

Enhancing Customer Loyalty in E-commerce: The Role of AI Virtual Assistant Service Quality and Mediating Factors¹

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ABSTRACT

Purpose- This study aims to investigate the relationship between customer perceptions of AI virtual assistant service quality and its influence on customer loyalty in the context of e-commerce. The study also examines the sequential mediating role of perceived value, trust, and satisfaction in this relationship.

Design/methodology/approach- A descriptive quantitative research design was employed, and data were collected through an online survey from a sample of 729 e-commerce customers. Structural equation modelling (SEM) analysis was conducted to test the hypothesized relationships.

Findings- The findings indicate that AI virtual assistant service quality significantly influences customer loyalty, perceived value, satisfaction, and trust. Perceived value partially mediates the relationship between service quality and loyalty, as does trust. However, satisfaction does not mediate service quality's influence on loyalty.

Originality- The originality of this study lies in its investigation of the relationship between customer perceptions of AI virtual assistant service quality and customer loyalty in the context of e-commerce. While prior research has explored the influence of service quality on loyalty, this study specifically focuses on AI virtual assistant services, which represent a novel and growing area in customer service. Moreover, this research extends existing knowledge by examining the sequential mediating roles of perceived value, trust, and satisfaction in this relationship. The findings contribute to the originality of this study by providing unique insights into the factors that drive customer loyalty in the context of AI virtual assistant services, offering theoretical and practical implications for businesses operating in the e-commerce industry

Keywords: AI virtual assistant, chatbots, customer experiences, customer loyalty, customer perceptions, e-commerce, human service alternatives, perceived value, satisfaction, service quality, trust.

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1. INTRODUCTION

In the current age, Artificial Intelligence (AI) virtual assistants have significantly transformed e-commerce, revolutionizing customer interactions and service delivery (Lari, Vaishnava, & Manu, 2022; Ntumba, Aguayo, & Maina, 2023). These automated conversational agents have become indispensable tools for businesses, offering constant assistance, scalability, and cost-effectiveness (Babu & Akshara, 2024; Soliman & Al Balushi, 2023).

E-commerce, characterized by the electronic buying and selling of goods and services, has undergone profound transformations owing to AI virtual assistants. Recent data underscores the widespread adoption of these assistants in e-commerce globally (Smith & Johnson, 2023; Wang, Mintz, Chen, & Chen, 2024). According to a Statista (2022) report, over 55% of U.S. consumers prefer online shopping, with a substantial increase in online channel preference in recent years (Statista, 2022). While 76% of consumers are open to AI assistant interactions, satisfaction levels remain varied, highlighting opportunities for improvement in AI-driven customer interactions (White, Habib & Hardisty, 2019).

For instance, Alibaba Group, China's largest e-commerce company, exemplifies the transformative influence of AI on customer service. During its peak event, the Double 11 shopping festival in 2021, Alibaba processed transactions worth 540 billion RMB (approximately US \$85 billion) using AI chatbots, significantly enhancing customer satisfaction and operational efficiency (Wang et al., 2024).

Similarly, Zalando, a leading European online platform, integrates an AI-powered fashion assistant to enhance customer engagement and satisfaction. This technology not only provides personalized recommendations but also improves the overall shopping experience by understanding and responding to specific customer queries (Zalando, 2023).

Even in developing countries, AI is increasingly leveraged to optimize customer service and operational efficiency in e-commerce (Adam, Wessel, & Benlian, 2021; Nguyen & Tran, 2024). This global trend underscores the importance of investigating AI virtual assistant service quality and its implications for customer loyalty (Huang, Markovitch, & Stough, 2024; Niu & Mvondo, 2024).

This study introduces a novel approach through a sequential mediation model, examining how perceived value, trust, and satisfaction mediate the relationship between AI virtual assistant service quality and customer loyalty. Building on the SERVQUAL framework, the study expands with dimensions tailored to AI virtual assistants in e-commerce: availability, consistency, response accuracy, human service alternatives, and personalized recommendations. It aims to provide a comprehensive understanding of AI virtual assistant service quality's influence on customer loyalty, offering theoretical insights and practical implications for e-commerce organizations.

The study is structured as follows: The Literature Review will delve into existing research and identify gaps. The Methodology section will detail the research design and data collection methods. Results and Discussion will present findings on the AI virtual assistant service quality and loyalty relationship. The Implications section will explore theoretical and practical significance, while the Conclusions will summarize findings and suggest future research directions. In an e-commerce landscape shaped by AI virtual assistants, this study aims to serve as a vital resource for businesses and researchers navigating this evolving field.

2. LITERATURE REVIEW

In recent years, advancements in AI technology, have significantly influenced the capabilities of virtual assistants (Hadi, Qureshi, Shah, Irfan, Zafar, Shaikh, & Mirjalili, 2023). This technological leap has not only improved the speed and accuracy of customer interactions but also transformed how businesses engage with consumers in real-time scenarios (Johnson & Smith, 2023).

Understanding consumers' perceptions of AI virtual assistant service quality and its influence on their loyalty is crucial in this dynamic and evolving landscape (Lian & Lian, 2023). The rapid adoption of AI-driven solutions in e-commerce underscores the need to explore how these technologies influence consumer behavior and loyalty (Raji, Olodo, Oke, Addy, Ofodile, & Oyewole, 2024).

