Customer Engagement with Perceived Digital Servitization: An Empirical Investigation

Shuwen Huang

Guangdong polytechnic of industry and commerce, Guangzhou, 510510, China

150440253@qq.com

Abstract. This study examines how businesses can boost customer engagement and loyalty amidst market competition and digital change. It explores the impact of perceived digital servitization on brand loyalty through customer engagement, considering factors like product involvement, perceived value, and self-consistency. The research used surveys and statistical analysis on mobile consumers, finding that product involvement, perceived value, and self-consistency positively influence customer engagement, affecting loyalty. The study suggests that enhancing Perceived digital servitization can strengthen customer engagement and loyalty, offering insights for market strategies.

Keywords: engagement; involvement; perceived value; loyalty; digital servitization.

1   Introduction

In the digital era, enterprises are facing unprecedented challenges, especially in the context of rapidly changing economic environments and increasingly fierce market competition. More and more companies are realizing that their biggest challenge is not creating high-quality products or attracting customers, but maintaining a high level of engage with their customers. Customer engagement (CE) has received rapidly growing practitioner and researcher interest in the past decade[1,2].

Here, CE has been demonstrated to lead to higher sales, a stronger competitive edge, and lower costs.[3].CE not only reflects the stability of the relationship between the enterprise and customers, but also an important indicator for building brand loyalty. With the acceleration of digital transformation, the relationship between customer engagement and brand loyalty has become increasingly close, which requires us to deeply understand the role of digital service perception in this relationship.

Perceived digital servitization(PDS)refers to consumers' overall evaluation of the quality and effectiveness of digital services provided by enterprises.The concept of PDS is frequently linked to the principle of sustainability, among other related ideas[4,5,6]. In the current wave of digital transformation, companies are increasingly enhancing the value of their products and services through digital servitization. However, according to the provided literature, there is a lack of research focusing on con-

sumers' perception of the digital servitization offered by businesses. Consumer perception is crucial for companies because it directly affects their satisfaction, willingness to purchase, and loyalty to the brand. In the context of digital servitization, consumers expect more personalized, efficient, and convenient service experiences. Therefore, businesses need to gain a deep understanding of consumers' perception of these new types of services in order to better meet their needs and expectations.In the theory of Self-consistency, individuals tend to establish connections with brands that are consistent with their self-concept, while the service-dominant logic emphasizes the central role of services in creating value. This study integrates these two theories to construct a theoretical conceptual model aimed at deeply analyzing how the perception of digital servitization shapes customers' comprehensive evaluation of the brand and their loyalty.

The study systematically explores the key factors driving customer engagement from three dimensions: product involvement, customer perceived value, and self-consistency. Product involvement reflects the degree to which consumers care about a product based on personal needs, values, and interests. The notion of customer-perceived value encompasses the comprehensive assessment made by customers regarding the usefulness of products or services as they engage with a company's offerings. Self-consistency refers to the degree to which customers compare their own external and behavioral cognition with the product or brand image. These three dimensions jointly affect customer engagement, influencing the relationship between customers and the company.

In addition, the study also focuses on analyzing how the perception of digital servitization regulates the dynamic relationship between customer engagement and brand loyalty. Brand loyalty is the emotional commitment and preference of customers for the company's products or services, as well as the intention to maintain relationships and repurchase. The perception of digital servitization plays a mediating role in this process, affecting not only customers' loyalty to the brand but also regulating the relationship between customer engagement and brand loyalty.In the digital era, businesses must understand that customer engagement, shaped by both emotional and rational experiences, is crucial for fostering loyalty. Actions that enhance these experiences indirectly shape consumer loyalty[7].

Therefore, this paper's exploration of the relationships between the driving factors of customer engagement product involvement, customer perceived value, and self-consistency and the moderating variable of digital service perception, as well as its outcome variable of loyalty, holds theoretical significance. The theoretical and empirical findings of this study can provide new perspectives and directions for other scholars' research. In terms of practical significance, understanding the factors that influence customer engagement and viewing the connection and interaction between customers and companies from the customer's perspective is of great practical guidance for companies in formulating market strategies. This understanding offers tangible strategies for acquiring new customers and retaining existing ones.

