improve the perceived utility. Due to efficient and target- oriented communication, costumers are accepting these chatbots even they know that they are communicating with non-human representative (Van Doorn et al., 2017). Moreover, AI-chatbots limit their use in complex and sensitive situations due to lack of emotional intelligence (Huang & Rust, 2021).

Customer satisfaction is the valuative verdict that results from customers experience throughout purchase expedition. Oliver (1980) defined the satisfaction as evaluative judgement after sale that compare the performance with expectations. Santos (2003) reported that service efficiency, handy system, and precise data are the factors that influences the customer satisfaction. Amin (2016) and Casalo et al. (2008) investigated that satisfaction influence the loyalty and engagement and act as mediating variable among the loyalty and service quality. Investigation in Pakistani online businesses have shown that E-service quality (ESQ) improved the satisfaction and is liked with consumer loyalty (Amin, 2016).

Customer trust is perilous element of online costumer behavior where uncertain and perceived risk environments in particular (Gefen et al. 2003). It indicated the customer belief that a business is reliable ethically sound. Yuen et al. (2018) suggested that costumer trust is a significant mediator between customer satisfaction and engagement. Trust becomes more important in online interactions due to fear about computational decision making and data privacy (Martin & Murphy 2017). Trust is critically important factor to enhance customer engagement and purchase intentions. It acts as both mediator and moderator that influences the AI effectiveness and enhance engagement.

Customer satisfaction and trust are independent mediators and there is limited studies found in the literature to their sequential or serial relationship in AI-driven ecosystem. Customer experience follows a processed mechanism where satisfaction and trust ultimately lead to engagement. Oliver (1980) reported that satisfaction is developed when performance

meet expectations. In the AI ecosystem i.e., AI personalization and AI-chatbots interactions, customer evaluate the functional and practical features of the business. The satisfactory online interactions contribute to the trust and exhibit deeper and personal commitment (Gefen et al., 2003).

However, most of the existing literature focuses on developed markets, limiting its applicability to emerging economies such as Pakistan, where socio-cultural dynamics, digital infrastructure, and consumer trust differ significantly (Hollebeek et al., 2014; Ahmed et al., 2024).

2.1 Integration of Theoretical Framework

Integrates has three major theoretical frameworks i.e. *stimulus–organism–response*, *technology acceptance model* and *expectation confirmation theory*. The stimulus represents AI personalization & chatbots, organism defines satisfaction and trust whereas responses deals with customer engagement. The second framework explains the AI systems perceived usefulness and behavioral outcomes. Moreover, expectation Confirmation theory deals with experience, satisfaction and continued engagement (Davis, 1989; Oliver, 1980; Mehrabian & Russell, 1974). Overall, the integrated framework provides a comprehensive explanation of how AI technologies influence customer engagement through both cognitive and emotional mechanisms but also accounting for individual differences and contextual factors (Fig no. 2).