The Theoretical Underpinnings of AI Virtual Assistant Service Quality and Customer Perceptions

At the core of this study is the concept of AI virtual assistant service quality, a critical dimension in assessing the performance of virtual assistants. This

multifaceted evaluation hinges on several key criteria (Rane, 2023). AI virtual assistants are expected to provide timely and accurate responses to customer inquiries or requests (Chen, Lu, Gong, & Xiong, 2023). The ability to address customer queries swiftly and precisely is integral to ensuring a seamless and efficient service experience (Cui & van Esch, 2023). Furthermore, AI virtual assistants must demonstrate an aptitude for understanding the unique and specific needs of each customer, tailoring their responses and recommendations accordingly. This personalized touch enhances the overall quality of the service interaction and contributes significantly to customer satisfaction (Jin & Zhang, 2023). Ultimately, it is through these competencies that AI virtual assistants create service experiences that are not only functional but also genuinely satisfying (Li, et al., 2023). The theoretical underpinnings of AI virtual assistant service quality constitute the foundational basis upon which customers form their perceptions of the service. It is crucial to recognize that the quality of these perceptions is intimately intertwined with the actual customer interactions with the virtual assistant, as noted by Noor, Rao Hill, and Troshani (2022). Positive perceptions arise when customers have seamless, efficient, and effective interactions with AI virtual assistant, resulting in heightened satisfaction with the service. These positive perceptions, in turn, are believed to wield substantial influence in the realm of customer loyalty (Sohail, 2022). When customers perceive AI virtual assistant service quality as high and their interactions as positive, they are more inclined to maintain a lasting connection with the e-commerce platform or business, contributing to increased loyalty and the potential for long-term customer relationships (Naqvi, Hongyu, Naqvi, & Kun, 2023).

The SERVQUAL Model: The SERVQUAL model, first formulated by Parasuraman, Zeithaml, & Berry in 1988, is an important theoretical framework in the field of evaluating service quality and customer satisfaction, as recognised by Desai (2023). This model has gained extensive acclaim for its efficacy in assessing service quality across many sectors and circumstances, making it a resilient instrument for both academics and enterprises. The SERVQUAL methodology centrally focuses on conducting a thorough analysis of customer expectations and perceptions on many dimensions of service quality. The dimensions identified are reliability, assurance, tangibles, empathy, and responsiveness. Every one of these factors has an important function in determining the entire consumer experience

and contentment. The model's versatility and durability are seen in its capacity to be used to many circumstances, including its aptness for evaluating the quality of AI virtual assistant services in a nuanced way.

Perceived Value: Perceived value plays a crucial role in establishing a connection between how customers perceive the quality of AI virtual assistant services and their loyalty to e-commerce platforms (Datta & Ghosh, 2022). Perceived value serves as a fundamental bridge in understanding this relationship. It represents the subjective evaluation made by customers when they interact with AI virtual assistant services. According to McHale (2022), perceived value involves customers assessing the benefits they receive against the various costs they incur during their AI virtual assistant interactions. These costs encompass not only monetary expenses but also the time, effort, and potential emotional costs associated with using virtual assistants. To comprehend the significance of perceived value in the context of e-commerce, it's vital to dissect its components. Customers engaging with AI virtual assistants anticipate benefits such as quick and accurate responses, personalized recommendations, efficient issue resolution, and an overall enhanced shopping experience. These elements contribute to the perceived benefits side of the equation (Rane, 2023). Conversely, customers also experience costs during their interactions, which may include frustration due to technical glitches, perceived inefficiency, or concerns about data privacy. Consequently, customers conduct a critical assessment to determine if the perceived benefits outweigh these costs, resulting in a net perceived value that shapes their satisfaction and decision-making (Agnihotri & Bhattacharya, 2023; Kaushal & Yadav, 2023). The nexus between perceived value and customer loyalty to e-commerce platforms, as elucidated by Risnaldi and Prasetya (2023), is a central aspect of this discussion. When customers perceive a high level of value in their AI virtual assistant interactions on a specific platform, their loyalty to that platform tends to strengthen significantly. Satisfied customers are not only more likely to revisit the platform for future purchases but may also become advocates, spreading positive word-of-mouth, and potentially attracting new customers. Recognizing and actively working to enhance this perceived value can thus be a strategic imperative for e-commerce businesses, resulting in increased customer satisfaction, loyalty, and competitiveness in the marketplace.

Trust: Trust is a fundamental element in understanding the dynamics of customer loyalty within the e-commerce realm (Al-hujri & Keshavrao, 2025). It plays a pivotal role in shaping the foundation of customer loyalty. Customer trust in the quality of AI virtual assistant services relies on key factors such as reliability, security, and the virtual assistant's ability to effectively meet customer needs, as outlined in Fickers' study (2023). Trust, a multifaceted concept, acts as a critical link connecting perceived value and customer loyalty. For customers to trust the AI virtual assistant and, consequently, the e-commerce platform, they must believe in the virtual assistant's dependability, security, and capability to fulfill their requirements. This trust forms the vital foundation upon which customers build their overall perception of the virtual assistant service and the platform. Essentially, trust serves as a bridge, connecting customer perceptions to their loyalty (Rawashdeh, 2024). In practical terms, when customers trust the AI virtual assistant to provide reliable and secure assistance while meeting their needs, they are more likely to perceive higher value in the service. This trust alleviates concerns and uncertainties, enhancing the overall customer experience (Chen et al., 2023). Consequently, this positive perception of both the virtual assistant and the e-commerce platform strengthens customer loyalty. Trust, therefore, operates as a cornerstone that not only underpins the quality of AI virtual assistant interactions but also acts as a catalyst in fostering enduring loyalty, ultimately benefiting e-commerce businesses in an increasingly competitive marketplace.

Satisfaction: Customer satisfaction is a pivotal component in understanding customer loyalty across various service scenarios, including e-commerce, as supported by Dasoomi, Naderan, and Allahviranloo (2023). In the context of AI virtual assistant service quality, customer satisfaction serves as the channel through which trust influences loyalty dynamics. This interplay among trust, satisfaction, and loyalty illuminates the intricate dynamics within the realm of AI virtual assistants in e-commerce. Hsu and Lin (2023) argued that customer satisfaction reflects the extent to which customer expectations are met during interactions with the virtual assistant, indicating how well it aligns with their requirements and preferences. Satisfied customers signal that their trust in the virtual assistant's reliability, security, and capability to meet their needs has been validated. Satisfaction plays a crucial role in connecting the dots between trust and customer loyalty, as emphasized by Bhatnagar (2022). It is through satisfaction that the

influence of trust on customer loyalty becomes tangible (Rezeki, Majid, & Kassim, 2023). When customers trust the virtual assistant, they are more confident in engaging with it, and this trust, validated through satisfactory interactions, strengthens their loyalty to the e-commerce platform.