2   Conceptual Framework and Hypotheses Development

In the context of the digital economy, customer engagement has become a key factor for enterprises to gain competitive advantage. Before proposing its own research model, this study conducted a literature review on the core variable of customer engagement and the relationship between influencing factors such as product involvement, customer perceived value, self-consistency, and loyalty. In addition, this study also explored the moderating effect of perceived digital servitization on customer engagement and loyalty, in order to find supporting theories for the model from previous research results.

2.1   Product Involvement and Customer Engagement

Product Involvement refers to the level of personal interest and investment that consumers have in a particular product or product category. Scholarly evidence has established a notably strong and affirmative correlation between the depth of consumer engagement with a product and their choices to make purchases. Liu and Lu have formulated a theoretical framework that examines the interplay between customized intelligent suggestions, the extent of product engagement, and the decisions consumers make on online retail platforms[8]. Their empirical study dissected how customized intelligent suggestions influence consumer purchasing behavior. The findings revealed that both customized recommendations and the level of product engagement positively and significantly sway consumer decisions to buy, with product engagement acting as a mediator in the relationship between the recommendations and purchasing actions[9]. Vivek and colleagues have also highlighted that the degree of customer engagement is affected by their vested interest and attention to the product[10].

Therefore, we propose hypothesis H1: Product involvement has a positive impact on customer engagement.

2.2   Perceived Value and Customer Engagement

Perceived Value, which is a personal assessment of the merits of a product or service relative to its price, is widely acknowledged for its role in shaping customer engagement[11]. This includes the practical, experiential, and social merits and serves as a key forecaster of consumer actions. It markedly affects the loyalty of customers and their tendency to spread positive word-of-mouth, possibly acting as an intermediary between the quality of service and these actions. Research indicates that in China's predominantly mobile market, amplifying the perceived value from a brand's social media presence can notably increase customer contentment and strengthen brand loyalty[12]. Individuals who see greater value in their digital interactions with a brand are more likely to participate, illuminating the powerful connection between the perception of value and customer engagement[13].

Therefore, we propose hypothesis H2: Customer perceived value has a positive impact on customer engagement.

2.3   Self-Consistency and Customer Engagement

Self-consistency refers to the degree of consistency between an individual's self-concept and a product or brand. The self-consistency theory suggests that when a product or brand aligns with a consumer's self-concept, it is more likely to generate positive purchasing behavior. Self-consistency in customer engagement is crucial; tailored participation strategies based on customers' self-regulation states enhance satisfaction[14].

Therefore, we propose hypothesis H3: self-consistency has a positive impact on customer engagement.

2.4   Loyalty and Customer Engagement

Loyalty is the degree of loyalty and support that customers have towards a brand or enterprise, and is one of the results of customer engagement. Strong customer engagement fosters deeper loyalty through enhanced brand relationships and positive experiences[15]. And higher levels of engagement often lead to increased customer loyalty through more meaningful brand interactions[16].The relationship between customer engagement and loyalty is also the focus of this study. Vivek et al. found that customer engagement has a positive impact on loyalty[17].

Therefore, we propose hypothesis H4: Customer engagement has a positive impact on loyalty.

