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The influence of e-commerce seller reverse logistics quality on customer loyalty: The mediating role of customer experience and perceived value

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Abstract: In the era of highly competitive e-commerce business, the quality of reverse logistics plays an important role in customer experience and customer loyalty. This research aimed to study the relationship between reverse logistics quality, customer experience, value perception, and customer loyalty by collecting data from 400 consumers who have experience in purchasing and returning products via e-commerce platforms. The data analysis used the Structural Equation Modeling (SEM) technique. The results of the hypothesis testing found that the quality of reverse logistics has no direct effect on customer loyalty, but it has an indirect effect through the mediating variables: customer experience and value perception. In addition, the analysis results indicated that the quality of reverse logistics has a significant positive effect on customer experience and perceived value, whereby customers who have a good experience in returning products are more likely to perceive the value of the service and be more loyal to the seller. These findings suggest that sellers should focus on improving the reverse logistics process to be transparent, convenient, and less disruptive to customers to enhance their competitiveness in the e-commerce market.

Keywords: *Customer experience, Customer loyalty, E-commerce, Reverse logistics, value perception.*

1. Introduction

In the period of unprecedented growth and the competitive landscape for e-commerce, the competition of sellers not only lies in fast and reliable delivery but also reverse logistics management, namely, the efficient return process to the seller and the ability to meet customer needs properly [1, 2]. The scientific community has invested much research in e-commerce systems, as returns were a key aspect of success for enhancing customer satisfaction and long-term relationships, where customers anticipate transparent, convenient and lengthy return services [3]. Proper reverse logistics management not only increases the confidence of a customer over the entire trading process but also assists in improving the image of the seller in the online market. And yet, the reverse logistics services portfolio has limitations and gaps on every research aspect in study, especially when it comes to call upon the consolidated effects such as customer satisfaction, customer experience, as well as customer loyalty. Such gaps are significant issues, as having a complete understanding of these factors can enable e-commerce companies to provide better return processes and gain a more competitive position in a highly competitive market [2]. Hence, studying this issue is needed and can create long-term value for both the sellers and customers.

A good reverse logistics service impacts on the quality of customer experience, which is a critical factor influencing customer loyalty. For example, customers assess their return experience in terms of the ease-of-processing of their return/replacement, the information transparency provided throughout the process, and the capability to effectively address and resolve the challenges process [4]. When a customer finds the return process friendly and simple, they are more likely to trust and form a long-

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term association with the seller. But it is because customer expectations are growing in a very competitive e-commerce space that businesses must evolve their returns processes to satisfy hybrid and digital needs. For example, using digital technology to deliver up-to-date status notifications can minimize mistakes as well as give assurance to customers at all stages of the return process [5]. Most of the existing research examined overall logistics service quality and customer satisfaction, but limited studies have focused on reverse logistics quality and how it affects customer experience, particularly regarding its perceived value [6, 7]. Therefore, it is imperative to help e-commerce businesses to develop processes to meet the needs of customers and make them more loyal, in a highly competitive market.

Besides the reasons previously mentioned, the quality of reverse logistics is also directly associated with the customer opinion of value, specifically in terms of value creation, which is a significant factor that influences customer perception regarding their trust and repurchase behavior. Customers deem reverse logistics quality as worthy once it fulfills their expectations in different dimensions, including fast and seamless processing, fair prices and other value-added services, like avoiding having to provide information or collecting items directly from customers' circulation [6]. Such value-added services not only lessen the difficulty of providing a return process but also create a positive experience that helps earn the trust of customers in the long term. Nevertheless, previous studies have shown significant gaps in research regarding the role played by intermediate variables, such as customer experience and perceived value, that can mediate the relationship between reverse logistics quality and customer loyalty [8]. This differentiation is crucial as it delineates the path through which reverse logistics quality translates into purchasing behavior and ultimately the customer-seller relationship over time. Nonetheless, when it is directed to e-commerce in Thailand, there is not much research on identifying how reverse logistics quality can be improved so that the realization of service that really meets customer needs can be achieved. Hence, large-scale and comprehensive investigations into such issues are necessary for the enhancement of competitiveness and better customer experience in an uncompetitive market.