Expanding the SERVQUAL Model: While the SERVQUAL model is widely respected for its theoretical robustness, it has its drawbacks and criticisms. One significant concern pertains to the accuracy and reliability of the scale itself. The subjective nature of customer expectations and perceptions can pose challenges in obtaining precise and consistent measurements. Additionally, the model's universal applicability across diverse service situations and cultures has been questioned. Cultural variations in customer expectations can render the model less effective in some contexts. Moreover, the dynamic nature of customer expectations and preferences presents an ongoing challenge. The SERVQUAL model may not adequately capture the evolving landscape of customer service experiences as elucidated by Ali, Jusoh, Idris, Nor, Wan, Abbas, and Alsharif (2023), Gupta (2022), & Jusufbašić and Stević (2023). To address these limitations, researchers have proposed modifications to the SERVQUAL model, tailoring it to better suit specific service contexts and industries (Tadeo, Mendoza, & Pichay, 2023). By adapting the SERVQUAL model to the particulars of the service industry being studied, researchers can address some of the limitations associated with its generic framework, ultimately enhancing its effectiveness in evaluating service quality and customer satisfaction.

Expanding the Model for AI virtual assistants in E-commerce: In this study, the author suggests adding five more dimensions to the SERVQUAL model to assess the efficacy of AI virtual assistants within the realm of e-commerce. The aspects included are "Always Available," "Consistency," "Accuracy of Response," and "Availability of Human Service Alternatives." The dimensions are derived from study results on the capabilities and limitations of AI virtual assistants in e-commerce environments, as well as consumer expectations and preferences.

The "Always Available" dimension of AI virtual assistant service quality pertains to the virtual assistants' capacity to be easily available and provide support to clients at any given moment, irrespective of their geographical location. This dimension prioritises the aspects of ease, accessibility, responsiveness, and

dependability (Weurlander, 2023). In the realm of e-commerce, where consumers have the freedom to buy at any given moment, it is crucial for AI virtual assistants to be always accessible to provide support whenever clients want it (Magno & Dossena, 2023).

The "Consistency" dimension of AI virtual assistant service quality reflects the degree of uniformity and standardization in the service provided across different situations and interactions. Consistency ensures that customers receive a consistent and reliable experience regardless of the complexity of their queries, technical factors, or environmental influences (Chen, et al., 2023; Rossmann, Zimmermann, & Hertweck, 2020). The "Accuracy of Response" dimension of AI virtual assistant service quality measures how well virtual assistants provide correct and relevant information and solutions to customers. Accuracy of response directly affects the quality, effectiveness, satisfaction, and trustworthiness of the service (Magno & Dossena, 2023).

The "Availability of Human Service Alternatives" dimension of AI virtual assistant service quality refers to the option for customers to switch to human service providers when necessary or preferred. This dimension enhances flexibility, adaptability, empathy, and assurance (Li & Zhang, 2023). Customers may require human interaction for more complex queries or for emotional or social reasons. Xu, Liu, Guo, Sinha, and Akkiraju (2017) compare virtual assistants and humans and mention the availability of human service alternatives as an advantage of human customer service.

The "Personalized Recommendation" dimension of AI virtual assistant service quality refers to the extent to which virtual assistants provide customized and tailored suggestions and advice based on customers' preferences, needs, and behavior. This dimension enhances the value, attractiveness, satisfaction, and loyalty of the service. In e-commerce settings, customers often seek guidance in making purchase decisions and appreciate personalized offers and promotions (Remountakis, Kotis, Kourtzis, & Tsekouras, 2023; Taufique & Mahiuddin Sabbir, 2023).

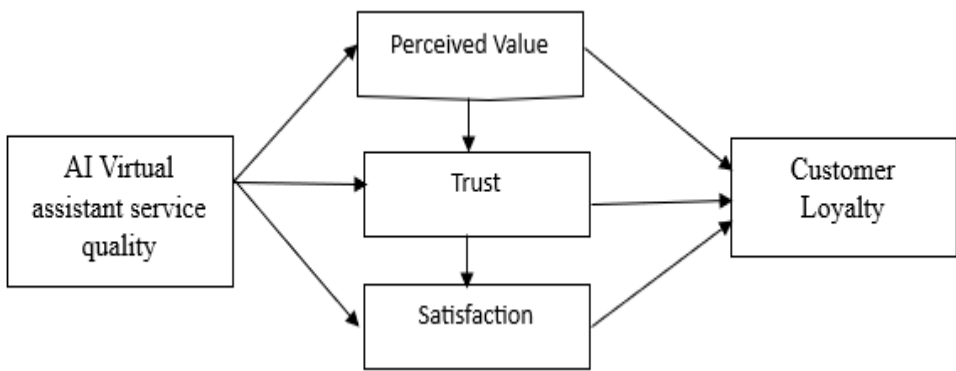


Figure 1: Conceptual Framework

This literature review emphasizes the importance of understanding customer perceptions of AI virtual assistant service quality and its influence on customer loyalty in the e-commerce industry. It also highlights the theoretical constructs of perceived value, trust, and satisfaction as key factors in this relationship. The hypotheses of this study, presented below, provide a comprehensive framework for understanding the dynamics of customer loyalty in the era of AI virtual assistants and e-commerce.

Hypotheses

- H1:** There is a positive and significant influence of AI Virtual Assistant service quality on Customer Loyalty in the context of e-commerce.
- H2:** AI Virtual Assistant service quality positively influences Perceived Value in the context of e-commerce, as customers perceive higher service quality to offer greater value.
- H3:** AI Virtual Assistant service quality positively influences Satisfaction in the context of e-commerce, indicating that higher service quality leads to increased customer satisfaction.
- H4:** AI Virtual Assistant service quality positively influences Trust in the context of e-commerce, suggesting that better service quality enhances customer trust in the virtual assistant.
- H5:** Perceived Value positively influences Customer Loyalty in the context of e-commerce, indicating that customers who perceive higher value from AI virtual assistant interactions are more likely to exhibit loyalty.