2.5   The Regulatory Role of Perceived Digital Servitization(PDS)

In the era of the digital economy, digital servitization has become an essential strategy for enterprises to enhance product value and strengthen customer engagement and loyalty. Digital servitization refers to enterprises providing services through digital means to increase the value of their products. Heiko G. et al. proposed that digital servitization integrates servitization and digitization, reflecting the shift from product to service, customers' demand for advanced services, and improved experiences through complex solutions[18]. This transformation involves the application of technology and how enterprises can enhance interaction and value co-creation with customers through service ecosystems. Simonsson and Agarwal's study suggests that individual entrepreneurial orientation (IEO) influences customer perceived value in providing digital service-oriented products, while functional subordination does not have a significant effect[19]. This indicates that digital servitization may enhance customers' perception of product value, thereby strengthening customer engagement and loyalty. Paiola, M believes that digital servitization is the process by which businesses provide value-added services through digital technology, which can change consumers' perception of the brand and potentially enhance brand loyalty [20]. This further confirms the crucial role of digital service-oriented perception in improving customer experience and satisfaction. Tronvoll, B. Research suggests that companies can achieve a shift from product-centric to service-centric through digital servitization,

which requires strategic organizational transformation to meet consumers' expectations for digital services and enhance customer engagement[21].

Therefore, this study proposes hypothesis H5: Perception of digital servitization has a moderating effect on the relationship between customer engagement and loyalty, and customer engagement has a positive impact on loyalty. The higher the perception of digital servitization, the stronger the positive impact, and vice versa.

In summary, this study found through literature review that product involvement, customer perceived value, and self-consistency are important factors affecting customer engagement, and customer engagement is an important predictor of loyalty. Meanwhile, the perception of digital servitization may play a moderating role between customer engagement and loyalty (Fig.1). These findings provide a solid theoretical foundation and support for the theoretical model constructed in this study.
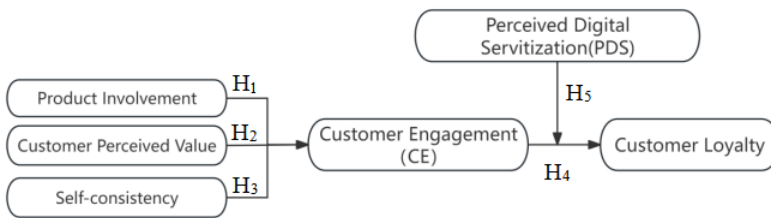

Fig. 1. Research model

3   Measures

3.1   Sample and Data Collection

This study focuses on the consumer group in the mobile phone market in China and collects data through a large-scale questionnaire survey. After the questionnaire design was completed, it was distributed through a combination of online and offline methods, and a total of 328 questionnaires were collected. After screening the collected questionnaires, some incomplete or obviously arbitrary responses were excluded, resulting in 306 valid questionnaires with an effective response rate of 93.29%.

In the valid sample, the gender distribution is relatively balanced, with males accounting for 44.4% and females accounting for 55.6%. The age distribution is mainly between 18-30 years old, accounting for 79.6% of the total sample, indicating that young consumers are the main consumer group in the mobile phone market. The education level is mainly undergraduate, accounting for 59.9%, indicating that the sample group has a high level of education. In terms of occupational distribution, students have the highest proportion at 35.2%, followed by private enterprise employees and government employees. The monthly income is mainly concentrated in two ranges: below 5000 RMB and 5001-8000 RMB, accounting for 48.2% and 36.3% respectively. In terms of mobile phone brand usage, Huawei and Apple have the highest number of

users, accounting for 25% and 23.6% respectively, demonstrating the strong position of these two brands in the market.

3.2   Variable Measurement

The variables involved in this study include product involvement, customer perceived value, self-consistency, loyalty, customer engagement, and perceived digital servitization. All variable measurements are adapted or directly used based on existing mature scales, ensuring the reliability and effectiveness of the measurements.

This study adopts quantitative research methods, collects data through questionnaire surveys, and defines and measures key variables in an operational manner.