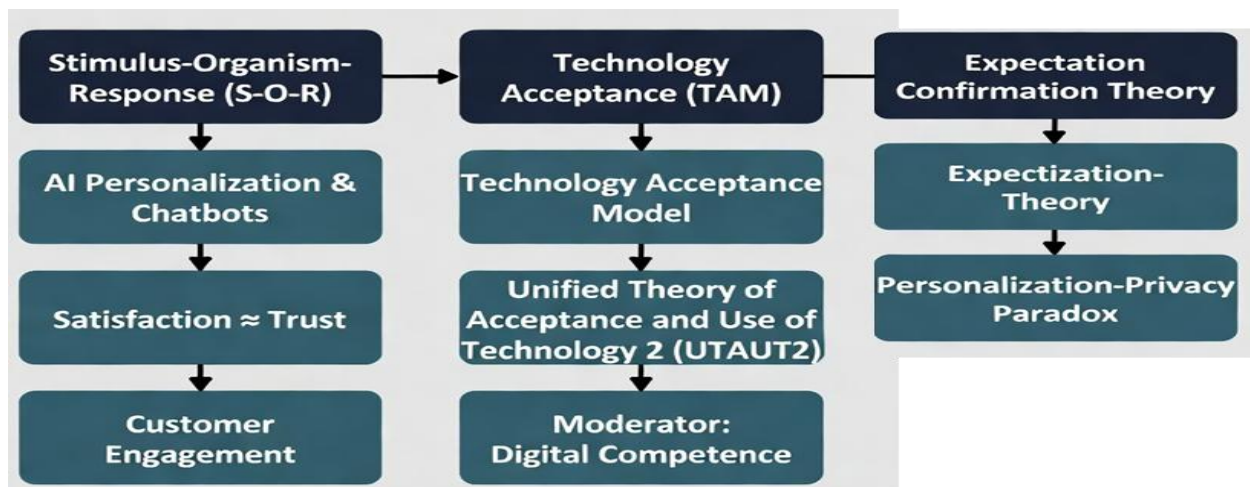


Figure No 2: Integrated Theoretical Model

2.2 AI-Driven Personalization

It rises the use of artificial intelligence to modify content with recommendations and also services that based on individual customer choices. The personalization enhances the relevance of information presented to users in e-commerce, by this means it improves the overall understanding. Moreover, personalization acts as a stimulus that positively influences internal cognitive and emotional states which conferring to the Stimulus–Organism–Response framework leading to behavioral responses such as engagement. All the previous findings propose that personalized experiences increase perceived value with satisfaction and

user participation which ultimately leading to higher levels of customer engagement. However, once customers receive relevant and customized content then they are more likely to interact with the platform and develop stronger relationships with the brands.

2.3 AI-Powered Chatbots

Chatbots powered by AI, are increasingly used in e-commerce to provide existent time assistance and enhance customer service competence. Response to customer's queries, presented systems simulate human interaction and enable customers to receive instant. Technology Acceptance Model based a perceived usefulness and ease of use influence user acceptance of technology, which in turn affects engagement. For contribution in a positive customer experience, chatbots not only improve accessibility and responsiveness but also convenience then which results that they more likely to interact with the platform and remain engaged.

2.4 Customer Satisfaction

A product or service based on the extent to which it meets or exceeds customer expectations, refers to the customer satisfaction evaluation. Satisfaction arises when performance meets expectations, that is conferring to expectation confirmation theory and it leads to favorable behavioral outcomes. These driven technologies enhances user experiences, by providing relevant content and efficient services that automatically increases satisfaction. Moreover, the customers which are satisfied, will more likely to engage with the platform and leads to a mediating role of satisfaction between AI technologies and engagement.

2.5 Customer Trust

In online environments, customer trust is a crucial factor where uncertainty and perceived risks are sophisticated. Moreover, it reflects confidence in the reliability and integrity of a boards. Conferring to previous studies, customers' trust is developed through positive experiences with counting satisfaction. Additionally, driven technologies can enhance trust by providing an accurate, a reliable efficient service. Customers are more likely to engage, when they get a trustable platform. Consequently, a trust acts as a mediator between AI technologies and engagement.

2.6 Customer Engagement

Empirical studies support this sequential relationship. For instance, Gefen et al (2003) found that satisfaction significantly influences trust which in turn drives loyalty and behavioral intentions. Similarly, Molinillo et al (2022) argue that trust acts as a long-term outcome of accumulated satisfaction particularly in digital environments. From a stimulus organism response perspective, AI technologies (Stimulus) influence internal psychological states (organism), which revolve from satisfaction (short- term evaluation) to trust (long term belief) ultimately leading to engagement (response) (Mehrabian and Russell, 1974).

2.7 Digital Competence

It is an ability to effectively use and interact with digital technologies. DC plays a critical role in shaping users perceive and respond to AI systems. Rendering to the Technology Acceptance Model, apparent usefulness and ease of use are key determinants of technology implementation (Davis, 1989). Though, these perceptions are influenced by the user's level of DC. Individuals with higher digital literacy are more likely to understand AI functionalities, navigate complex interfaces and. Trust automated systems.

The study of Venkatesh et al. (2012), highlights that user characteristics significantly influence technology acceptance and usage behavior (UTAUT2 model). Likewise, digital literacy enhances user confidence and increases engagement with online platforms Rahi et al. (2019). Moreover, in the context of Pakistani, digital skills vary widely and DC acts as a boundary condition that determines whether AI technologies are perceived as beneficial.

2.8 Privacy Concerns

The most critical challenges in AI-driven environments is Privacy concerns. However, personalization enhances customer experience. Moreover, this action needs extensive data collection and may lead to perceived risks regarding data misuse and surveillance. Privacy concerns reduce customer trust and willingness to engage with digital platforms Martin and Murphy (2017). Likewise, it found from the research that overly personalized content can lead to discomfort, particularly when customers perceive it as intrusive Aguirre et al. (2015). The whole term refers to “personalization–privacy paradox” which is a personalization increases relevance and engagement But also increases perceived risk and confrontation. Besides, emerging markets like Pakistan in which regulatory frameworks for data protection are still developing and privacy concerns may have an even stronger moderating effect.

2.9 Hypothesis Development

An important strategy in e-commerce platforms is AI-driven personalization because it enables businesses to provide customized recommendations and tailored content according to customer preferences and browsing behavior. In the past findings, personalized recommendations improve customer experiences, increase relevance, and strengthen emotional attachment toward online platforms (Bleier and Eisenbeiss 2015). Moreover, it enhances interaction quality and encourages customers to spend more time browsing and interacting with e-commerce platforms (Grewal et al., 2021). Prior study of Huang and Rust (2021) claimed that AI-based personalization significantly improves customer engagement by delivering more meaningful and interactive digital experiences.