- H6:** Perceived Value positively influences Trust in the context of e-commerce, suggesting that perceived value enhances customer trust in the virtual assistant.
- H7:** Trust positively influences Customer Loyalty in the context of e-commerce, indicating that customers who trust the AI virtual assistant are more likely to exhibit loyalty.
- H8:** Trust positively influences Satisfaction in the context of e-commerce, suggesting that higher levels of trust lead to increased customer satisfaction with the virtual assistant.
- H9:** Satisfaction positively influences Customer Loyalty in the context of e-commerce, indicating that satisfied customers are more likely to exhibit loyalty.

Mediation Hypotheses

- H10:** Perceived Value mediates the relationship between AI Virtual Assistant service quality and Customer Loyalty in the context of e-commerce, suggesting that perceived value plays a significant role in translating service quality into loyalty.
- H11:** Satisfaction mediates the relationship between AI Virtual Assistant service quality and Customer Loyalty in the context of e-commerce, indicating that satisfaction acts as a mediator between service quality and loyalty.
- H12:** Trust sequentially mediates the relationship between AI Virtual Assistant service quality and Customer Loyalty, first mediating with Trust and then Satisfaction, in the context of e-commerce.
- H13:** Satisfaction mediates the relationship between Trust and Customer Loyalty in the context of e-commerce, suggesting that satisfaction mediates the influence of trust on loyalty.
- H14:** Perceived Value sequentially mediates the relationship between AI Virtual Assistant service quality and Customer Loyalty, first mediating with Trust and then Satisfaction, in the context of e-commerce.

- H15:** Perceived Value sequentially mediates the relationship between AI Virtual Assistant service quality and Customer Loyalty, first with Perceived Value, then Trust, and finally Satisfaction, in the context of e-commerce.
- H16:** Trust mediates the relationship between AI Virtual Assistant service quality and Customer Loyalty in the context of e-commerce, suggesting that trust acts as a mediator between service quality and loyalty.
- H17:** Trust mediates the relationship between Perceived Value and Customer Loyalty in the context of e-commerce, indicating that trust mediates the influence of perceived value on loyalty.
- H18:** Perceived Value sequentially mediates the relationship between AI Virtual Assistant service quality and Customer Loyalty, first with Perceived Value, then Trust, in the context of e-commerce.
- H19:** Trust mediates the relationship between AI Virtual Assistant service quality and Satisfaction in the context of e-commerce, suggesting that trust acts as a mediator between service quality and satisfaction.
- H20:** Trust mediates the relationship between Perceived Value and Satisfaction in the context of e-commerce, indicating that trust mediates the influence of perceived value on satisfaction.
- H21:** Perceived Value sequentially mediates the relationship between AI Virtual Assistant service quality and Satisfaction, first with Perceived Value, then Trust, in the context of e-commerce.
- H22:** Perceived Value mediates the relationship between AI Virtual Assistant service quality and Trust in the context of e-commerce, suggesting that perceived value mediates the influence of service quality on trust.

3. METHODS

This study employed a quantitative research approach. The participants in this study were selected using a convenience sampling method. The sample comprised 729 customers in Egypt who had previously interacted with AI virtual assistants during their e-commerce experiences. The sample size was determined based on Watson (1982) formula:

$$n = \frac{Z^2 * p * (1 - p)}{e^2} = \frac{(1.96)^2 * 0.5 * (1 - 0.5)}{0.05^2} = 385 < 729$$

A structured questionnaire was developed to collect data from the participants. Demographic questions were included in the questionnaire to gather information on gender, age, academic experience, occupation, and income. The measurement items were adapted from validated and tested scales employed in previous studies. Participants were asked to rate their responses on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

AI virtual assistant service quality was assessed through five dimensions: (1) Always available was adapted from the work of Venkatesh, Zhang, and Sykes (2011); (2) Consistency, derived from Alge (2001); (3) Accuracy of response, adapted from Mayer and Davis (1999); (4) Availability of human service alternatives, based on the research by Furneaux and Wade (2011); and (5) Personalized recommendation, which drew from Zhang, Agarwal, and Henry (2011). The Perceived Value construct was adapted from the framework proposed by Sweeney and Soutar (2001). To measure Trust, the items employed in this study were adapted from the works of Komiak and Benbasat (2006) and Stewart and Gosain (2006). The measurement items for Satisfaction were derived from the research conducted by Fang, Qureshi, Sun, McCole, Ramsey, and Lim (2014). Lastly, the construct of Customer Loyalty in this study was adapted from the work of Harris and Goode (2004).

A pilot study was conducted to assess the feasibility and validity of the research methods and techniques selected for the study. It involved 30 respondents to ensure the practicality and effectiveness of the chosen approaches and identify any potential challenges. Following that, the survey was distributed online using Google Forms.

For the study, descriptive statistics were obtained using SPSS. Structural equation modelling (SEM) was employed to test the proposed sequential mediation model.

4. RESULTS

4.1 Descriptive Analysis

Table 1: Frequency Table for Demographic Variables

Variable	Categories	Frequency	Percentage
Gender	Female	317	43.5
	Male	412	56.5
Age	21-30	327	44.9
	31-40	203	27.8
	41-50	125	17.1
	Over 50	74	10.2
Academic Experience	High School	11	1.5
	Bachelor's degree	670	91.9
	Postgraduate Degree	48	6.6
Occupation	Private Organization	302	41.4
	Public Organization	300	41.1
	Business Owner/ Self Employed	127	17.4
Income	<10,000	129	17.7
	10,000-20,000	213	29.2
	20,000-30,000	275	37.7
	>30,000	112	15.4

Source: Calculations based on sample collected through surveys using SPSS software

The sample consisted of 412 females and 317 males, with most respondents falling into the age range of 21-30, accounting for 44.9% of the sample (327 individuals). A smaller proportion, 27.8% of the sample (203 individuals), were aged between 31-40. Individuals over 50 years old represented 10.2% of the sample (74 individuals), while those aged between 41-50 made up 17.1% (125 individuals). In terms of academic qualifications, most of the sample, 91.9% (670 individuals), held bachelor's degrees, while only 6.6% (48 individuals) held postgraduate degrees. Regarding occupations, 41.4% of the respondents were employed in private organizations (302 individuals), 41.1% were employed in public organizations (300 individuals), and 17.4% were business owners (172 individuals). Approximately

67% of the sample reported an income level between 10,000-30,000 (488 individuals), while 17.7% had an income less than 10,000 (129 individuals).