4   Data Analysis

4.1   Reliability and Validity Analysis

4.1.1 Reliability Analysis.

This study used multiple authoritative scales to validate the internal consistency of product involvement, customer perceived value, self-consistency, loyalty, customer engagement, and digital service perception scales through Cronbach's alpha coefficient. The reliability levels ranged from good to excellent, as shown in Table 1:

Table 1. Reliability analysis results of each dimension

Variables	Items	Cronbach' s α
Product involvement	I1~I5	0.697
Perceived Value	V1~V6	0.873
Self-consistency	S1~S4	0.909
Loyalty	L1~L3	0.728
Customer engagement	CE1~CE10	0.835
Perceived digital servitization	PDS1~PDS5	0.802

4.1.2 Validity Analysis.

This study uses a combination of content validity and construct validity to test the validity of the article.

1. Content validity

The purchase measurement of this research questionnaire is based on existing scales developed by scholars. The three dimensions of product involvement are measured using a combination of Zaichkowski (1985) and Strazzier (1994) scales. The three dimensions of customer perceived value are measured using scales designed by Kantameni&Coulson (1996), Parasuraman (2000), and Sweeney&Soutar (2001). Self-consistency was calculated using the Sirgy&Su (2000) scale. Loyalty is measured using the scales developed by Zeithaml et al. (1996) and Du Jiangang and Fan Xiucheng (2001). The scale used for the perception of digital service is proposed by

Bharadwaj & Venkatraman (2013). Finally, customer engagement was measured using Vivek's (2010) scale. The question combines the research results of previous scholars, including literature and scales. After being screened and revised by experts, this scale has a considerable degree of content validity.

2. Construct validity

Construct validity is the validation of whether a test truly measures the theoretical construction, that is, the extent to which the test can measure the theory or concept. Nunnally (1978) suggested that the factor loading must be greater than 0.4 in order to have high construct validity. This study will conduct confirmatory factor analysis (CFA) in the next section to test its validity.

4.2   Structural Equation Modelling (SEM)

This section will conduct structural equation modeling using the LISREL statistical software, primarily consisting of confirmatory factor analysis and path analysis, to verify the validity of the data collected by this questionnaire and to support the operation of the model. It will also explore the impact of driving factors such as product involvement, customer perceived value, and self-consistency on customer engagement, as well as the influence of customer engagement on loyalty. Additionally, hierarchical regression analysis will be performed using SPSS to investigate the moderating role of Perception digital service(PDS) needs.

Assumption of structural path for research architecture:

H1: Product involvement has a positive impact on customer engagement

H2: Customer perceived value has a positive impact on customer engagement

H3: Self-consistency has a positive impact on customer engagement

H4: Customer engagement has a positive impact on loyalty

Structural equation modeling generally consists of two parts: measurement equation and structural equation.

4.2.1 Confirmatory Factor Analysis, CFA.

This study will first analyze from the following two parts:

1. Preliminary fit criteria. The basic fitting degree standard is used to detect errors in patterns, identification or input errors, etc. The inspection indicators are that the measurement error cannot have negative values, it needs to reach a significant level, the factor load range is 0.4 or above, and the standard error value cannot be too large. This study first established a measurement model using SIMPLIS, and then performed fitting. Based on the basic fitting degree index, the CE2 measurement term with a factor load of only 0.11 (which made me unhappy using the phone) was discarded, and then re fitted. The results of the new measurement model show that all the measurement indicators of its various facets meet the standard, and the measurement error is not negative. Therefore, the measurement model is displayed, assuming that the model has reached the basic fitting standard.

2. The overall pattern fitting degree of the model. When the overall fit index is close to or meets the standard, it indicates that the model fit of this study is acceptable, and both the internal and external quality of the model have reached a certain standard.