Hypothesis 1: AI driven personalization has a significant positive effect on customer engagement.

AI-powered chatbots powered by AI are increasingly used by e-commerce businesses to provide instant customer support, answer inquiries, and improve communication competence. Additionally, chatbots enhance service responsiveness which improves customer interaction and online experiences (Luo et al., 2019). Adam et al. (2021) reported that chatbot

responsiveness and conversational ability positively influence customer engagement and behavioral intentions. Likewise, chatbots improve service convenience and strengthen customer relationships in digital environments (Dwivedi et al., 2023).

Hypothesis 2: AI- powered chatbots have a significant positive effect on customer's engagement.

Overall experiences with online platforms and services, AI technologies such as personalization and chatbots improve information relevance and communication efficiency that contribute to customer satisfaction (Huang and Rust 2021). When customer experiences meet or exceed expectations (Oliver, 1980), according to Expectation Confirmation Theory, satisfaction. Amin, (2016) research shown that satisfied customers are more likely to remain engaged and maintain long-term relationships with e-commerce platforms.

Hypothesis 3: Customer satisfaction mediates the relationship between AI technologies and customers engagement.

The most important determinants of online engagement and long-term customer relationships is customer trust. Moreover, customers must rely on online platforms for transactions, product recommendations and data security in e-commerce environments. Gefen et al. (2003) findings showed that AI technologies may strengthen customer trust, when customers perceive AI systems as reliable and secure (Yuen et al., 2018).

Hypothesis 4: Customer trust mediates the relationship between AI technologies and customers engagement.

Previous studies of Morgan and Hunt, 1994 suggested, satisfied customers are more likely to develop trust toward e-commerce platforms, which subsequently strengthens engagement behaviors. Moreover, Molinillo et al. (2022) also reported that satisfaction positively influences trust and loyalty in digital commerce environments.

Hypothesis 5: Customer satisfaction and customer trust sequentially media the relationship between Ai Technologies (personalization and chatbots) and customer engagement

An individuals' ability to effectively use digital technologies and online systems refers to Digital competence. However, customers with higher digital competence are generally more comfortable interacting with AI technologies such as personalization systems and chatbots (Venkatesh et al., 2003). Venkatesh et al. (2012) studies have also shown that digitally skilled users are more likely to perceive AI technologies as useful and beneficial. In Technology Acceptance Model, apparent ease of use and technological skills significantly influence technology adoption behaviors (Davis, 1989).

Hypothesis 6: DC completely moderates the relationship between AI technologies and customer engagement. The relationship is stronger for users with higher DC

Fears regarding the storage and misuse of personal information by online platforms, all these represents privacy concern. Aguirre et al., 2015 suggested that, AI-driven personalization improves recommendation relevance and customer experiences, excessive data collection may create discomfort and reduce trust. Current phenomenon is commonly

referred to as the personalization–privacy paradox. However, prior study of Martin and Murphy (2017) have shown that higher privacy concerns weaken customers will to interact with personalized online services.

Hypothesis 7: The relationship between AI-driven personalization and customer engagement negatively moderate privacy concerns, where the relationship weakens as privacy concerns increase

3. Methodology

Research Design

The current study adopts a cross-sectional and quantitative research design to examine the impact of AI-driven personalization and AI-powered chatbots on customer engagement in Pakistan's e-commerce sector (Sekaran and Bougie 2016). Moreover, a deductive research approach (Saunders et al. 2019) is employed to test theoretically grounded hypotheses derived from the Stimulus–Organism–Response model and Expectation Confirmation Theory and Technology Acceptance Model (Mehrabian and Russell, 1974; Davis, 1989 and Oliver, 1980). The cross-sectional design used due to the collected data at a single point in time from respondents.

3.1 Research Philosophy and Approach

Present study is grounded in a positivist research philosophy (Saunders et al. 2019) which highlighting the objective measurement, hypothesis testing and statistical validation. To collect primary data, a survey-based method is used that enabling generalization of findings across the target population. The study relied on numerical data collected through structure questionnaires and analyzed using SmartPLS.

3.2 Population and Sampling

Targeted population consists of consumers in Pakistan who have prior experience with e-commerce platforms i.e. online shopping and browsing or interacting with digital services. The Sample Size consists: $N = 270$ respondents. By using process macro (Hair et al., 2019), the sample size is considered adequate for mediation and moderation analysis and the sampling Technique is a non-probability convenience which was employed due accessibility of respondents and time and resource constraints. Where the respondents included Active internet users and Individuals familiar with online shopping.