4.2 Confirmatory Factor Analysis (CFA)

Table 11: Model Measurements of the Phenomenon

Variables	Components	Loadings	Outer VIF	CA	CR	AVE
AI Virtual Assistant Service Quality	AI1	0.739	2.390	0.905	0.920	0.515
	AI2	0.875	2.425			
	AI3	0.868	2.842			
	AI4	0.706	2.539			
	AI5	0.788	2.418			
	AI6	0.779	1.611			
	AI7	0.776	2.209			
	AI8	0.586	1.939			
	AI9	0.730	1.416			
	AI10	0.713	2.128			
	AI11	0.790	2.710			
Perceived Value	PV1	0.812	2.554	0.885	0.908	0.527
	PV2	0.657	1.773			
	PV3	0.725	2.985			
	PV4	0.558	1.593			
	PV5	0.765	2.867			
	PV6	0.669	1.700			
	PV7	0.826	3.410			
	PV8	0.788	2.621			
	PV9	0.693	1.731			
Loyalty	CL1	0.816	3.097	0.926	0.936	0.530
	CL2	0.778	2.398			
	CL3	0.693	2.057			
	CL4	0.756	2.308			
	CL5	0.695	1.988			
	CL6	0.730	2.277			
	CL7	0.683	2.116			
	CL8	0.741	2.093			
	CL9	0.646	2.111			
	CL10	0.658	2.130			
	CL11	0.751	2.349			
	CL12	0.754	2.337			
	CL13	0.746	2.159			
Trust	T1	0.753	1.747	0.857	0.894	0.586
	T2	0.829	2.988			
	T3	0.798	3.049			
	T4	0.777	2.134			
	T5	0.627	1.650			
	T6	0.794	2.015			
Satisfaction	S1	0.761	1.611	0.866	0.910	0.716
	S2	0.866	2.265			
	S3	0.886	2.675			
	S4	0.866	2.523			

Source: Calculations based on sample collected through surveys using SmartPLS

To mitigate the potential issue of common method bias, the full collinearity approach was utilized in this study. The Variance Inflation Factors (VIFs) were calculated, and the results indicated that common method bias was not a significant concern (Shrestha, 2020).

To assess the reliability and validity of the measurement instrument, Confirmatory Factor Analysis (CFA) was conducted. The Cronbach alpha coefficients were computed, and the values obtained exceeded the threshold of 0.7, indicating satisfactory reliability. Additionally, Composite Reliability (CR) and Average Variance Extracted (AVE) were assessed, and both measures surpassed the recommended thresholds, demonstrating adequate construct validity, as suggested by Ribeiro, Vicente, Sousa, Teles, Trindade, Martins, and Cardoso (2021).

Table III: Fornell-Larcker Criterion for Measuring Discriminant Validity

	AI Virtual Assistant Service Quality	Customer Loyalty	Perceived Value	Satisfaction	Trust
AI Virtual Assistant Service Quality	0.718				
Customer Loyalty	0.597	0.728			
Perceived Value	0.707	0.624	0.726		
Satisfaction	0.723	0.539	0.648	0.846	
Trust	0.708	0.519	0.550	0.720	0.766

Source: Calculations based on sample collected through surveys using SmartPLS

Discriminant validity was examined using the Fornell-Larcker criterion. The square root of AVE for each construct exceeded the correlation coefficients with other constructs, further confirming discriminant validity (Afthanorhan, Ghazali, & Rashid, 2021). The results of the Fornell-Larcker criterion are presented in Table III.

4.3 Structural Equation Modelling (SEM)

To examine the relationships depicted in Figure I, SEM was employed. The loadings of the statements were found to be greater than 0.6, indicating that the variables can be measured properly (Cui, Wang, Chen, Wen, & Han, 2021).

