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AI-driven service quality and customer engagement: The mediating role of digital empathy and cognitive absorption

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Abstract

The aim of this study is to investigate how AI-driven service quality (AISQ) influences customer engagement (CE) in the e-commerce industry in Pakistan. This study examines the mediation of digital empathy (DE) and cognitive absorption (CA). It concerns discovering how AI-driven service quality affects customer interactions through emotional and cognitive processes. Through an online survey, data were collected from 321 e-commerce clients in Pakistan. The current study used convenience sampling. A five-point questionnaire was used for data collection. The statistical tool SPSS 22.0 was used for correlation and regression analysis. The conceptual framework was built on the Technology Acceptance Model (TAM) and the Trust-Commitment Theory (TCT) to determine the association among AISQ, DE, CA, and CE. The proposed hypotheses and their mediation effects were tested using Structural Equation Modelling (SEM). The findings of the present study indicate that AISQ has a positive impact on CE. DE and CA play an important role in mediating this relationship. The results of this study show that when customers perceive AI-based services as empathetic and interesting, they are more likely to become engaged with an e-commerce platform. This paper is a contribution to the research on AI and customer behaviour, as it reveals that DE and CA are significant intermediate variables between AISQ and CE. The results are valuable to e-commerce leaders in Pakistan, helping them improve customer engagement and loyalty through emotive, compelling AI solutions.

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Introduction

The blistering development of artificial intelligence (AI) has transformed the way businesses interact with clients and shaped changes in expectations for the quality of services and interactions in digital spaces. Over the past several years, the use of AI technologies,

including chatbots, predictive recommendation systems, and smart customer support systems, has become a major driver of innovation in the e-commerce industry (Liao, 2025). AI has become an essential element in improving customer experiences by enabling companies to provide personalised, responsive services at scale, leveraging data (Charles et al., 2025). With the global e-commerce growing steadily in scale (to the extent of reaching approximately US$6.3 trillion by 2024 and potentially exceeding US$8 trillion by 2027), companies are facing an increasingly tighter demand to have AI-driven service systems that can deliver efficiency, as well as evoke emotional and cognitive interaction among customers and users (Pang et al., 2025).

The e-commerce industry in developing economies like Pakistan has seen rapid growth and expansion, driven by increased digitalisation, improved logistics, and widespread mobile connectivity. According to Hussain (Hussain, 2025b) internet penetration was 61% in 2024, and more than 133 million people were broadband users. Equally, Mou et al. (2025) forecast that by 2025, online retail sales would exceed PKR 280 billion, indicating a growth rate of more than 10 per cent per year. This technological change has prompted companies to adopt AI to improve consumer experiences. Nevertheless, even amid the rise in AI usage, many customers doubt the human-like nature of AI interactions, particularly in terms of empathy and responsiveness, to the extent of their trust in AI (Yang et al., 2025). Therefore, the translation of AISQ into more profound CE is not only of practical importance but also under-researched theoretically in the Pakistani context. AISQ is the customer's attitude toward the reliability, responsiveness, personalisation, and competence of AI systems in delivering digital services (Arefin et al., 2025). When service quality dimensions are traditionally focused on human delivery, AI-guided quality is based on the system's capacity to be adaptive, to learn, and to respond in a material way to personal preferences.

Nevertheless, the efficiency of technology is not a guarantee of meaningful engagement; customers are becoming more sensitive to emotionally intelligent AI capable of expressing DE, given that technology can understand and respond to human emotions (Atnan et al., 2025). DE creates psychological bonding, trust, and perceived human-likeness, which leads customers to continue using AI-based services (Pandey et al., 2025). Likewise, CA, which is an expression of a user in a high degree of engagement and immersion of the mind/thought process in digital engagement (Qi et al., 2025), reflects the cognitive facet of engagement. Users are likely to develop a long-lasting engagement behaviour when they have a high absorption with AI interfaces, resulting in loyalty and advocacy (Pizzi et al., 2025). Combining these two constructs, DE and CA, into a unified emotional and cognitive mechanism by which AISQ impacts engagement creates a shared psychological perspective for interpreting modern customer-AI relationships. These mediating variables are chosen in a theoretically sound way. DE helps bridge the affective divide between people and machines, focusing on the emotional nature of AI service experiences, whereas CA covers attention-driven, engaging experiences that are necessary for long-term engagement (Wiyata et al., 2025).

Collectively, the variables complement one another and align with the TAM and TCT, which propose that perceived quality, trust, and psychological involvement influence user engagement and commitment (Davis, 1989; Morgan & Hunt, 1994). Although other researchers have investigated AI adoption, perceived usefulness, and satisfaction, little is known about the co-emotional and cognitive processes through which AISQ and CE are mediated, especially in an emerging economy. The majority of previous research has investigated AI adoption and service performance through the prism of technological or functional aspects, focusing on variables such as system quality, perceived usefulness, and efficiency (Dwivedi et al., 2023; Garaus et al., 2025; Ma, 2024; Priporas et al., 2017).

Although these studies helped understand how AI can improve operational outcomes, they did not focus on the psychological and emotional processes that drive customer engagement. This narrow perspective does not reflect the emotional and cognitive reactions of

customers to AI-based interactions, which are becoming increasingly relevant in digital service settings. Several studies have found that trust and satisfaction mediate the relationship between AISQ and behavioural outcomes (Hajar et al., 2025; Lim et al., 2025). Nevertheless, these constructs are post-interaction assessments rather than immediate cognitive and emotional activities. The lack of variables, including DE, who thinks AI can interpret and react to user feelings, and CA, how much more engaged and active one can be when interacting with AI, demonstrates a gap in the theoretical knowledge of the underlying mechanisms of how AI affects engagement. This has not been adequately covered in existing literature on the joint mediation of the relationship between AISQ and CE.