After removing exogenous indicators that do not meet the factor load requirements, this study obtained a new hypothesis model with a chi square value of 805.97 and a degree of freedom of 317. Through calculation, it can be seen that the ratio of the chi square value to the degree of freedom of the hypothesis model is about 2.54, which is mainly based on the non-linear relationship between chi square and degree of freedom. After the two are combined, they form a linear relationship. The general rule is that a ratio of 2:1 or 3:1 is an acceptable indicator of fit, but it is generally considered desirable to be below 5. Therefore, this value indicates that the hypothesis model has a good fit. The root mean square RMSEA value of the approximation error is 0.074, which is within 0.08, indicating an acceptable fit. The comparative fitting index CFI is 0.97, which is greater than 0.9, indicating a very good fit between the hypothesis model theory and the data. Similarly, the Tucker Lewis index TLI is 0.97, which is greater than 0.9, indicating a good fit of the model. The standard fitting index NFI is 0.95, which is higher than the NFI index of 0.9, indicating a good fit of the model. But the goodness of fit index GFI is only 0.83, and the adjusted goodness of fit index AGFI is only 0.79, both lower than the indicator 0.9, indicating poor model fit. Based on the LISREL analysis results and the correction coefficients provided in Table 4-6, the null hypothesis model has been revised. According to the principle of structural equation modeling correction, M The maximum value of I begins to increase in the path correction model. By adding three paths, the modified model has a chi square value of 783.06 and df of 316. The ratio of chi square value to degrees of freedom is 2.48, which is lower than 3 and lower than the null hypothesis model of 2.54. In addition, compared with the null hypothesis model, the RMSEA is 0.072, which is smaller than the null hypothesis model. The fitting degree of the modified model is better than that of the null hypothesis model. In addition, the AGFI is 0.8, although still lower than the indicator of 0.9, it is already higher than the null hypothesis model. So after correction, the fitting degree of the structural model is better. The specific indicators and hypothesis model fitting degree are shown in Table 2, Table 3.

Table 2. Assuming model correction

	M.I
CE10→Loyalty	9.62
Perceived Value→Loyalty	8.95
I5→Perceived Value	8.45

Table 3. Comparative analysis of measurement models

Model fitting degree	Evaluation Criteria	Hypothetical Model	Corrected Model
Chi-square / df	<5	2.54	2.48
RMSEA	<0.08	0.074	0.072
CFI	>0.9	0.97	0.97

FLI	>0.9	0.97	0.97
NFI	>0.9	0.95	0.95
GFI	>0.9	0.83	0.83
AGFI	>0.9	0.79	0.80

Prior to conducting structural equation modeling analysis, conducting correlation analysis between variables using SPSS can provide strong support for hypotheses. According to Table 4 it can be seen that there is a significant positive correlation between product involvement, customer perceived value, self-consistency, and customer engagement, and there is also a significant positive correlation between customer engagement and loyalty. Therefore, so far, based solely on the results of the correlation analysis, the above hypotheses are all valid.

Table 4. Correlation matrix between variables

Variables	Mean	1	2	3	4	5
1.Product involvement	3.94	1				
2.Perceived Value	3.73	0.514**	1			
3.Self-consistency	3.59	0.423**	0.614**	1		
4.Customer engagement	3.44	0.570**	0.653**	0.639**	1	
5.Loyalty	3.38	0.386**	0.639**	0.571**	0.753**	1

N=284;**p<0.01

4.2.2 Model Hypothesis Testing.

After verifying the fit of the model and the correlation between variables, the structural equation model was run. The criterion for determining whether the regression coefficient is significantly different from zero in structural equation modeling techniques is the t-test value. When the absolute value of the t-test value is greater than the critical criterion of 1.96, the regression coefficient can be considered to have a significant difference from zero at the significance level (Hou Jietai, Wen Zhonglin&Cheng Zijuan, 2004). The results are shown in Table 5:

Table 5. The structure model results

Path relationships	Coefficients	S.E	T-value
Product involvement→CE	0.36***	0.09	4.08
Perceived Value→CE	0.31***	0.09	3.37
Self-consistency→CE	0.31***	0.08	3.84
CE→Loyalty	0.78***	0.14	5.63
Perceived Value→Loyalty	0.42*	0.09	2.29

N=284,*p<0.05   **p<0.01   ***P<0.001

According to Table 5, the following conclusions can be drawn from the results of the structural equation:

Product involvement (β=0.36, t=4.08, p<0.001), customer perceived value (β=0.31, t=3.37, p<0.001), and self-consistency (β=0.31, t=3.84, p<0.001) all significantly and positively correlate with customer engagement, supporting H1, H2, and H3, respec-

tively. The relationship between customer engagement and loyalty is also strongly positive (β=0.78, t=5.63, p<0.001), validating H4. Additionally, customer perceived value has a significant positive impact on loyalty (β=0.42, t=2.29, p<0.001).