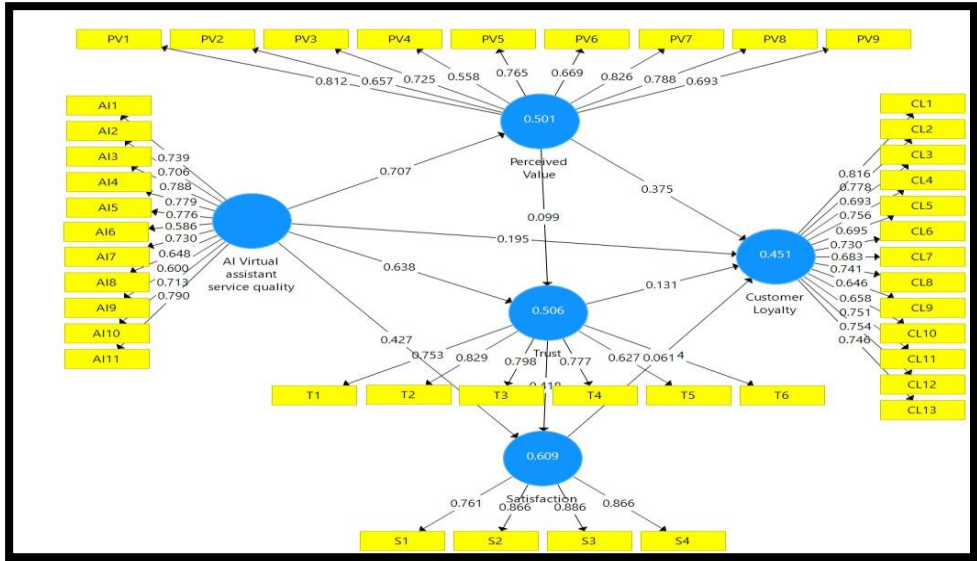


Figure II: Structural Equation Model for Phenomenon

Table IV: Path Coefficients of the Model

	Hypothesis	Original Sample	Standard Deviation	P Values	Result of Hypothesis Testing
H1	AI Virtual assistant service quality -> Customer Loyalty	0.195	0.049	0.000	Accepted
H2	AI Virtual assistant service quality -> Perceived Value	0.707	0.022	0.000	Accepted
H3	AI Virtual assistant service quality -> Satisfaction	0.427	0.033	0.000	Accepted
H4	AI Virtual assistant service quality -> Trust	0.638	0.036	0.000	Accepted
H5	Perceived Value -> Customer Loyalty	0.375	0.046	0.000	Accepted
H6	Perceived Value -> Trust	0.099	0.041	0.016	Accepted
H7	Trust -> Customer Loyalty	0.131	0.049	0.008	Accepted
H8	Trust -> Satisfaction	0.418	0.035	0.000	Accepted
H9	Satisfaction -> Customer Loyalty	0.061	0.052	0.246	Rejected
	Mediating Influences				
H10	AI Virtual assistant service quality -> Perceived Value -> Customer Loyalty	0.265	0.034	0.000	Accepted
H11	AI Virtual assistant service quality -> Satisfaction -> Customer Loyalty	0.026	0.023	0.259	Rejected
H12	AI Virtual assistant service quality -> Trust -> Satisfaction -> Customer Loyalty	0.016	0.014	0.244	Rejected
H13	Trust -> Satisfaction -> Customer Loyalty	0.025	0.022	0.243	Rejected

	Hypothesis	Original Sample	Standard Deviation	P Values	Result of Hypothesis Testing
H14	Perceived Value -> Trust -> Satisfaction -> Customer Loyalty	0.003	0.003	0.327	Rejected
H15	AI Virtual assistant service quality -> Perceived Value -> Trust -> Satisfaction -> Customer Loyalty	0.002	0.002	0.328	Rejected
H16	AI Virtual assistant service quality -> Trust -> Customer Loyalty	0.083	0.032	0.010	Accepted
H17	Perceived Value -> Trust -> Customer Loyalty	0.013	0.008	0.086	Accepted
H18	AI Virtual assistant service quality -> Perceived Value -> Trust -> Customer Loyalty	0.009	0.005	0.091	Accepted
H19	AI Virtual assistant service quality -> Trust -> Satisfaction	0.266	0.025	0.000	Accepted
H20	Perceived Value -> Trust -> Satisfaction	0.042	0.018	0.019	Accepted
H21	AI Virtual assistant service quality -> Perceived Value -> Trust -> Satisfaction	0.029	0.013	0.020	Accepted
H22	AI Virtual assistant service quality -> Perceived Value -> Trust	0.070	0.029	0.017	Accepted

Source: Calculations based on sample collected through surveys using SmartPLS

The findings presented in Table IV demonstrate the significant positive influence of AI Virtual assistant service quality on Customer loyalty, Perceived Value, Satisfaction, and Trust ($\beta=0.195$, 0.707 , 0.427 , and 0.638 , respectively) at a 99% confidence level. Additionally, Perceived Value was found to have a significant positive influence on both Customer loyalty and Trust ($\beta=0.375$ and 0.099 , respectively) at a 99% confidence level. Trust, in turn, had a significant positive influence on Customer loyalty and Satisfaction ($\beta=0.131$ and 0.418 , respectively) at a 99% confidence level. However, Satisfaction was found to have an insignificant influence on customer loyalty.

Regarding the mediating influences, Perceived Value was identified as a partial mediator between AI Virtual assistant service quality and Customer loyalty, as well as between AI Virtual assistant service quality and Trust, with a significance level of 99%. Trust was also observed to be a partial mediator between AI Virtual assistant service quality and Customer loyalty. Furthermore, Trust was found to mediate the relationship between AI Virtual assistant service quality and Satisfaction, as well as between Perceived Value and Satisfaction, at a 99%

confidence level. However, Satisfaction was not found to mediate the relationship between AI Virtual assistant service quality and Customer loyalty. Additionally, Trust and Satisfaction were not identified as mediators between AI Virtual assistant service quality and Customer loyalty. Satisfaction did not act as a mediator between Trust and Customer Loyalty. Neither Trust nor Satisfaction served as double mediators between Perceived Value and Customer loyalty. Moreover, Perceived Value, Trust, and Satisfaction were not found to mediate between AI Virtual assistant service quality and Customer loyalty. Trust did not mediate between Perceived Value and Customer loyalty. Lastly, Perceived Value and Trust were not identified as mediators between AI Virtual assistant service quality and Customer loyalty, as their p-values exceeded 0.05.

Table V: Model Evaluation Metrics

Dependent Variables	SSO	SSE	Q ²	R Square	R Square Adjusted
Customer Loyalty	9477.000	7302.630	0.229	0.451	0.448
Perceived Value	6561.000	4860.812	0.259	0.501	0.500
Satisfaction	2916.000	1652.669	0.433	0.609	0.608
Trust	4374.000	3109.515	0.289	0.506	0.505

SRMR=0.084, d_ ULS=6.606, d_ G=3.333, Chi-Square=10966.652, NFI=0.589

Source: Calculations based on sample collected through surveys using SmartPLS

As presented in Table V, the model accounted for 44.8% of the variance in Loyalty, 50.0% in Perceived Value, 60.8% in Satisfaction, and 50.5% in Trust. These percentages indicate a substantial portion of the variation explained by the model. Furthermore, based on the criteria established by Hair, Hult, Ringle, Sarstedt, and Thiele (2017), the goodness-of-fit indices (Q₂ and SRMR) supported a favourable fit of the model to the data, suggesting that the proposed model adequately captured the relationships among the variables.