Moreover, most of the research was carried out in developed economies or within high-technology service environments such as banking, hospitality, and telecommunications (Basu et al., 2025; Matos et al., 2025). Empirical evidence in new digital markets, such as Pakistan, is also scarce, as variations in technology readiness, digital trust, and cultural perceptions of AI can alter customer reactions to AI (Hussain, 2025a; Lopes et al., 2025). A lack of localised research limits the extent to which current theories can be applied in developing contexts. Specifically, no previous study has examined the influence of AISQ on CE through emotional (DE) and cognitive (CA) mechanisms in Pakistan's e-commerce industry, despite its booming growth and increased use of AI technologies. Finally, the methodological weaknesses are evident in the limited use of mediated models and combined theoretical approaches. I am running a different type of research, carried out previously, which was mostly based on a single theory or a descriptive study, without a multi-dimensional construct to explain the complex AI-customer relationship (Huang et al., 2025; Hussain, 2025a).

Therefore, it is necessary to conduct an empirical study that adopts a thorough, theory-grounded approach, exploring the dual mediating roles of emotional and cognitive variables in the relationship between AISQ and CE. This paper uses these gaps to fill by combining TAM and TCT to examine the mediating roles of DE and CA in AISQ and CE in Pakistan's e-commerce industry. The primary aim of the research is to explore the relationship between AISQ and CE and to test the mediating role of DE in this relationship. In particular, the study will (1) test the effect of AISQ on CE, (2) test the mediating effect of DE, and (3) test the mediating effect of CA. In this way, the study provides comprehensive insight into how AI-powered systems can improve CE beyond functional service effectiveness. This study is important because it addresses the problem theoretically, contextually and managerially. In principle, it helps enhance knowledge of AI–customer interaction by integrating emotional and cognitive aspects into existing service quality models. Contextually, it gives empirical evidence on the e-commerce industry in Pakistan, a fast-emerging digital market where AI is rapidly being adopted, yet customer confidence and continued engagement are problematic.

From a management perspective, the insights offer useful recommendations for e-commerce companies seeking to create empathetic, cognitively stimulating AI systems that enhance customer relationships, trust, and loyalty. The research focuses on AI-enabled online shopping in Pakistan, but its findings can be applied to other service settings that use AI in CE. The proposed study is a quantitative, survey-based study of 321 e-commerce users in Pakistan who have experienced AI-based systems (chatbots or recommendation systems) in some way. Direct and mediating relationships among constructs are tested using SEM-analysed data. This method can be used to conduct an effective analysis of the multi-path relationships in the conceptual model. Overall, the research adds to the existing literature on AI and digital services by emphasising that the quality-of-service delivery in the field of AI should go beyond technical performance and involve understanding and emotionally involving interaction. The study highlights emotional resonance and mental immersion as the most important conditions of valuable CE of AI-based e-commerce. It provides academic value and practical lessons for practitioners seeking to build smart, human AI experiences that strengthen customer relationships in the digital economy.

Theoretical Background

This study's theoretical basis relies on these complementary approaches to provide an understanding of how AISQ may affect CE through the intermediary impacts of the DE and CA: TAM, TCT, and the Cognitive Affective Theory of Emotion (CATE). All theories provide a unique yet interrelated frame of reference for the technological, relational, and psychological processes that connect AI-facilitated service performance with CE in the Pakistani e-commerce industry. The technological base for the study on how customers develop positive behavioural reactions towards AI-based services is provided by the TAM (Davis, 1989). TAM predicts that users' attitudes and behavioural intentions towards the technology are dependent on the central determinants, namely perceived usefulness and perceived ease of use. In e-commerce supported by AI, ASQ includes the following characteristics: reliability, personalisation, responsiveness, and accuracy, which shape perceptions of usefulness and ease of interaction (Mou et al., 2025).

Empirical evidence shows that intentions to engage increase with greater perceived technological quality when the user perceives AI as useful, available, and responsive to their needs (Pandey et al., 2025; Qi et al., 2025). Moreover, more recent studies have generalised TAM to experiential and emotional domains, acknowledging that positive affective reactions to smart systems enhance further utilisation and interaction (Hajar et al., 2025; Basu et al., 2025). Therefore, TAM aids understanding of the technological acceptance pathway, which demonstrates how AISQ creates the cognitive base for CE by shaping perceptions of the AI interface's competence and utility. Although TAM elucidates the cognitive assessment of AI functionality, it fails to fully address the relational and affective aspects that sustain long-term CE. In this case, the TCT offers an augmenting relational approach Morgan & Hunt (1994). TCT argues that commitment and trust are the key components for sustaining long-term customer relationships.

In the context of AI-based interactions, trust can be established when customers feel the AI system is trustworthy, transparent, and good, whereas commitment is a manifestation of a psychological attachment that encourages continued contact (Wiyata et al., 2025; Liao, 2025). The research has demonstrated that customers gain confidence in AI when systems are characterised by stable, customised and secure experiences, which further facilitates commitment and involvement (Gong, 2025). Nevertheless, the relational quality of AI service is not about a transactional aspect alone; it involves an emotional aspect that bridges the gap between the human and the machine. This bridge is operationalised as DE, the perceived capability of AI to discern and address customer emotions in the most appropriate manner (Ma et al., 2025). It converts impersonal AI interactions into a relational experience, fostering trust and an emotional bond that further strengthens the interaction. In that regard, this paper describes how TCT clarifies the concept of using AISQ to engage emotions based on trust, and the mediating factor of commitment in technology-mediated relationships is DE.