Hence, this study aims to analyze reverse logistics quality, customer experience, value perception, and customer loyalty by developing a conceptual framework to gather all the essential dimensions that can address the research gaps in the context of e-commerce in Thailand. The importance of this research lies in the fact that reverse logistics quality is a crucial factor in selling, which can help the seller create a competitive third-party differentiation in a competitive market. The purpose of this research is not only to study how reverse logistics quality influences customer satisfaction, but also to try to connect complex variables such as customer experience and perceived value Jain, et al. [9] which may be significant influences of customer loyalty. It also enables the sellers to make a clear distinction between good customer experience and good value perception to ensure that the reverse logistics product return is managed in an efficient way to cater to customer expectations. By investigating the efficacy of long-term relationships, this research helps sellers build their competitiveness in the competitive e-commerce marketplace, thereby ensuring their future business success [9].

2. Literature Reviews

2.1. E-Commerce Seller Reverse Logistics Quality

The reverse logistics process of a seller refers to the process of efficiently managing returns, exchanges, and refunds to customers [7, 10, 11]. The process of reverse logistics for an online seller is important in terms of customer experience and loyalty. These factors assist customers in obtaining accurate and complete details about return conditions, such as return periods, fees, processing procedures, based on the volume of communication and information. Effective and transparent answers to questions can mitigate negativity and increase trust [1, 2, 12]. It is also a reflection of return processing efficiency that enhances the quality of the return process. Transparent processes, for instance, convey timely warnings of status and quick refunds, which lead to greater customer satisfaction and lower anxiety [13-15]. The ease of returning these products lies in simple processes

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with multiple options including refunds, exchange, in-store credit, and customer service via readily available digital channels [1, 15]. The customer understanding factor includes the extent to which the seller can provide a service tailored to customer needs like return processing catering to customer constraints or refunding a returned product if needed, enabling improved relationship dynamics and the minimization of churn relative to competitors [13-15]. Automation and transparency also make the return process quicker and more precise. Automated approaches that automatically approve return requests and allow return status notifications using applications improve accuracy and raise consumer trust [7, 16, 17]. While forms of transparency, such as transparent fees and precise process times, can establish trust and decrease complaints [13, 18]. Therefore, enhancing the quality of the reverse logistics process including communication, information, return, convenience, customer comprehension, and automation will assist sellers to gain a competitive edge in the growing e-commerce sector and aid in fostering long-term client loyalty [7, 19].

2.2. Customer Experience

Customer experience is the culmination of all interactions a customer has with a business, from purchasing goods and services to the emotions and perceptions that these interactions generate [20]. In the domain of reverse logistics, customer experience can be characterized along key dimensions like process friction, digital usability, convenience and speed, data transparency, and proper issue handling. The ease of process means the ease and convenience of the product return steps. The process at hand is optimized—with this process deterministic, it reduces customers' unmet expectations [21]. Ease of use is essential, especially in the digital era where customers expect online systems to be user-friendly and compatible with all their familiar devices [22]. Immediacy and convenience are also integral to greater customer satisfaction. A simple and quick return process, such as collection from home, establishes goodwill [14, 15]. Transparency, real-time notification of product status, and refunds reinforce confidence in the return process. Also, the ability to resolve problems, such as quickly correcting mistakes or helping customers in the event of a problem, helps strengthen the trust and consequently the business's long-term commitment to their customers [23]. Hence, customer experience is a crucial factor affecting seller satisfaction, trust, and loyalty. Because it is currently in the digital age, designing a reverse logistics process by prioritizing the dimension of customer experience is one of the strategies that can enhance the competitiveness of businesses [20].

2.3. Perceived Value

Perceived value is a customer's subjective assessment of the value of a product or service, usually in terms of the ratio of benefits gained over cost paid or effort made in terms of time, money, and other resources [24]. Specifically, from a retailing/circular economy perspective when selling their products, e-commerce companies want to have their customers' opinions on whether they fulfil sufficient value of what was expected or if the return process was value-shedding. Pivotal indicators include time and effort value, comparative value, and fee fairness. As an instance, customers will rate the return process to be valuable only if the seller has been able to eliminate the time and effort involved in the return process [23]. Moreover, by giving added value, like appropriate advice or sustainable options, for the returning process can create an added value much higher than helping with returns. This makes customers more willing to believe that the return process is worth it, as they perceive that the seller offers a higher service than other sellers [7, 25]. Another major contributor to higher value perception is the experience that exceeds expectations. When customers are offered services beyond what they expect, for example, a speedy refund or quick and professional resolution of their issue, they are more likely to feel satisfied with the service[14, 15]. Thus, perceived value not only influences immediate satisfaction but also cultivates enduring customer loyalty. Sellers that are able to develop processes for handling returns that justify the time, resources and expense involved will be better positioned to earn the trust and backing of customers over the long term [23, 24].