5. DISCUSSION

The findings of the study show that customer loyalty is significantly positively influenced by the quality of AI virtual assistant services. This result aligns with earlier research that has demonstrated how customer loyalty is shaped by the quality of the services provided (Biscaia, Yoshida, & Kim, 2023; Theodorakis, Alexandris, Tsigilis, & Karvounis, 2013). Consumers are more likely to grow in confidence and happiness with AI virtual assistant services, which will boost their

loyalty to the e-commerce platform. Moreover, perceived value was found to be positively influenced by the quality of the AI virtual assistant service, which corresponds with earlier work that emphasises the relevance of perceived value in the customer decision-making process (Aditi, Nabella, Djakasaputra, & Haryani, 2023; Marcos & Coelho, 2022). Customers are more likely to adopt favourable opinions of the e-commerce platform and show higher levels of loyalty when they believe that AI virtual assistant services are beneficial. Furthermore, it has been revealed that customer satisfaction is positively influenced by the quality of AI virtual assistant services. This finding is in accordance with past research that has demonstrated the link between service quality and customer satisfaction (Ayinaddis, 2022). Clients who are happy with the e-commerce platform's AI virtual assistant services are more inclined to stick around and make more purchases. Furthermore, findings demonstrate that AI Virtual assistant service quality positively influences trust. This result is consistent with the literature on trust in the context of e-commerce and technology-based services (Amarullah, Handriana, & Maharudin, 2022; Yang, Van Ngo, & Nguyen, 2024). Trust plays a crucial role in building strong customer relationships and fostering loyalty. When customers trust the AI Virtual assistant services, they are more likely to rely on the platform and develop long-term loyalty. Additionally, the study confirms that perceived value has a positive influence on customer loyalty. This finding is supported by previous research that has shown the significance of perceived value in predicting customer loyalty (Aditi et al., 2023; Marcos & Coelho, 2022). Customers who perceive high value in the AI Virtual assistant services are more likely to exhibit loyalty towards the e-commerce platform. Moreover, results reveal that trust positively influences customer loyalty. This finding is consistent with the existing literature on the importance of trust in driving customer loyalty (Amarullah et al., 2022; Yang et al., 2024). Trust acts as a foundation for building and maintaining strong relationships with customers, leading to increased loyalty.

However, it is worth noting that the direct relationship between satisfaction and customer loyalty was not significant. This finding is somewhat unexpected, as previous research has consistently demonstrated a positive link between customer satisfaction and loyalty (Ayinaddis, 2022). One possible explanation for this result could be the mediating influences of other variables, such as trust and perceived value, which may weaken the direct influence of satisfaction on loyalty. In terms

of the mediating influences, the findings partially support the proposed mediating pathways. Specifically, the mediating influence of perceived value in the relationship between AI Virtual assistant service quality and customer loyalty was significant. This result is consistent with the theoretical framework proposed by Marcos and Coelho (2022) and highlights the importance of perceived value as a mechanism through which service quality influences loyalty. However, the mediating influences involving trust, satisfaction, and customer loyalty were not statistically significant. This finding deviates from previous studies that have suggested the mediating role of trust and satisfaction in the relationship between service quality and customer loyalty (Amarullah et al., 2022; Yang et al., 2024). It is possible that other factors not considered in this study may be influencing these relationships, and further research is needed to explore these complex mediating pathways.

6. IMPLICATIONS

6.1 Theoretical Implications

The results of this study have significant theoretical implications. By identifying specific dimensions of AI virtual assistant service quality, such as "Always Available," "Consistency," "Accuracy of Response," "Availability of Human Service Alternatives," and "Personalized Recommendation," the study offers a comprehensive framework for evaluating and enhancing the quality of AI virtual assistant services. These dimensions provide a detailed understanding of the specific aspects that customers value in their interactions with AI virtual assistants, which can guide future research and inform the design of effective AI virtual assistant systems. Moreover, the study highlights the mediating role of perceived value in the relationships between AI virtual assistant service quality and customer loyalty, as well as between AI virtual assistant service quality and trust. This finding enhances the understanding of the underlying mechanisms through which AI virtual assistant service quality influences customer loyalty and trust, emphasizing the importance of customers' perceived value in shaping their attitudes and behaviours toward e-commerce platforms. Additionally, the study underscores the significance of trust as a key driver of customer loyalty and satisfaction in AI virtual assistant interactions, aligning with the broader literature on trust in e-commerce contexts. Interestingly, the study challenges the conventional view that satisfaction

directly leads to loyalty. It reveals that satisfaction has an insignificant influence on customer loyalty in the context of AI virtual assistant service quality, suggesting that other factors, such as trust and perceived value, may have a stronger influence on customer loyalty in AI virtual assistant interactions. This finding calls for a re-evaluation of the role of satisfaction and its measurement in the context of AI virtual assistant services, highlighting the need to explore alternative drivers of customer loyalty.

6.2 Practical Implications

The findings of this study have practical implications for e-commerce businesses seeking to enhance customer loyalty through AI virtual assistant services. E-commerce businesses should focus on improving the dimensions of AI virtual assistant service quality, including "Always Available," "Consistency," "Accuracy of Response," "Availability of Human Service Alternatives," and "Personalized Recommendation." This can be achieved through continuous monitoring and training of AI virtual assistant systems, ensuring prompt and accurate responses, and providing personalized recommendations based on customer preferences. Moreover, to enhance the perceived value of AI virtual assistant services, businesses should strive to deliver tangible benefits to customers. This can be achieved by offering personalized and relevant recommendations, providing quick and accurate information, and ensuring the availability of human service alternatives when needed. Clear communication of the value proposition of AI virtual assistant services can also help in enhancing perceived value. Building trust in AI virtual assistant services should be a priority for e-commerce platforms. This can be achieved by ensuring transparency in AI virtual assistant interactions, maintaining data privacy and security, and providing reliable and consistent service. Offering clear channels for human service alternatives, when necessary, can also help in building trust. Regular communication and feedback mechanisms can also contribute to fostering trust with customers. While customer satisfaction is important, businesses should recognize that it may not have a direct influence on customer loyalty in the context of AI virtual assistant service quality. Instead, businesses should focus on providing a comprehensive customer experience that emphasizes trust, perceived value, and other relevant dimensions of AI virtual

assistant service quality. By prioritizing these factors, businesses can create a positive and engaging experience that fosters customer loyalty.