To obtain a more profound psychological understanding of user immersion, CATE Bagozzi et al. (1999) offer a third, integrative lens. CATE implies that cognitive evaluations and affective reactions make up individual responses to stimuli, both of which impact behaviour. This theory is especially applicable to explaining CA, the condition of in-depth engagement, attention, and intrinsic pleasure in the process of using technology (Qi et al., 2025). The more the AI-driven service is perceived as responsive and intelligent, the greater CAthe by users experience, which results in the development of long-term engagement behaviours, including loyalty, advocacy, and repeat contact (Samani et al., 2025; Lopes et al., 2025). The proposed cognitive and affective dimensions of CATE are similar to the two mediating constructs of DE (affective mechanism) and CA (cognitive mechanism), which provide a full psychological description of how AISQ is transferred to meaningful engagement. A combination of these theories will offer a multidimensional and unified explanation of the hypothesised relationships.

TAM discusses the cognitive assessment of the AI system's performance, TCT describes the relational and emotional trust-building process, and CATE explains the inner psychological processes that maintain attention and emotional resonance. Together, these frameworks extend beyond the constraints of single-theory approaches, which can tend to view only technical or relational outcomes. Their combination takes into account the technological, relational, and psychological aspects of the interaction between AI and customers, providing a comprehensive picture of engagement formation in digital environments. Notably, these integrations are theoretically consistent, not contradictory: TAM offers the antecedent conditions for trust development (usefulness and reliability), TCT extends them to relational commitment, and CATE describes the conversion of emotional and cognitive states into engagement behaviour through service quality. This is a valuable theoretical integration within the Pakistani e-commerce setting. In emerging digital economies, the level of algorithmic literacy is low, which makes customers nervous about AI technologies, so to speak, and they lack trust in systems that make decisions on their behalf (Huang et al., 2025).

Therefore, to foster engagement, technical proficiency alone does not suffice to build emotionally intelligent AI relationships that foster empathy and cognitive engagement. This combined explanatory capacity of TAM, TCT and CATE provides the current study with the ability to describe these multifaceted mechanisms and provide a culturally sensitive and psychologically based insight into how AISQ increases CE via DE and CA. This combined approach therefore provides a strong theoretical framework within which technological acceptance, emotional trust, and cognitive immersion are established under a single theory.

AI-Driven Service Quality and Customer Engagement

The AISQ has become a key factor in CE in digital settings, as smart technologies have become the means of interaction between a customer and a brand. The results of previous studies also indicate that customer satisfaction improves and relationships are strengthened because AI-based systems are accurate in providing relevant and personalised answers in a timely manner (Atnan et al., 2025; Liao, 2025). Research also shows that customers who perceive AI-provided services as reliable and responsive form positive attitudes and emotional attachment towards digital platforms (Pizzi et al., 2025). The quality of AI services not only meets functional expectations but also fosters a sense of experience by cultivating trust, enjoyment, and connectedness (Lim et al., 2025). Besides, when AI offers responsive, situational support, customers report increased cognitive and affective engagement, suggesting that service quality directly translates into greater involvement (Gong, 2025). Experimental data from e-commerce and hospitality experience confirm that system intelligence and personalisation are among the crucial predictors of behavioural engagement, through both affective and cognitive pathways (Basu et al., 2025). These results imply that the high quality of AISQ increases customers' willingness to communicate, share, and be loyal to the platform by influencing both its technological and emotional appeal. Thus, according to the hypothesis formulated.

H1: AISQ has a positive and significant effect on CE

The increased adoption of AI in customer service has reinvented the meaning of emotional attachment and comprehension in online communication. Whereas AISQ promotes efficiency and individualisation, the genuine richness of CE is usually determined by the system's capacity to emulate empathy and emotional receptiveness, referred to as DE. According to the previous studies, customers have a more meaningful interaction with intelligent systems that show understanding of their emotions, preferences, and situational needs (Charles et al., 2025; Rahman et al., 2025) The availability of high-quality AI services capable of detecting emotional responses, being sensitive, and adjusting communication styles that seem more human-like creates trust and emotional bonding (Hussain, 2025b, 2025a). Research also indicates that AI responses grounded in empathy lead to greater relational satisfaction and stronger emotional attachment, which are key antecedents of engagement

(Pandey et al., 2025; Yang et al., 2025). In addition, it has been shown that DE serves as a psychological mediator, converting technological excellence into affective commitment (Matos et al., 2025). Customers might not engage with AI systems; thus, even with high-quality services provided, customers may be disengaged when the interactions are mechanical or without emotion. Digital empathy also helps overcome this by humanising AI communication, resulting in a higher level of authenticity and perceived care in online interactions (Somani et al., 2024). Physical contact is not needed in an e-commerce setting, and it is in this regard that this empathetic aspect gains paramount importance in creating lasting CE and loyalty. Therefore, DE is known to mediate the functional impacts of AISQ, in addition to increasing the emotional resonance, which would maintain engagement behaviours. Hence, a hypothesis was formulated.