4.3 Hierarchical Regression Analysis

Hypothesis on the regulatory effect of research architecture:

H5: Perception digital service(PDS) has a moderating effect on the relationship between CE and loyalty, and CE has a positive impact on loyalty. The higher the PDS, the stronger the positive impact, and vice versa.

According to Table 6, PDS has a moderating effect on the relationship between CE and loyalty. After verification, in this regression model, CE has a significant positive correlation with loyalty (β=0.933***, p=0.000), which further confirms H4. From the data analysis of the regression model, it can be seen that the interaction between CE and PDS is significantly positively correlated with loyalty (β=0.137 *, p=0.021), and the regression model has R2=0.576, Δ R2=0.571, F-value=126.765, p=0.000, which is also significant. Therefore, it can be inferred that PDS has a moderating effect on the relationship between CE and loyalty. Therefore, hypothesis H5 holds true. Fig.2 shows results of hypotheses testing.

Table 6. The regulatory role of PDS

Independent variable	β value	S.E	T-values	p-value	Model evaluation
Constant	0.137	0.184	0.749	0.454	R^2=0.576
CE	0.933***	0.052	17.943	0.000	ΔR^2=0.571
PDS	0.004	0.045	0.088	0.930	F value=126.765
CE*PDS	0.137*	0.059	2.323	0.021	P=0.000

Dependent variable:Loyalty;N=284,*p<0.05   **p<0.01   ***P<0.001
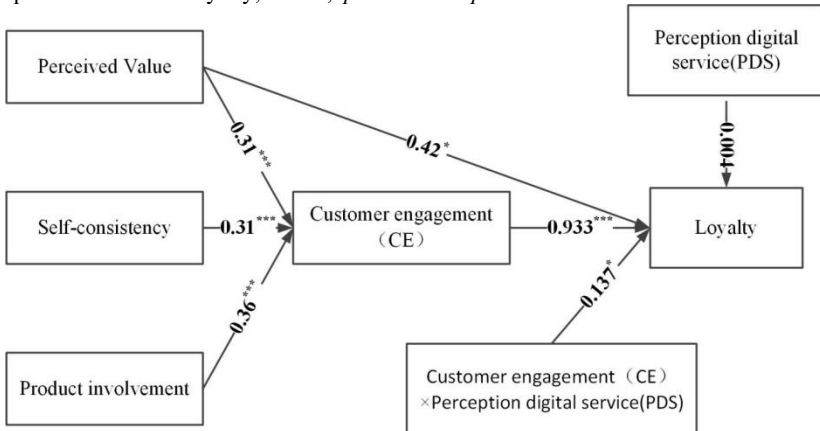

Fig. 2. The structure model results.

5   Discussion and Implications

5.1   Conclusion

This study focuses on consumers in the mobile phone market and uses empirical research methods to explore in depth the impact of product involvement, customer perceived value, and self-consistency on customer engagement, as well as the moderating effect of digital service perception on the relationship between customer engagement and loyalty. The research results provide important insights into understanding and improving customer engagement, thereby enhancing customer loyalty.

The main conclusions are as follows:

1. Product involvement has a significant positive impact on customer engagement. The higher the level of consumer concern for the product, the higher the interaction and participation with the brand, thereby enhancing customer engagement.

2. Customer perceived value has a significant positive impact on customer engagement. When customers perceive that the value brought by the products or services provided by a company exceeds their efforts, they are more willing to interact with the company, thereby improving customer engagement.