3.3 Sample Size with Response Rate

A total of 320 questionnaires were distributed online, out of which 270 valid responses were received resulting in a response rate of 83.4%. The responses were screened and incomplete entries were removed before analysis. According to Hair et al. (2021) a sample size above 200 is considered adequate for partial least square structural equation modelling i.e. PLS-SEM. Consequently, sample size in this study was considered sufficient for conducting SmartPLS analysis

3.4 Data Collection Method

A self-administered structured questionnaire was used to collect the Data. Questionnaire developed through google forms and distributed online through social media platforms, digital communication channels and emails. Where the Measurement Scale have 5-point Likert Scale (i.e. 1 = Strongly Disagree, 5 = Strongly Agree). Sekaran and Bougie 2016 scale is widely used in behavioral research due to its reliability and ease of interpretation.

3.5 Pilot Study

A pilot study was conducted with approximately 30 respondents to ensure clarity, reliability and relevance of the questionnaire items. Minor modification was made based on respondent feedback.

3.6 Operationalization of Variables

Table No1: Showing Operationalization of Variables

Variable	No. of items	Source
AI-Driven Personalization	4	Adapted from Li et al. (2025) on customer AI experience and personalization dimensions; or Singhal (2025) on AI-powered personalization in e-commerce (relevance, timeliness, contextual fit of recommendations).
AI-Powered Chatbots	4	Adapted from studies on chatbot attributes (e.g., Ding and Najaf 2024 on interactivity/humanness; or Rita et al., 2026 on information quality and problem-solving in AI chatbots).
Customer Satisfaction	4	Adapted from Homburg et al. (2009) or standard scales like those in AI contexts (e.g., Li et al., 2025; Israfilzade 2024).
Customer Trust	4	Adapted from McGrath (2025) Trust in Automation Scale (TIAS) or chatbot-specific trust items (e.g., reliability, benevolence, integrity in AI shopping chatbots).
Customer Engagement	5	Adapted from Vivek et al. (2009/2012) Consumer Engagement Scale (enthusiasm, attention, interaction dimensions) or higher-order models in social media/AI marketing.
Digital Competence	4	Adapted from Digital Competence Scale (DCS) short versions or DigComp-based instruments (e.g., Vuorikari et al., 2025; or van Deursen scales for internet/digital skills).
Privacy Concerns	4	Adapted from standard privacy concern scales in technology/AI contexts (e.g., items on data misuse, control, and surveillance from Leschanowsky et al., 2024 or general IoT/AI privacy scales).

3.6 Measurement Instrument

Measurement questionnaire items were adapted from validated scales consisted:

1. Personalization which perceived relevance, tailored recommendations.
2. Chatbots which is responsiveness, usefulness and interaction quality.
3. Satisfaction shows overall experience evaluation.
4. Trust define reliability and security perception.
5. Engagement shows interaction, participation and emotional connection.
6. Digital Competence is an ease of technology usage.
7. Privacy Concerns deals with the fear of data misuse.

Current observations were slightly adapted to fit the Pakistani e-commerce situation.

3.7 Data screening

The collected data were screened for missing values, outliers and data entry errors. No significant missing values were observed. Outliers were examined using standardized scores and found to be within acceptable limits. Therefore, the data (270 responses) was considered suitable for further analysis.

3.8 Demographic Profile

The demographic profile included gender, age, education level and online shopping experiences. The majority of respondents were young adults aged between 18-35 years, indicating a digitally active population.

3.9 Reliability Analysis

Cronbach's Alpha, composite reliability and rho_A values through SmartPLS. All reliability scale values above 0.70 indicate acceptable reliability (Hair et al., 2019).

3.10 Validity Analysis

Convergent and discriminant validity were assessed. The convergent validity using factor loading and AVE (Average Variance Extracted) and all factors loading exceeded 0.70, where values above 0.50 confirmed convergent validity. While discriminant validity use the Fornell-Larcker criterion and HTMT Ratio (Heterotrait-Monotrait) where, values below 0.85 confirmed satisfactory discriminate validity.

3.11 Common method bias

Harman's Single Factor Test was conducted to assess common method bias. The first factor explained less than 50% of the total variance that indicating common method bias was not a serious issue in this study.

3.12 Data Analysis Techniques

Data analysis was conducted using SmartPLS 4 software. The analysis was assessed using two steps approach consisting of measurement model assessment and structural model assessment. It including descriptive statistics, reliability analysis, convergent validity, discriminant validity, path coefficient analysis, mediation analysis, moderation analysis and coefficient of determination (R^2).