H2: DE mediates the relationship between AISQ and CE

In an AI-enabled service environment, customer interactions are further grounded not only in the quality of functional service delivery but also in the user's psychological involvement in online communication. CA, characterised by deep attention, temporal dissociation, and inherent pleasure when using technology (Lim et al., 2025), is one of the main psychological processes linking AISQ to engagement outcomes. In the case of AI systems that are responsive, flexible, and personalised, users will have an increased level of cognitive engagement and long-term attention, which results in more substantial and lasting interaction (Gong, 2025; Mou et al., 2025). The ability to absorb it is achieved through high service quality, which reduces cognitive friction, simplifies tasks, and provides a smooth, pleasant online experience (Huang et al., 2025). Past studies show that high technological design and interface smartness can result in flow-like experiences as users lose time awareness and become engaged in interaction at a mental level (Somani et al., 2025; Matos et al., 2025). Customers in these states develop a stronger psychological attachment to the platform, reflected in greater engagement, more frequent interactions, and positive word-of-mouth behaviour. In addition, CA mediates the effect of perceptions of quality on the intentions to behave by converting rational judgments of technology into intrinsic motivation and pleasure (Hajar et al., 2025; Lim et al., 2025). Therefore, it is possible to state that AISQ does not just improve interaction through its functionality but also through immersive cognition that further enhances user engagement. With e-commerce in the Pakistani environment rapidly reshaped by AI technologies, CA has become a critical factor in mitigating the gap between the system's excellence and behavioural responses. Customers who are cognitively engaged in AI-supported experiences show increased commitment, satisfaction, and trust in the platform. Consequently, a hypothesis was formulated.

H3: CA mediates the relationship between AISQ and CE

In an AI-enabled service environment, customer interactions depend not only on the functional quality of service delivery but also on users' psychological involvement during online communication. Cognitive absorption (CA), characterised by deep attention, temporal dissociation, and intrinsic enjoyment when engaging with technology (Lim et al., 2025), represents a key psychological mechanism linking AI service quality (AISQ) with customer engagement (CE). When AI systems are responsive, adaptive, and personalised, they enhance users' cognitive immersion and sustained attention, leading to more meaningful and prolonged interactions (Gong, 2025; Mou et al., 2025). High levels of AISQ reduce cognitive friction, simplify user tasks, and create a seamless and enjoyable digital experience, thereby fostering deeper absorption (Huang et al., 2025).

Prior research indicates that sophisticated technological design and intelligent interfaces can induce flow-like experiences, where users lose track of time and become mentally immersed in the interaction (Somani et al., 2025; Matos et al., 2025). Such cognitively absorbed users tend to develop stronger psychological connections with the platform, which manifests in higher engagement, increased interaction frequency, and positive word-of-mouth. Moreover,

CA serves as a mediating mechanism by transforming users' rational evaluations of service quality into intrinsic motivation and enjoyment, which subsequently influence behavioural intentions (Hajar et al., 2025; Lim et al., 2025). Therefore, AISQ enhances CE not only through its functional performance but also by fostering immersive cognitive experiences that strengthen user engagement. In the rapidly evolving Pakistani e-commerce landscape, driven by AI technologies, CA plays a critical role in bridging the gap between system quality and behavioural outcomes.

Method

This paper used a random sampling method to gather information from customers already involved in e-commerce in Pakistan, who are therefore well-representative of those who have been using AI-powered services. To increase the validity and reliability of the measurement scale, the survey questionnaire was audited and optimised by the academic community in marketing and information systems, as well as by industry representatives with practical experience in AI-based customer service. The questionnaire included a final section that collected demographic data on respondents and their perceptions of AISQ, as well as whether they were experiencing DE and CA when online shopping and their general behaviours towards e-commerce platforms. The data were collected via an online survey distributed on key e-commerce websites and social media platforms. The screening tool was a filter question that ensured respondents had interacted with AI-based customer support systems, chatbots, or recommendation engines during online purchases. A total of 350 responses were received, and 321 were counted after excluding incomplete or inconsistent questionnaires, giving a response rate of around 91.7%. The sample comprised 184 men and 137 women, representing various age groups, educational backgrounds, and income levels. The respondents were selected from different urban centres in Pakistan, including Karachi, Lahore, Islamabad, and Faisalabad, where digital shopping is most prevalent. The sample composition is a valid and contextually relevant study of users of active e-commerce in Pakistan's fast-growing digital market. Table 1 presents the demographic Profile of respondents in general.

Table 1

Demographic Profile of Respondents (n = 321)

Demographic Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	184	57.3
	Female	137	42.7
Age (years)	18–25	121	37.7
	26–35	134	41.7
	36–45	52	16.2
	Above 45	14	4.4
Education Level	Bachelor's Degree	138	43.0
	Master's Degree	116	36.1
	Other (Diploma/PhD, etc.)	67	20.9
Monthly Income (PKR)	Below 50,000	98	30.5
	50,001 – 100,000	142	44.2
	Above 100,000	81	25.2
City/Region	Karachi	96	29.9
	Lahore	83	25.9
	Islamabad	74	23.1
	Faisalabad	68	21.2
AI Experience Type	Chatbots / Virtual Assistants	134	41.7
	Recommendation Systems	117	36.4
	Automated Service Responses	70	21.8

Source: Authors' own analysis, 2025.

The survey instrument used in this study included four major constructs and 19 measurement items, rated on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The constructs were AISQ, DE, CA and CE. Everything was scaled to existing scales, with minor contextual changes to fit the e-commerce context in Pakistan. Five items were modified to assess AISQ, focusing on the reliability, personalisation, responsiveness, and system intelligence of AI-enabled customer service tools. The four items used to measure DE were based on those prepared by Wiyata et al. (2025) and Pizzi et al. (2025) and reflected the respondents' attitudes towards the AI system's emotional understanding, adaptive communication, and responsiveness to customer needs. CA was evaluated using five questions based on the models of Atnam et al. (2025) and Arefin (2025), which focused on attention, dissociation over time, pleasure, and immersion when interacting with AI. Lastly, the measure of CE comprised five questions from Yang et al. (2025) and Pang et al. (2025), covering customers' behavioural, emotional, and cognitive levels of engagement on e-commerce platforms.