3. Self-consistency has a significant positive impact on customer engagement. The consistency between brand image and customer self-image can promote a close connection between customers and the brand, enhancing customer engagement.

4.customer engagement has a significant positive impact on loyalty. The closer the connection between customers and enterprises, the higher their participation and loyalty to the brand.

5.The level of perceived digital servitization significantly moderates the positive correlation between customer engagement and loyalty. Specifically, when customers perceive a high level of service digitization, the positive impact of customer engagement on loyalty is significantly enhanced; On the contrary, when the perceived level of digital servitization is low, the positive effect of customer engagement on loyalty is relatively weakened.

This discovery emphasizes the strong demand of customers for personalized experiences and customized services in the digital environment. Customers are increasingly expecting highly personalized and innovative service experiences through digital platforms, which not only meet their basic needs but also enhance their satisfaction and loyalty.

5.2   Managerial Implications

CE has been cited as the source of competitive advantage (Kumar & Pansari, 2016).This research scale can provide insights into how customers' level of connection and participation in the products, services, or activities provided by the company is influenced by their level of interest in the product, perceived value of the product or activity, and the degree of consistency between the company's brand image and its own image. Enterprises will make strategic adjustments based on the degree of impact.

The research results reveal that the higher the customer's attention and interest in the product or related information, the more actively they participate in purchasing the company's products and services, and the closer their connection with the company. Therefore, companies should conduct market research to gain a deeper understanding of consumer needs and interests, design products that meet consumer expectations, enhance product attractiveness, and thus increase consumer engagement. At the same time, companies need to enhance customer engagement by providing high-quality products and services to ensure that the perceived value of customers exceeds the cost they incur. This means that companies not only need to make customers perceive the advantages in product quality and functionality, but also strive to create the emotional and social value of their products.

In addition, when customers perceive a high degree of consistency between the company's brand image and their own image, they will participate or purchase the company's products, services, or activities with a more positive attitude. Therefore, when conducting market promotion or advertising activities, enterprises should target the target consumer group, shape and convey a brand image that matches the target group's image, in order to attract consumers. For example, in the promotion of the sports car market, a brand image full of personality, vitality, passion, and coolness should be created to meet the psychological expectations of the target consumers. Enterprises should also strengthen interaction and communication with customers, and enhance customer engagement and fit through social media, customer relationship management, and other means. At the same time, enterprises must attach great importance to the digital service strategy, recognizing that digital service is not only a channel for providing products and services, but also a key to enhancing customer loyalty. In a fiercely competitive market, enterprises should actively invest in digital technology, optimize customer experience, and ensure that digital services can meet customers' pursuit of personalization and uniqueness, thereby enhancing customer engagement, strengthening customer loyalty, and achieving success in the digital economy.

This study provides a new perspective for understanding the formation mechanism and influencing factors of customer engagement, which has important theoretical and practical significance for enterprises to formulate effective customer relationship management strategies. Future research can further explore the formation and impact mechanisms of customer engagement in different industries and market environments, providing more specific guidance for business practices.

5.3   Limitations and Future Research Directions

This study aims to be rigorous and objective in terms of literature review, research methods, data collection, and statistical analysis. However, there are still many areas that need improvement and elaboration. Therefore, this section will propose some limitations in the study and provide some suggestions for future researchers, hoping to serve as a reference for future research.

5.3.1 Research Limitations.

This study, while innovative, has limitations due to research conditions and time constraints, including a narrow focus on mobile phone users, limited literature on customer engagement, potential cultural bias in translated questionnaires, and a less rigorous Likert scale. The sample size of 306 is also restrictive.

5.3.2 Subsequent Suggestions.

In the digital age, the relationship between customer engagement and digital service perception will be a hot research topic. How to use digital technology to better improve customer engagement is worth further research. They might also test various models to understand changing digital age behaviors. This study, focusing on the mobile market, could be expanded to other sectors like FMCG and services. Using a seven-point Likert scale could enhance survey rigor.

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