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2.4. Customer Loyalty

Customer loyalty refers to customers' intentions to maintain a long-term relationship with a seller, expressed through behaviors and attitudes that continuously support the seller. Behavioral loyalty is concerned with repeat purchase by customers, recommendations to friends and the willingness to use the services of the same seller. In contrast, attitudinal loyalty refers to a customer's emotional commitment and trust toward the seller, for example, the feeling that the seller offers better service than other vendors [24, 26]. For attitudinal loyalty in the context of e-commerce, customers intend to purchase from the same seller in the future and feel more attached to this seller than other platforms. Behavioral loyalty is simply indicated by repurchase intention; customers tend to buy again from the same seller, which indicates that customers agree with the values of the seller [27]. For example, word-of-mouth loyalty by customer referral of a seller is an indicator of behavioral loyalty that affects the seller's reputation and the opportunity to expand the new customer base. Long-term relationship loyalty as customers' trust for the seller in the long run is an important element to achieve business sustainability [28]. Thus, the proposed five indicators can describe the magnitude of customer loyalty comprehensively from behavior and attitude. In the highly competitive e-commerce setting, one of the important indicators is customer loyalty. A quality return process and experience will attract return business and recommendations from customers, which matters for long-term business growth [7, 14, 15].

2.5. Conceptual Framework and Hypothesis Development

An e-commerce seller's reverse logistics process establishes a key link in customer loyalty since the return, exchange and refund processes enhance customer experience and perceived service value [2, 4, 7, 21]. It is then proposing that hypothesis one is supported, indicating that the quality of the seller's reverse logistics process positively impacts customer loyalty (H1), as an efficient and transparent return process serves to establish trust, and motivates customers to return [13-15]. Moreover, customer experience is a significant mediator between the quality of a seller's reverse logistics process and customer loyalty (H2). When customers perceive the return process as smooth, easy to use, convenient, and transparent, they are more likely to exhibit loyalty to the seller [20, 21]. Similarly, customer value perception is another variable that deserves special attention in the reverse logistics process quality customer loyalty model, because under these circumstances, when customers can return unordered products at a low cost and this service will bring value to the customers, the customers will feel that return of the product is worthy (H3), such as obtaining fair and better services [7, 24]. Furthermore, customer experience and value perception are jointly on the mediating chain linking reverse logistics process quality to customer loyalty (H4), which means if customers can experience a great procedure in the return process, in other words, the process yields value to them, customer loyalty will increase [14, 15, 23]. So, the quality of the reverse logistics process of a seller not only directly influences customer loyalty but also indirectly through creating both good experience and appropriate value perception around which are important factors that can lead to achieving a competitive edge for sellers in the e-commerce market [3, 4, 6, 8]. Based on that summary, the conceptual framework can provisionally be defined as:

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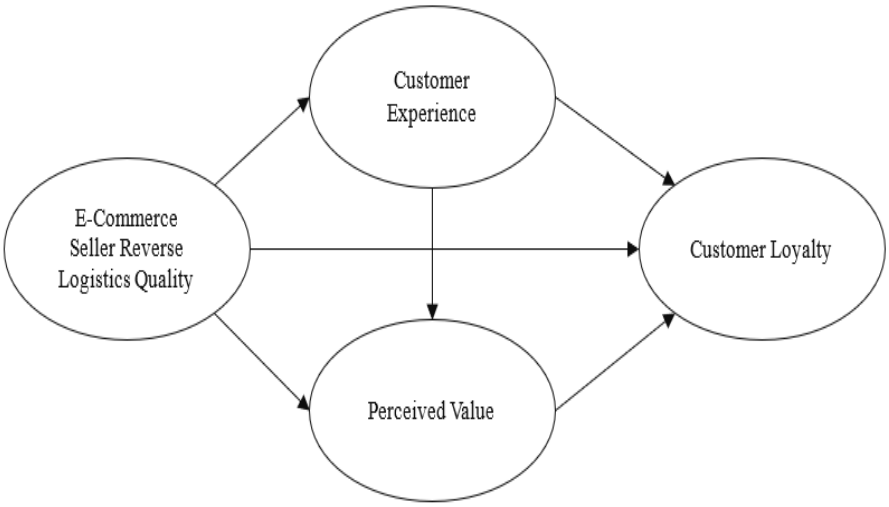

Figure 1.
Conceptual Framework.