7. CONCLUSION

This research aimed to explore the relationship between customer perceptions of AI virtual assistant service quality and customer loyalty in the e-commerce context. The study examined various dimensions of AI virtual assistant service quality, including "Always Available," "Consistency," "Accuracy of Response," "Availability of Human Service Alternatives," and "Personalized Recommendation," to gain a comprehensive understanding of how AI virtual assistant service quality influences customer loyalty. Data was collected through an online questionnaire from a representative sample of 729 e-commerce consumers, and smart PLS was employed to investigate and validate the hypothesized relationships among the variables of interest.

The findings of this study contribute to the existing knowledge by shedding light on the factors that influence customer loyalty in the realm of AI virtual assistant services. The results revealed a significant influence of AI virtual assistant service quality on customer loyalty, perceived value, satisfaction, and trust. The dimensions of AI virtual assistant service quality, such as availability, consistency, accuracy of response, availability of human service alternatives, and personalized recommendation, emerged as crucial factors in shaping customer perceptions and experiences. Perceived value was identified as a partial mediator between AI virtual assistant service quality and customer loyalty, as well as between AI virtual assistant service quality and trust. Trust was also found to mediate the relationship between AI virtual assistant service quality and customer loyalty and satisfaction. Interestingly, satisfaction did not have a significant influence on customer loyalty within the context of AI virtual assistant service quality.

These findings underscore the importance of enhancing AI virtual assistant service quality, perceived value, and trust-building factors to foster customer loyalty in e-commerce settings. However, it is important to acknowledge the limitations of this study. The use of an online questionnaire may introduce response bias, and the generalizability of the results may be limited to the specific context of e-commerce customers in Egypt. Future research could address these limitations and further contribute to the field by employing mixed-method approaches.

Combining qualitative interviews or focus groups with quantitative surveys could provide deeper insights into customer perceptions and experiences with AI virtual assistants. This approach would allow for a more comprehensive understanding of the factors influencing customer loyalty across different demographic and behavioral segments. Moreover, while this study focused exclusively on e-commerce customers, it would be beneficial to explore the applicability of these findings in other industries and service contexts. Research in sectors such as healthcare, finance, and education could explore how AI virtual assistants influence customer loyalty and satisfaction differently, considering the unique dynamics of each industry. By expanding the scope of research methodologies and exploring diverse industry contexts, future studies can enrich the understanding of AI virtual assistant service quality and its implications for customer relationships and loyalty.

Finally, this research study contributes to the understanding of the relationship between customer perceptions of AI virtual assistant service quality and customer loyalty in e-commerce. By examining different dimensions of AI virtual assistant service quality and investigating mediating variables such as perceived value, trust, and satisfaction, this study provides valuable insights into the factors influencing customer loyalty in the realm of AI virtual assistant services. While the study has its limitations, further research can address these constraints and expand knowledge in this emerging field.

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تعزيز ولاء العملاء في التجارة الإلكترونية: دور جودة خدمة المساعد الافتراضي بالذكاء الاصطناعي والعوامل الوسيطة

د. دينا الشحي

ملخص البحث باللغة العربية

الهدف: تهدف هذه الدراسة إلى التحقيق في العلاقة بين تصورات العملاء حول جودة خدمة المساعد الافتراضي بالذكاء الاصطناعي وتأثيرها على ولاء العملاء في سياق التجارة الإلكترونية. كما تتناول الدراسة الدور الوسيط المتسلسل للقيمة المدركة، والثقة، والرضا في هذه العلاقة.

التصميم/المنهجية/النهج: تم اعتماد تصميم بحثي كمي وصفي، وجمعت البيانات من خلال استبيان عبر الإنترنت من عينة مكونة من 729 عميلاً في التجارة الإلكترونية. تم إجراء تحليل نموذج المعادلات الهيكلية (SEM) لاختبار العلاقات المفترضة.

النتائج: تشير النتائج إلى أن جودة خدمة المساعد الافتراضي بالذكاء الاصطناعي تؤثر بشكل كبير على ولاء العملاء، والقيمة المدركة، والرضا، والثقة. تلعب القيمة المدركة دور الوسيط الجزئي في العلاقة بين جودة الخدمة والولاء، وكذلك الثقة. ومع ذلك، لا يتوسط الرضا تأثير جودة الخدمة على الولاء.

الأصالة: تكمن أصالة هذه الدراسة في التحقيق في العلاقة بين تصورات العملاء حول جودة خدمة المساعد الافتراضي بالذكاء الاصطناعي وولاء العملاء في سياق التجارة الإلكترونية. بينما تناولت الأبحاث السابقة تأثير جودة الخدمة على الولاء، تركز هذه الدراسة تحديداً على خدمات المساعد الافتراضي بالذكاء الاصطناعي، والتي تمثل مجالاً جديداً ومتنامياً في خدمة العملاء. علاوة على ذلك، توسع هذه الدراسة المعرفة الحالية من خلال فحص الأدوار الوسيطة المتسلسلة للقيمة المدركة، والثقة، والرضا في هذه العلاقة. تسهم النتائج في أصالة الدراسة من خلال تقديم رؤى فريدة حول العوامل التي تدفع ولاء العملاء في سياق خدمات المساعد الافتراضي بالذكاء الاصطناعي، مما يقدم دلالات نظرية وعملية للشركات العاملة في قطاع التجارة الإلكترونية.

الكلمات الدالة: المساعد الافتراضي بالذكاء الاصطناعي، الدردشة الآلية، تجارب العملاء، ولاء العملاء، تصورات العملاء، التجارة الإلكترونية، بدائل الخدمة البشرية، القيمة المدركة، الرضا، جودة الخدمة، الثقة.

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