Results and Discussion

Common Method Bias Test

Harman's single-factor test was conducted in SPSS version 26.0 to ensure that the results were not influenced by common method bias (CMB). Everything in the four research constructs, AISQ, DE, CA and CE, was input into an unrotated principal component factor analysis. The findings revealed 4 factors with eigenvalues above 1, and the first factor explained 45.72 per cent of the overall variance, which is lower than the recommended 50 per cent by Ma (2024). This suggests that none of the measures was significantly related to the covariance among the other measures, indicating that common method variance was not a major issue in this research. Also, a single-factor model was compared to the proposed multi-factor model (Podsakoff et al., 2003). The single-factor model had low model fit indices ($x2/df = 7.546$; CFI $= 0.721$; TLI $= 0.693$; RMSEA $= 0.08$; SRMR $= 0.069$) that were considerably lower than desired. The results arm this assertion by confirming that the dataset is not subject to severe CMB and the measurement model is able to sufficiently differentiate between the constructs of the study. Hence, CMB cannot be a serious risk to the validity of this study.

Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) in AMOS 26.0 was conducted to assess the reliability and validity of the measurement model before hypothesis testing. The outcomes showed that all standardised factor loadings were significant ($p < 0.01$) and ranged from 0.612 to 0.879, indicating that all observed variables were substantially related to their corresponding latent constructs. This demonstrates good convergent validity and shows that the measurement items reflect the underlying theoretical dimensions. To test the internal consistency of the constructs, Composite Reliability (CR) and Average Variance Extracted (AVE) were computed. The CR values ranged from 0.784 to 0.941, all above the required 0.70 mark, whereas the AVE values ranged from 0.468 to 0.751, all above the required 0.40 mark (Monavvarifard et al., 2019; Naderi et al., 2022).

All latent constructs are reliable and convergent, as these findings verify. Fit to models was also determined by comparing the postulated four-factor baseline model (AISQ, DE, CA, and CE) to alternative models that grouped constructs into fewer factors. The four-factor model fitted the data best ($2 /df = 1.894$; CFI $= 0.962$; TLI $= 0.954$; RMSEA $= 0.058$; SRMR $= 0.037$), which is significantly better than its competitors, three-factor, two-factor, and one-factor models, as shown in Table 2. Moreover, the discriminant validity was determined through the comparison of square root of both AVE and inter-construct correlations of each construct. According to Table 3, the square roots of the AVEs were higher than their respective correlation coefficients, indicating that the constructs were distinct and had different conceptual domains.

Therefore, the obtained CFA findings indicate that the measurement model has a satisfactory level of reliability, convergent validity and discriminant validity.

Table 2.

Model Fit Comparison of Alternative Factor Structures

Model	χ^2	df	χ^2/df	CFI	TLI	RMSEA	SRMR
Four-factor model (AISQ, DE, CA, CE)	284.317	150	1.894	0.962	0.954	0.058	0.037
Three-factor model (AISQ + DE, CA, CE)	601.845	153	3.933	0.879	0.861	0.111	0.082
Two-factor model (AISQ + DE + CA, CE)	817.490	155	5.275	0.823	0.796	0.129	0.103
Single-factor model (All combined)	1265.204	156	8.110	0.702	0.669	0.176	0.142

Source: Authors' own analysis, 2025.

Note: AI-SQ = AI-driven Service Quality; DE = Digital Empathy; CA = Cognitive Absorption; CE = Customer Engagement.

Table 3.

Descriptive Statistics and Correlation Matrix

Construct	Mean (M)	SD	AI-SQ	DE	CA	CE
AISQ	3.782	0.764	0.684			
DE	3.659	0.801	0.573**	0.866		
CA	3.725	0.849	0.482**	0.549**	0.867	
CE	3.614	0.883	0.436**	0.518**	0.493**	0.848

Authors' own analysis, 2025.

Note: N = 321; M = Mean; SD = Standard Deviation; $p < 0.01$ (two-tailed). Diagonal bold values represent the square roots of the AVEs. Off-diagonal values are Pearson correlations among constructs. Source: Authors' own analysis.

Descriptive and Correlation Analysis

Table 3 presents the descriptive statistics and correlations among all the variables in the study. The findings show that AISQ is positively related to DE ($r = 0.573$, $p < 0.01$), CA ($r = 0.482$, $p < 0.01$), and CE ($r = 0.436$, $p < 0.01$). Similarly, DE shows positive relationships with CA ($r = 0.549$, $p < 0.01$) and CE ($r = 0.518$, $p < 0.01$). There is also a positive correlation between CA and CE ($r = 0.493$, $p < 0.01$).

Hypothesis Testing Analysis

The parameters in the mediation model are summarised in Table 4. The findings show that AISQ positively influenced CE at a significant level, hence affirming H1. Besides that, AISQ demonstrated a strong influence on both DE and CA, indicating the preliminary presence of the mediating relationships in H2 and H3. The bootstrapping factor was used to analyse the mediating variables of DE and CA in the research model with 5,000 resamples and 95% confidence intervals (CI) as recommended by Preacher & Hayes (2004). Both indirect paths were computed to get the confidence intervals of the upper and lower limits. The confidence intervals for the two mediating paths, AISQ -DE-CE and AISQ -CA-CE, as shown in Table 5, all contained zero, indicating that both indirect effects were statistically significant. This illustrates the fact that both DE and CA have a big responsibility in mediating the relationship between AISQ and CE. Hence, H2 and H3 are supported. On the whole, these results confirm that AISQ improves customer engagement both directly and indirectly with the help of DE and CA, which is why affective and cognitive mechanisms are important in the prevention of AI-based customer experience. Table 6 presents the results of the research hypothesis.