3. Research Methodology

The study population consisted of consumers in Bangkok and vicinity who had purchased products online via e-commerce platforms, for instance, e.g. Lazada, Shopee, JD Central and others, and belonged to target groups that have experience in the product return process and in reverse logistics. The population for the study comprised e-commerce internet users who had engaged in product return. Hair Jr, et al. [29] recommend a sample size of 390 people, and their psychology study, which found the optimal sample size for SEM analysis with a minimum of 5-10 observed variables or free parameters. A total of 39 observed variables were included in this study, so at least 390 people form the minimal adequate sample size. Moreover, to overcome the missing value issue, the researchers added more samples to make up to the final number of 400 samples [30]. The type of sampling that aims to create a targeted sample group that fulfills the research requirements is purposive sampling combined with convenience sampling [31, 32]. Data collection was conducted by a questionnaire distributed through online social groups concerned with e-commerce and collected through online channels. Since Bangkok is the economic center of the country with a high volume of e-commerce transactions and shoppers there exhibit a wide range of buying and returning practices, the study area is Bangkok and the surrounding vicinity [1, 33, 34].

The data was collected via an online questionnaire to measure the respondents' data from the following variables: the quality of seller reverse logistics, customer experience, perceived value, and customer loyalty. The questionnaire is composed of 5 sections: (1) demographic information of the respondents including gender, age, education, income, and online shopping behavior; (2) e-commerce seller reverse logistics quality measured components including communication and information, quality of return process, convenience, customer understanding, and automation and transparency; (3) customer experience including ease of use, convenience, smoothness of process, and transparency; (4) perceived value including value of time and effort, and reasonable fees; and (5) customer loyalty including intention to repurchase, recommendation of the seller, and long-term commitment. The questionnaire utilized a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The index of item-objective congruence (IOC) test was used to validate the research instrument. Questions with an item-objective congruence (IOC) sensibility of ≥ 0.5 were deemed appropriate. Cronbach's alpha was used to measure the reliability of the measurement instrument where the value must be greater than 0.70 for the questionnaire to be considered reliable and capable of collecting real data [29, 35-37].

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The analysis used partial least squares structural equation modeling (PLS-SEM) [29, 38, 39]. The measurement model including convergent validity was assessed through average variance extracted (AVE ≥ 0.5), composite reliability (CR ≥ 0.7), rho_a, rho_c, and Cronbach's alpha. The Furnell and Larcker Criterion method was applied to conduct the discriminant validity test, where the AVE value of each variable must be higher than the correlation coefficient between the variables [38-40]. To confirm the causal relationship of the variables, hypothesis testing was performed through using the path coefficients, which required a t-value of ≥ 1.96 at the 0.05 significance level. Also, the explained variance (R^2) was taken into account to evaluate the ability of the independent variables to predict the dependent parameter, where the R^2 threshold value was above 0.3 [41, 42].

4. Study Results

4.1. Profile of Respondents

The researcher studied personal data of the respondents who had purchased products online through e-commerce platforms such as Lazada, Shopee, JD Central and other platforms in Bangkok and its vicinity. The details are as follows:

Table 1.
Respondent's profile.

Respondent's profile	Persons	Percent
Gender		
- Male	149	37.3
- Female	251	62.8
Education Level		
- Lower than bachelor's degree	153	38.3
- Bachelor's degree	240	60.0
- Higher than bachelor's degree	7	1.8
Average Monthly Income		
- Below 10,000 Baht	232	58.0
- 10,001-20,000 Baht	106	26.5
- 20,001-30,000 Baht	28	7.0
- Above 30,00 Baht	34	8.5
Online Shopping Frequency		
- Less than 1 time per month	152	38.0
- 1-2 times per month	168	42.0
- 3-4 times per month	80	20.0
Most Frequently Purchased Product Type		
- Clothing and Fashion	173	43.3
- Electrical Appliances	26	6.5
- Cosmetics and Personal Care	130	32.5
- Food and Beverage	22	5.5
- Others	49	12.3
Frequency of Product Returns via Online Platforms		
- Less than 1 time per year	290	72.5
- 1-3 times per year	52	13.0
- More than 3 times per year	58	14.5
Reasons for Returning Products via Online Platforms		
- Product is damaged	120	30.0
- Product does not match description/picture	102	25.5
- Received the wrong product	79	19.8
- Product does not fit (e.g. clothing size)	32	8.0
- Other	67	16.8
Total	400	100.0