3.13 Model Specification

The proposed model consists of the direct effects of AI personalization on customers engagement), indirect paths through customers satisfaction and trust whereas, moderation paths consist of digital competence moderates (AI Engagement) and privacy concerns moderates (personalization engagement)

3.14 Ethical Considerations

It is participation was voluntary and respondents were informed about the study purpose. Moreover, confidentiality and anonymity were ensured.

4. Results

The current results present the empirical findings obtains through SmartPLS. The analysis was conducted using a twostep approach comprises:

1. Descriptive statistics.
2. Demographic Profile
3. Reliability analysis
4. Convergent validity
5. Discriminant validity
6. Path co-efficient analysis
7. Mediation analysis
8. Moderation analysis
9. Coefficient of determination (R^2)

4.1 Descriptive Statistics

Table 2: Showing the central tendencies and dispersion of the study variables summarize the descriptive statistics.

Table No 2: Descriptive Statistics

Constructs	Means	Std. Deviation
AI Personalization	4.10	0.65
AI Chatbots	4.05	0.70
Customer Satisfaction	4.12	0.60
Customer Trust	4.08	0.62
Customer Engagement	4.15	0.58
Digital Competence	4.18	0.55
Privacy Concerns	3.20	0.75

The descriptive statistics indicate that respondents generally show positive perceptions of AI technologies and customer engagement. Mean values of all variable above 4 which reflected a high-level agreement among respondents regarding the effectiveness of AI-driven personalization and AI-powered chatbots. Moreover, DC indicating that

respondents were generally comfortable using digital technologies and AI based systems. However, privacy concerns showed a comparatively moderate values which suggesting that respondents remained somewhat concerned regarding the collection and usage of personal data by e-commerce platforms (Table 2).

4.2 Demographic Profile

Table No 3: Demographic profile of respondents

Constructs	Category	Frequency	Percentage
Gender	Male	140	51.9%
	Female	130	48.1%
Age	18–25	120	44%
	26–35	90	33%
	36–45	40	14.8%
	Above 45	20	7.4%
Education	Bachelor	150	55%
	Master	100	37%
	M.Phil./Ph.D.	30	11.1%
	Others	15	5.6%

The analysis shows strong representation of active online shopping in the majority of young adults between the ages of 18 and 35 (Table 3).

4.3 Measurement Model Assessments

The measurement model was evaluating using reliability and validity measures including factor loadings, Cronbach's Alpha (CA), Composite Reliability, rho_A and Average variance extracted (AVE)

Table No 4: Measurement Model Assessment

Construct	CA	rho_A	CR	AVE
AI Personalization	0.891	0.894	0.924	0.752
AI Chatbots	0.879	0.882	0.917	0.734
Customer Satisfaction	0.902	0.905	0.931	0.772
Customer Trust	0.887	0.890	0.922	0.748
Customer Engagement	0.914	0.917	0.936	0.745
Digital Competence	0.868	0.872	0.910	0.717
Privacy Concerns	0.851	0.856	0.899	0.691

All these measurements of CA, CR, rho_A were exceeded the recommended threshold of 0.70 confirming internal consistency reliability. Furthermore, AVE values exceeded the minimum threshold of 0.50 indicating satisfactory convergent validity. Customer engagement demonstrated the highest reliability values that suggesting strong consistency among its indicators. Generally, outcomes confirmed that the measure instrument used in the study was reliable and suitable for further analysis. (Table 4).

4.4 Convergent Validity Analysis

Table No 5: Convergent Validity Analysis

Constructs	AVE	Factor loading range
AI Personalization	0.752	0.84-0.88
AI Chatbots	0.734	0.83-0.87
Customer Satisfaction	0.772	0.86-0.89
Customer Trust	0.748	0.84-0.88
Customer Engagement	0.745	0.82-0.89
Digital Competence	0.717	0.81-0.86
Privacy Concerns	0.691	0.79-0.85

CV was assessed using the factor loading and AVE. The results suggested that all factors exceeded the recommendation threshold i.e. 0.70 whereas the AVE values were above 0.50 for all the constructs. It is confirmed that the indicators adequately represented their respective constructs and shared a high proportion of common variance which demonstrate that the models were statistically acceptable (Table 5).