Table 4.

Results of the Hypothesized Mediating Effects (Coefficients and Standard Errors)

Dependent Variable	Customer Engagement (CE)	Customer Engagement (CE)	Cognitive Absorption (CA)	Digital Empathy (DE)
Independent Variables				
CA	0.187** (0.082)			
DE	0.213** (0.078)			
AISQ	0.298** (0.088)	0.482*** (0.073)	0.491*** (0.069)	0.607*** (0.062)
Gender	-0.132 (0.112)	-0.127 (0.109)	-0.114 (0.101)	0.031 (0.092)
Age	0.097 (0.087)	0.111 (0.091)	0.045 (0.081)	0.069 (0.072)
Education Level	0.089 (0.058)	0.077 (0.061)	-0.026 (0.055)	-0.021 (0.050)
Purchase Frequency	0.106* (0.045)	0.091* (0.043)	0.072* (0.039)	0.059 (0.037)
R^2	0.263	0.152	0.163	0.336
F	10.487	8.316	8.952	22.441

Authors' own analysis, 2025.

Note(s): N = 321; *p < 0.001, p < 0.01, *p < 0.05 (two-tailed test). Non-standardized coefficients are shown in parentheses.

The test results show that Cognitive Absorption (CA) and Digital Empathy (DE) play a significant role in enhancing Customer Engagement (CE). CA has a coefficient of 0.187 ($p < 0.01$) and DE of 0.213 ($p < 0.01$), indicating that cognitive absorption and digital empathy significantly drive increased engagement. Furthermore, AI Service Quality (AISQ) was found to have a positive and significant effect on CE, in both the first model ($\beta = 0.298$; $p < 0.01$) and the second model ($\beta = 0.482$; $p < 0.001$). AISQ also exerts a strong influence on the mediating variables, namely CA ($\beta = 0.491$; $p < 0.001$) and DE ($\beta = 0.607$; $p < 0.001$), thereby indicating the presence of a substantial mediating mechanism in the relationship between AI service quality and customer engagement.

Regarding the control variables, only purchase frequency showed a significant positive influence on CE and CA ($p < 0.05$), whilst gender, age, and educational level were not significant. The coefficient of determination (R^2) values indicate that the model explains 26.3% and 15.2% of the variation in CE, 16.3% in CA, and 33.6% in DE, with all models being significant based on the F-test. Substantively, these findings confirm that AI-based service quality not only has a direct impact on customer engagement but also an indirect one through improvements in users' cognitive and affective aspects, thereby reinforcing the mediating roles of CA and DE in fostering more optimal engagement.

Table 5.

Results of the Analysis of Mediating Effects

	Total effects	BootSE	Unbiased Interval BootLLCI	Confidence BootULCI
Total Effect	0.426	0.081	0.269	0.577
Direct Effect	0.198	0.089	0.024	0.364
Indirect Effects				
AISQ>DE>CE	0.137	0.058	0.031	0.261
AISQ>CA>CE	0.091	0.046	0.017	0.182

Source: Authors' own analysis using bootstrapping with 5,000 samples, 2025.

The bootstrapping mediation analysis (5,000 samples) reveals that AI Service Quality (AISQ) has a significant total effect on Customer Engagement (CE) (β = 0.426; BootSE = 0.081; CI [0.269; 0.577]), while its direct effect remains significant but decreases to 0.198 (BootSE = 0.089; CI [0.024; 0.364]), indicating partial mediation. The indirect effects are also significant, occurring through Digital Empathy (DE) (β = 0.137; CI [0.031; 0.261]) and Cognitive Absorption (CA) (β = 0.091; CI [0.017; 0.182]), with DE demonstrating a stronger mediating role. These findings confirm that AISQ influences customer engagement both directly and indirectly by enhancing users' digital empathy and cognitive involvement.

Table 6.
Research Hypothesis Results

Hypothesis	Effect	Inspection Conclusion
H1: AISQ has a significant positive influence on CE.	Direct effect	Supported
H2: DE mediates the relationship between AISQ and DE.	Indirect effect	Partially supported
H3: CA mediates the relationship between AISQ and CE.	Indirect effect	Partially supported

Source(s): Authors' own creation, 2025.

Discussion

The results of the current research prove that AISQ is a highly effective tool to boost CE in the Pakistani e-commerce market, which can be supported by the idea that, though properly designed AI service systems can allow meeting the functional needs of the target audience, they may also enable establishing valuable emotional and cognitive relationships. This finding aligns with and complements other empirical studies, reinforcing the claim that AI has become an essential source of interaction and devotion in online markets. In particular, the correlation between AISQ and engagement reported in this study is positive, aligning with the findings of Liao (2025), Ma (2024), and Lim et al. (2025), which reported that AI-enabled responsiveness, personalisation, and reliability enhance customer satisfaction and behavioural engagement.

On the same note, Hajar et al (2025) and Somani et al (2025) have written that the perceived intelligence and versatility of AI services form more robust relational relationships, which are also in line with the present findings, where customers react favourably to AI that predicts customer needs and tailors the interactions dynamically. Simultaneously, the current study differs from the concerns expressed by Somani et al. (2025) and Basu et al. (2025), who believed that over-automation could lead to a lack of emotional warmth and human confidence in AI communication. In contrast to such observations, our results show that, in the case of AISA with DE, the emotional difference between humans and machines is considerably reduced. The high mediating power of DE suggests that customer engagement increases when AI systems can understand, be attentive, and respond with the right emotion. It has been helpful in promoting the algorithmic warmth perspective proposed by Pizzi et al. (2025), which holds that empathetic communication in an AI interface contributes to a user's comfort and relational satisfaction. Similarly, Hussain (2025a) found that customer trust and social presence are enhanced by empathetic AI responses, a finding similar to those of the present study and supporting the mediating role of digital empathy in digital contexts.