As shown in Table 1, most respondents to this survey were females which is almost double males. Education levels showed that more than half had a bachelor's degree (50.8%) while almost 2 out of 5 had

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a lower degree and only a small number had studied at a higher level (0.1%). As for average monthly income, most had an income of less than 10,000 baht, which was higher than all higher income groups combined. When it comes to how often the sample purchased products online, the group that did so 1-2 times per month was the largest, followed by the group that did so less than once a month, and the group that did so 3-4 times per month constituted about 1 in 5 of the sample. Clothing and Fashion was the most popular product category to buy among others. Almost half of the group sampled responded to buying from this product group, followed by cosmetics and personal care products, while electronic products, food and beverages were bought much less often. Surprisingly, only a few people returned products through online platforms less than once a week in the past year. Only one out of four returned products annually at least once and a small group returned products three times or more per year. For the most part, damage to a product is the biggest reason people return items, following up with not matching a description or photos, and finally receiving the wrong item. Again, size problems, clothes being too big or too small, are also prevalent.

4.2. Descriptive Statistics and Measurement Validation

In the descriptive analysis of the four groups of variables, namely e-commerce seller reverse logistics quality, customer experience, perceived value, and customer loyalty, the researcher used the mean, standard deviation (S.D.), coefficient of variation (CV), Kurtosis, and Skewness. In addition, in the model development, the researchers assessed the reliability of the analytical variables by considering various indices such as loading and t-value, which indicate the relationship between the observed variables and the latent variables, rho_c (composite reliability) and rho_a (reliability of average variance extracted) to measure the internal consistency of the variables, AVE (average variance extracted) to reflect the amount of variance in the variables explained by the latent variables, and α (Cronbach's Alpha), which is an indicator of reliability in terms of consistency within the groups of variables of the first-order and second-order confirmatory factor analysis. The statistical results for confirmatory factor analysis of first-order and second-order appear in Tables 2 and 3 , respectively. In addition, the discriminant validity was assessed separately using the Fornell and Larcker Criterion, in which each variable must have an AVE value higher than the correlation between the variables, and these results appear in Table 4.

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Table 2.
Descriptive Statistics, Loading, and t-value of First-order Confirmatory Factor Analysis.

Measure	Mean	S.D.	CV	Kur	Skew	Loading	t-value	rho_c	rho_a	AVE	α
ECIQ1	3.180	1.250	0.393	-0.841	-0.244	0.926	94.676	0.971	0.962	0.869	0.962
ECIQ2	3.167	1.229	0.388	-0.862	-0.201	0.947	146.628				
ECIQ3	3.195	1.256	0.393	-0.876	-0.213	0.929	78.280				
ECIQ4	3.215	1.264	0.393	-0.861	-0.276	0.931	94.337				
ECIQ5	3.170	1.249	0.394	-0.885	-0.194	0.926	100.073				
EQRP1	3.172	1.226	0.387	-0.798	-0.267	0.929	114.531	0.968	0.959	0.857	0.958
EQRP2	3.140	1.223	0.389	-0.828	-0.204	0.932	111.696				
EQRP3	3.135	1.213	0.387	-0.816	-0.252	0.912	71.629				
EQRP4	3.125	1.222	0.391	-0.881	-0.257	0.918	94.611				
EQRP5	3.160	1.253	0.397	-0.869	-0.228	0.937	116.858				
ECON1	3.100	1.194	0.385	-0.734	-0.176	0.913	87.038	0.971	0.962	0.869	0.962
ECON2	3.053	1.202	0.394	-0.824	-0.136	0.909	66.147				
ECON3	3.147	1.215	0.386	-0.796	-0.260	0.940	139.770				
ECON4	3.175	1.235	0.389	-0.821	-0.296	0.945	150.579				
ECON5	3.112	1.237	0.397	-0.857	-0.223	0.943	144.219				
EEC1	3.098	1.220	0.394	-0.780	-0.187	0.939	125.646	0.971	0.963	0.869	0.962
EEC2	3.070	1.219	0.397	-0.840	-0.193	0.936	124.739				
EEC3	3.105	1.243	0.400	-0.839	-0.184	0.920	95.683				
EEC4	3.120	1.261	0.404	-0.942	-0.137	0.947	162.646				
EEC5	3.098	1.238	0.400	-0.852	-0.138	0.918	93.546				
EAT1	3.143	1.246	0.396	-0.862	-0.171	0.932	84.238	0.974	0.967	0.883	0.967
EAT2	3.152	1.218	0.386	-0.829	-0.211	0.936	105.183				
EAT3	3.172	1.238	0.390	-0.843	-0.244	0.942	123.323				
EAT4	3.203	1.231	0.384	-0.854	-0.213	0.940	135.359				
EAT5	3.228	1.231	0.381	-0.815	-0.239	0.947	156.282				
CEX1	3.083	1.181	0.383	-0.732	-0.170	0.922	102.228	0.972	0.964	0.874	0.964
CEX2	3.170	1.209	0.381	-0.760	-0.296	0.936	118.710				
CEX3	3.215	1.218	0.379	-0.820	-0.259	0.939	131.394				
CEX4	3.160	1.183	0.374	-0.685	-0.295	0.936	132.148				
CEX5	3.163	1.221	0.386	-0.812	-0.181	0.941	115.177				
PVA1	3.125	1.206	0.386	-0.707	-0.199	0.940	95.418	0.965	0.952	0.875	0.952
PVA2	3.107	1.184	0.381	-0.671	-0.173	0.925	76.470				
PVA3	3.125	1.200	0.384	-0.725	-0.199	0.929	95.561				
PVA5	3.150	1.226	0.389	-0.787	-0.248	0.947	137.575				
CL1	3.150	1.201	0.381	-0.708	-0.239	0.932	113.723	0.968	0.960	0.860	0.959
CL2	3.050	1.154	0.378	-0.652	-0.166	0.920	70.142				
CL3	2.998	1.222	0.408	-0.776	-0.070	0.912	70.261				
CL4	3.042	1.209	0.397	-0.769	-0.107	0.934	91.903				
CL5	3.078	1.225	0.398	-0.823	-0.148	0.939	123.863				