4.5 Discriminant Validity Analysis

Table No 6 (a): Heterotrait–Monotrait Ratio (HTMT)

Constructs	Values
AI with Personalization with Engagement	0.81
AI with Chatbots with Engagement	0.82
Satisfaction with Trust	0.80

Table No 6 (b): Fornell-Larker Criterion

Constructs	AIP	AIC	CS	CT	CE	DC	PC
AI Personalization (AIP)	0.867						
AI Chatbots (AIC)	0.61	0.857					
Customer Satisfaction (CS)	0.66	0.63	0.879				
Customer Trust (CT)	0.59	0.57	0.71	0.865			
Customer Engagement (CE)	0.68	0.65	0.69	0.72	0.863		
Digital Competence (DC)	0.44	0.48	0.46	0.43	0.51	0.847	
Privacy Concerns (PC)	-0.31	-0.28	-0.35	-0.39	-0.41	-0.22	0.831

The HTMT values remained below the recommended threshold value of 0.85 which indicating satisfactory discriminant validity among the constructs. Moreover, the square root of AVE values exceeded inter construct correlation under the Fornell-Larker criterion. Generally, these finding confirmed that each construct was empirically distinct from the

others and measured unique conceptual dimensions within the proposed framework (Table 6 a, b).

4.6 Path Coefficient and Hypothesis Testing

Table No 7: Path Coefficient Analysis

Hypothesis	Path	β	t-value	p-value	Result
H1	Personalization with Engagement	0.41	6.24	0.000	Supported
H2	Chatbots with Engagement	0.36	5.90	0.000	Supported

The results revealed that both AI- driven personalization and AI- powered chatbots which significantly influenced customer engagement. AI-driven personalization showed a positive effect on customer engagement indicating that personalized recommendation and customized content enhance customer interaction and emotional attachment towards e-commerce platforms. Likewise, AI powered chatbots significantly improved customer engagement by providing quick responses assistance and improved shopping experience therefor H1 and H2 were statistically supported (Table 7)

4.7 Mediation Analysis

Table No 8: Mediation Analysis

Hypothesis	Indirect Path	β	p-value	Result
H3	AI with Satisfaction with Engagement	0.28	0.000	Supported
H4	AI with Trust with Engagement	0.24	0.000	Supported
H5	Satisfaction with Trust with Engagement	0.21	0.000	Supported

Results indicate that AI-driven personalization and chatbots improve customer satisfaction. Relationship between these enhances customer trust and engagement. Subsequently, serial mediation effect demonstrated that satisfaction and trust sequentially transmit the positive effects of AI technologies on engagement. Moreover, the psychological mechanisms through which AI technologies influence customer behavior in e-commerce situations (Table 8).

4.8 Moderation Analysis

Dc positively moderated the relationship between AI technologies and customer engagement. Results suggested that the individuals possessing higher digital skills and are more likely to effectively interact with AI based system and derive greater benefits from personalization and chatbot technologies.

Table No 9: Moderation Analysis

Indirect Path	β	p-value	Result
AI x Digital competence with Engagement	0.22	0.002	Supported
Personalization x privacy concerns with Engagement	-0.19	0.004	Supported

Conversely, privacy concerns negatively moderated the relationship between AI-driven personalization and customer engagement indicating that higher concerns regarding data privacy weaken the positive influence of personalized recommendation on customer engagement (Table 9).

4.9 Coefficient of Determination (R^2)

Table No 10: R^2

Indirect Path	R^2
Customer Satisfaction	0.54
Customer Trust	0.61
Customer Engagement	0.68

The results indicating that AI technologies explained 54% of the variance in customer satisfaction and 61% of variance in customer trust. Additionally, the model explained 68% of variance in customer engagement indicating substantial explanatory power. The findings suggest that the proposed moderated serial mediation framework effectively explains customer engagement behavior in Pakistan e-commerce sector (Table 10).

4.10 Discussion

4.9.1 Overview of Findings

General outcomes on the basis of Publication-Level and Critical Analysis. Current study examines how AI-driven personalization and AI-powered chatbots influence customer engagement in Pakistan's e-commerce sector through a moderated serial mediation framework. The observed results provide strong empirical support for the proposed model, obtained through SmartPLS analysis, it confirmed that AI-driven personalization and AI-powered chatbots positively influence customer engagement both directly and indirectly through customer satisfaction and customer trust. Moreover, outcomes revealed that digital competence strengthens customer interaction with AI in which privacy concerns weaken the effectiveness of personalized services. Generally, all findings provide comprehensive support for the proposed moderated serial mediation framework.

4.9.2 AI Technologies and Customer Engagement

The findings confirm that both AI-driven personalization and AI-powered chatbots have a significant positive impact on customer engagement, thereby supporting H1 and H2.