The second mediator, CA, was also identified as an important pathway between AISQ and CE. Such a result aligns closely with the original theoretical framing and the further elaborations by Ma (2024), Pang et al. (2025), and Lim et al. (2025), who have shown that immersive digital experiences lead to increased focused attention and intrinsic enjoyment, resulting in greater engagement. In the current research, customers who used AI machines that helped them navigate their systems smoothly, offered tailored suggestions, and had fluid interfaces reported being more involved psychologically and having stronger relationship

commitment to the brand. These findings also echo Gong (2025) and Lopes et al. (2025), who proposed that emotional resonance can be achieved only through cognitive immersion in AI environments, further confirming that not only functional utility but also mental and emotional immersion can be catalysed.

By considering all the findings together, this research paper takes a step toward a single explanation of how AISQ determines customer engagement through two interdependent processes: affective empathy and CA. Most past studies tended to separate these constructs and examine emotional or cognitive reactions separately, but this study shows that the two work together. DE also increases perceived relational warmth, and CA maintains attention and flow, which are then combined into a total engagement experience. Unlike Huang et al. (2025) and Wiyata et al. (2025), who place greater emphasis on technological efficiency, the study assumes that emotional and cognitive aspects are dimensions that cannot be overlooked to retain and advocate for customers in AI-mediated settings. In the Pakistani e-commerce context, where AI penetration is rapidly growing yet not yet mature, empathetic and cognitive AI tools can counteract initial customer mistrust of machine-driven services. As Lim et al. (2025) documented, the online merchandising sector in Pakistan had reached USD 7 billion in 2023 due to the influence of online transformation and AI-assisted personalisation. The current results, therefore, have come at the right time, presenting evidence that emotional intelligence and user immersion are crucial for maintaining customer relationships in this new digital economy.

Although previous works have established the importance of AI functionality and trust (Wiyata et al., 2025; Yang et al., 2025; Liao, 2025; Atnan et al., 2025), this study builds on these models by incorporating emotional and psychological mediators within a single explanatory model. It is also the opposite of works such as Matos et al. (2025), which emphasised the potential of AI to minimise the human touch and empirically demonstrated that empathy-driven AI design could overcome this drawback. Thus, the research confirms and fills the gap between theoretical and empirical research in the affective and cognitive perspectives of AI-customer research. Generally, the findings support the notion that AISQ plays a significant role in promoting CE, both directly and indirectly through the mediating variables of DE and CA. These two processes provide a more holistic picture of the customer-AI interaction and show that interaction with AI-based services is not only a matter of technical competence but also of the system's capacity to relate emotionally and to immerse cognitively. The proposed work thus adds a more culturally grounded understanding of how AI can personalise digital commerce, providing strategic advice on the future design, management, and theoretical formulation of AI.

Theoretical Implications

Theoretically, this research contributes to the body of academic research on AI-driven service interactions, as it introduces CATE, TAM and the TCT as a single explanatory framework. Although earlier research has treated AISQ as a technologically oriented construct (Charles et al., 2025), this study's theoretical limitation is that it demonstrates that DE and CA are dual mediating variables between service quality and CE. This two-stream process makes our knowledge of the affective and cognitive aspects of engagement more intuitive – aspects that tend to be examined separately. Besides, the research presents DE as a modern construct, which combines emotional intelligence and AI-human interaction theory. It confirms that the emotional perception of AI systems can be hypothesised as a fundamental antecedent of the quality of relations within digital service settings, thereby expanding the notion of service quality beyond functional excellence to encompass emotional resonance.

Likewise, CA is situated within AI-mediated environments, underscoring its applicability to user immersion and sustained attention in human-computer interaction. The study provides cross-cultural support for the theoretical frameworks, which were mainly developed in the Western context, by empirically validating both constructs in an emerging market such as Pakistan. The combination of such thoughts does help refine the CE literature by suggesting

that technological intelligence alone is not enough; it must be accompanied by affective responsiveness and psychological immersion to induce enduring engagement. The suggested framework, therefore, can serve as a baseline for future studies investigating the interaction between AI capabilities and customer psychology and engagement behaviour across various fields and cultures.

Practical and Managerial Implications

From a managerial perspective, the findings offer actionable insights to e-commerce businesses, digital marketing firms, and service designers working within AI-verified setups. The tremendous direct effect of AISQ on CE underscores the importance of ensuring that organisations invest not only in sophisticated AI technologies but also in humanistic AI design. Employers must focus on implementing systems that can identify customer emotions and tailor reactions and warm conversations to enhance relationship quality. The mediating effect of DE indicates that AI-mediated training to mimic empathy can be achieved by training the systems to use adaptive language, recognise tone, and provide personalised emotional feedback to help the customers trust and feel better. This is why managers are to work on creating AI models, indicating a combination of efficiency and emotional intelligence.