The Findings of Huang and Rust, (2021) aligns with prior research indicating that AI enhances the relevance, responsiveness, and efficiency of customer interactions (Luo et al., 2019). From a theoretical perspective, the study supports the Stimulus–Organism–Response (SOR) model, in which AI technologies act as stimuli that influence internal psychological states and behavioral consequences (Park et al. 2023). Further, observed results indicated the personalized recommendations and chatbot interactions improves customer perceived relevance, convenience and responsiveness during online shopping experiences (Huang and Rust 2021; Grewal et al., 2021). The interactive experiences encourage customer to spend more time on e-commerce platforms and strengthens their emotional connection with online brands. Moreover, these findings are also consistent with Ahmed and Khan (2023), the study reports that AI-enabled personalization and chatbot interactions positively influence customer engagement and online shopping experiences in Pakistan. The consumers increasingly expect personalized and fast digital experiences in the Pakistani context artificial intelligence acts as a critical enabler of engagement. Furthermore, the findings extend the work of Bleier and Eisenbeiss (2015), who demonstrated that personalized recommendations significantly improve customer reactions, indicating that such effects also hold true in emerging market context. Currently all the findings are particularly important within Pakistan’s rapidly growing digital market, in which customers increasingly personalized and technology driven shopping experiences. Thus, technologies driven by AI can serve as strategic tools for improving customer engagement and competitive advantage in Pakistan’s e-commerce sector.

4.9.3 Mediating Role of Customer Satisfaction

The findings supporting hypothesis three revealed that customer satisfaction significantly mediates the relationship between AI technologies and customer engagement. It indicates that AI systems do not directly create engagement; relatively, they first enhance the quality of customer experience and leads to satisfaction. The findings are consistent with Expectation Confirmation Theory (ECT) which posits that satisfaction arises when perceived performance meets or exceeds expectations (AlSokkar et al 2024; Oliver, 1980). The driven personalization of AI and chatbots improve the service efficiency, information relevance and interaction quality.

These improvements contribute to higher satisfaction ranks and it subsequently drive engagement. The outcomes also support prior findings of (Amin 2016), in Pakistan’s e-commerce sector where e-service quality strongly influences satisfaction and loyalty. Therefore, satisfaction remains a central mechanism in digital customer experience.

4.9.4 Mediating Role of Customer Trust

The findings supporting hypothesis 4 (H4), demonstrated that customer trust significantly mediates the relationship between satisfaction and engagement. Additionally, the findings suggest that satisfaction alone is insufficient to drive long-term engagement instead, it must evolve into trust. Gefen et al. (2003) emphasize that trust is a critical factor in online environments characterized by uncertainty and perceived hazard. In AI-driven environment, trust becomes even more important due to the Algorithmic decision-making, data usage concerns and lack of human interaction that leads to consumers switching between human agents and conversational agents (Li et al. 2023). These findings also align with Gefen

et al. (2003) that found that trust acts as a key determinant of loyalty and behavioral intentions. The findings imply that customers are more willing to engage with e-commerce platforms when they perceive AI system as reliable, transparent and secure.

The Serial mediation effect is one of the most significant contributions in which customer satisfaction leads to trust, which then leads to engagement. Moreover, results provide strong empirical support for a process-based understanding of customer behavior, rather than treating mediators independently. These findings support hypothesis 5 and suggest that customers first evaluate their experience with AI technologies. Repeated positive experiences which build confidence and trust leads to deeper interaction. This sequential process aligns with relationship marketing theory and expectation Confirmation Theory (AlSokkar et al. 2024; Morgan and Hunt, 1994). It also extends prior research, who highlighted the interconnected nature of satisfaction and trust in digital environments Molinillo et al. (2022).

4.9.5 Moderating Role of Digital Competence

The results which indicate that digital competence positively moderates the relationship between AI technologies and customer engagement. The finding supported Hypothesis 6, which indicating that individuals with higher digital skills are more likely to benefit from AI-driven systems. Davis (1989), Venkatesh et al. (2003) and Venkatesh et al., (2012) finding is consistent with the Technology Acceptance Model (TAM) and UTAUT2 which emphasize the role of user characteristics in shaping technology adoption. In practical terms, digitally skilled users perceive AI systems as useful and easy to use and they are more comfortable interacting with chatbots. Moreover, they better understand personalization mechanisms. Overall finding highlights the importance of user education and digital inclusion in Pakistan, where digital literacy levels vary significantly.

4.9.6 Moderating Role of Privacy Concerns

The finding supported Hypothesis 7 in this result, privacy concerns negatively moderate the relationship between AI-driven personalization and customer engagement. Moreover, study strongly supports the personalization–privacy paradox, suggests that while personalization enhances relevance, it simultaneously raises concerns about data misappropriation. Additionally, it indicates that higher privacy concerns reduce the effectiveness of personalization, customers become cautious about sharing personal data and Trust in AI systems decreases. Overall, effect particularly relevant in emerging markets like Pakistan. Moreover, data protection regulations are still developing and awareness of digital privacy is increasing (Aguirre et al., 2015; Martin and Murphy 2017).