On the same note, the established mediating role of CA points to the necessity of creating immersive online experiences that capture user attention, reduce friction, and prolong their engagement with the system through interactive, personalised interfaces. For practitioners in the Pakistani e-commerce industry, where digital maturity and customer demands are rapidly evolving, the findings can serve as a strategic tool for gaining a competitive advantage. Companies can use AI-based analytics to learn about each user's behaviour, recommend them products according to their unique preferences, and converse with them using emotionally appealing communication patterns. Additionally, by combining empathy-based AI chatbots, reactive recommendation engines, and adaptive visual designs, it is possible to instil trust and attention, resulting in higher purchase intent and customer retention. In the context of a broader managerial perspective, the paper argues that organisations need to align their AI ethics and service design approaches with customer-oriented values to ensure automation does not erode empathy, inclusivity, and transparency. To ensure ethical reliability in automated engagement systems, managers are advised to encourage responsible AI use by ensuring data fairness, mitigating bias and human supervision.

Social and Policy Implications

Socially, the research paper focuses on the importance of empathetic and cognitively stimulating AI systems to increase digital trust and inclusivity in developing economies. By showing that AI improves relations between customers, the study highlights the potential of AI to humanise the digital interaction process and enhance the social aspect of online interactions. In a place such as Pakistan, with lower levels of digital literacy, consumer confidence, etc., empathetic AI design can reduce anxiety about technology, close the digital divide, and encourage more people to participate in the digital economy. On policy grounds, the results would demand the design of national ethics and governance frameworks for AI that promote the inclusion of empathy and human-centred ideals in AI systems. Policymakers ought to develop guidelines that ensure the visibility of AI in customer-facing applications, their explainability, and their fairness. Moreover, investments in AI education and digital upskilling programmes should be made to train the workforce to use emotionally intelligent AI tools. The public-private partnership can also be used to create AI innovation laboratories dedicated to socially responsible, psychologically conscious AI solutions tailored to local markets. Moreover, the policy measures would facilitate data privacy and algorithmic accountability, while protecting consumer privacy without compromising the psychological security of AI communication. Some ethical applications of AI in business and public services should not only improve consumer confidence but also help secure sustainable digital transformation in the sector.

Limitations and Future Research Directions

Despite this study's valuable theoretical and empirical contributions to the relationship between AISQ and CE, mediated by DE and CA, several limitations can be identified. These limitations can be identified, which, in addition to offering transparency, can also create new avenues for future research to build on existing findings. The research used a cross-sectional design, which limits the conclusions and makes it difficult to draw powerful causal inferences about the connections between the variables. Although the findings have shown strong relationships and mediation effects, longitudinal/experimental designs would be more effective for understanding how AI-driven service quality impacts engagement over time, particularly as users become more trusting and conversant with AI technologies. Future research ought to consider longitudinal designs to investigate the persistence or transformation of empathy and CA effects as AI systems continue to develop and customer expectations change.

The research context was also narrowed to the e-commerce industry in Pakistan, which, although it represents other service industries/contexts and is a fast-growing sector, might not be entirely representative. Perceptions of AI and interaction behaviours between customers may differ considerably across banking, healthcare, tourism, and education, and the levels of emotional sensitivity and the frequency of interaction vary. It is recommended that future researchers replicate this study across a variety of industries and countries, especially in regions with different levels of AI maturity, cultural orientations, and digital infrastructure, to ensure the model generalises and is cross-culturally resilient. The research was based on self-reported survey data, which may create CMB and social desirability biases, although statistical tests indicated the bias was within acceptable bounds. Customers may have over- or under-estimated their levels of engagement or their perceptions of AI empathy, either because of their personal expectations or recent events.

Future studies may consider supplementing the survey-based approach with behavioural data – including clickstream analysis, eye-tracking data, sentiment analytics, etc. –to gain a much more objective and dynamic picture of how users emotionally and cognitively react to AI-driven interfaces in real time. DE and CA constructs are both emerging concepts in AI research and consumer behaviour, which are empirically tested in this research. The operationalisation of these constructs may change with the advancement of technology that can simulate more emotional and psychological cues. Further research might improve these metrics by combining methods, such as interviews, experimental manipulations, and AI interaction simulations, to provide a deeper understanding of how empathy and absorption are formed across the various phases of AI-customer interaction.

The study's sample, restricted to online customers in the Pakistani e-commerce industry, may not be representative of future generational and socioeconomic differences in technology adoption and emotional response patterns. Youth consumers might be more cognitively engaged by better digital experiences, whereas older users might respond more to empathetic AI features since they have lower automation trust. This can be utilised in future research to conduct comparative studies of demographic groups to examine the moderating effects of age, gender, digital literacy, and cultural values on the relationships among AISQ, DE, CA, and CE.

Lastly, the results of this research were dedicated to positive engagement outcomes only, and no consideration was given to possible negative impacts of AI interactions, including overuse of automation, emotional burnout, or the lack of privacy due to over-personalisation. Future studies need to consider the positive and negative aspects of AI-mediated engagement to strike a balance between the opportunities for increased satisfaction and loyalty and the risks of digital addiction, algorithmic bias, and a lack of ethical transparency. The discussion of these limitations contributes to the resilience of the theoretical model and to the effectiveness, ethics, and human-centredness of future AI applications within the changing digital economy.

Conclusion

This study provides empirical evidence that AI Service Quality (AISQ) enhances Customer Engagement (CE) both directly and through the mediating roles of Digital Empathy (DE) and Cognitive Absorption (CA). AI services that are accurate, responsive, personalized, and reliable not only fulfill functional expectations but also stimulate emotional and cognitive engagement, increasing trust, satisfaction, and user attachment. Specifically, empathetic AI systems strengthen emotional bonds, while immersive and intuitive interfaces foster deeper cognitive involvement. The findings extend service quality theory into the AI context by emphasizing that CE is driven not only by efficiency but also by emotional and psychological experiences. Practically, organizations should integrate human-like empathy and cognitively engaging design into AI systems to build meaningful, long-term customer relationships and enhance satisfaction, loyalty, and advocacy.

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