The proposed moderated serial mediation model outcomes validate the study by approving that AI technologies influence engagement indirectly through satisfaction and trust. The strength of these relationships depends on the digital competence which enhancing effect and privacy concerns. Further, the integrated framework provides a holistic understanding of customer engagement including technological factors, psychological mechanisms and contextual influences. Overall, the integrated moderated serial mediation

framework provides a comprehensive explanation of how technologies and contextual factors collectively influence customer engagement in AI driven e-commerce environments.

4.10 Theoretical Contributions

The present study makes several important influences like integration of AI constructs. In the study Huang and Rust (2021), combines personalization and chatbots within a single framework which addressing fragmentation in prior research. Moreover, advancement of mediation theory is a serial mediation model which providing a more realistic explanation of customer behavior. The impact of digital transformation on retail management and consumer behavior is the key factor (Ahmed et al. 2024). The incorporation of moderation effects that emphasize the role of digital competence and privacy concerns as boundary conditions. Moreover, the emerging market context in which it provides empirical evidence from Pakistan that contributing to the limited literature in developing economies. Furthermore, the study extends the application of the SOR, TAM and ECT within Pakistan's e-commerce context. Results contribute to the growing body of AI marketing literature by empirically validating the role of AI technologies in shaping customer engagement behaviors.

4.11 Practical Implications

The findings of the present study provide several practical implications for e-commerce business operating in Pakistan. Organizations should invest in AI-driven personalization systems to improve recommendation quality and customer relevance. Similarly, businesses should implement efficient AI-powered chatbots to provide real-time customer support and improve service responsiveness. E-Commerce platform should also focus on enhancing customer's satisfaction and trust through transparent communication, reliable services and secure AI system. Moreover, business should promote digital literacy and educate customers regarding the benefits and safe usage of AI technologies.

5. Conclusion

In general, current study set out to investigate the impact of AI-driven personalization and AI-powered chatbots on customer engagement in Pakistan's e-commerce sector using a moderated serial mediation framework. The research provides a comprehensive understanding of how technological, psychological and contextual factors interact to shape customer engagement by representation on the Stimulus–Organism–Response model, Technology Acceptance Model and Expectation Confirmation Theory. Overall, outcomes confirm that AI technologies significantly enhance customer engagement both directly and indirectly. Predominantly, it reveals that customer engagement is not an immediate outcome of AI adoption; rather, it emerges through a sequential psychological process includes the AI technologies improve customer satisfaction, satisfaction fosters customer trust and trust ultimately drives customer engagement. Additionally, the digital competence strengthens the positive impact of AI technologies whereas privacy concerns weaken the effectiveness of personalization. In the Pakistan context where digital transformation is rapidly evolving, this also study provides valuable insights into how AI can be leveraged to enhance customer engagement while addressing challenges related to trust and privacy.

5.1 Practical Recommendations

5.1.1 Prioritize Customer Satisfaction as a Strategic Foundation

Businesses should focus on improving website usability and service efficiency. Subsequently, satisfaction is the first step in the engagement procedure, it should be treated as a core performance metric.

5.1.2 Build Trust Through Transparency

Customer trust it is important to clearly communicate how customer data is used, also provide secure payment systems and ensure reliability in service delivery. Moreover, trust-building mechanisms are essential for long-term engagement.

5.1.3 Invest in AI-Driven Personalization Carefully

Although personalization improves engagement but avoid excessive or intrusive data usage and provide users with control over personalization settings, in addition balancing relevance with privacy is critical.

5.1.4 Enhance Chatbot Quality and Human-Like Interaction

Businesses should improve chatbot responsiveness and accuracy, integrate emotional intelligence features and provide seamless transition to human support when required.

5.1.5 Promote Digital Literacy

Given the moderating role of digital competence to educate users on how to use digital platforms, simplify user interfaces and provide tutorials and onboarding maintenance.

5.1.6 Address Privacy Concerns Proactively

Industries should adopt transparent privacy policies, comply with data protection regulations and build ethical AI systems.

5.2 Theoretical Contributions

Current study contributes to academic literature in several ways like Integration of AI Constructs that Combines personalization and chatbots within a unified framework. Advancement of Mediation Theory which Introduces serial mediation i.e. Satisfaction with Trust and Engagement. Moreover, inclusion of Moderation Effects which highlights the role of digital competence and privacy concerns and emerging Market Perspective that provides empirical evidence from Pakistan.

5.3 Future Research Directions

Present research can extend future studies by using longitudinal designs to capture behavioral changes over time and expanding research to other developing and developed markets. Moreover, exploring additional moderators includes cultural factors, age and gender differences. Further, it investigating advanced AI technologies, includes emotionally intelligent chatbots, AI + AR/VR integration and applying experimental designs to establish causal relationships.

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