Note: ECIQ1-5 = Communication and Information Quality, EQRP 1-5 = Quality of Return Process, ECON 1-5 = Convenience, EEC 1-5 = Empathy and Customization, EAT 1-5 = Automation and Transparency, CEX 1-5 = Customer Experience, PVA 1-4 = Perceived Value, CL 1-5 = Customer Loyalty.

From Table 2, it was found that the mean of the observed variables was between 2.998 and 3.228, reflecting the moderate level of opinions of the respondents. The standard deviation (S.D.) value indicated that the data was moderately dispersed, while the coefficient of variation (CV) value did not exceed 0.41, indicating that the variance was within the acceptable range. The skewness and kurtosis values were in the appropriate range according to the normal distribution assumption. The factor loading values ranged from 0.909 to 0.947, which was higher than the minimum criterion of 0.70, and had a statistically significant t-value ($p < 0.001$). The internal reliability of the latent variables assessed through the composite reliability (rho_c) and reliability of average variance extracted (rho_a) values

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were greater than 0.90 in all variables, indicating excellent internal consistency. In addition, the average variance extracted (AVE) values were greater than 0.85 in all variables, indicating convergent validity, and the Cronbach's alpha (α) values were greater than 0.95, indicating good reliability of the measurement instrument.

Table 3.
Descriptive Statistics, Loading, and t-value of Second-order Confirmatory Factor Analysis of E-Commerce Seller Reverse Logistics Quality.

Measure	Mean	S.D.	CV	Kur	Skew	Loading	t-value	rho_c	rho_a	AVE	α
ECIQ	3.185	1.165	0.366	-0.828	-0.192	0.956	122.495	0.991	0.990	0.811	0.990
EQRP	3.146	1.136	0.361	-0.801	-0.239	0.970	257.504				
ECON	3.117	1.132	0.363	-0.792	-0.231	0.972	242.462				
EEC	3.098	1.152	0.372	-0.823	-0.182	0.966	211.425				
EAT	3.179	1.158	0.364	-0.817	-0.217	0.966	220.667				

Note: ECIQ = Communication and Information Quality, EQRP = Quality of Return Process, ECON = Convenience, EEC = Empathy and Customization, EAT = Automation and Transparency.

From Table 3, it was found that the mean of the variables was between 3.098 and 3.185, reflecting the moderate level of opinions of the respondents. The standard deviation was at a moderate level, while the relative variance (CV) was less than 0.38, indicating an acceptable variance. The factor loading was between 0.956 and 0.972, which was higher than the standard of 0.70, and had a statistically significant t-value ($p < 0.001$). The composite reliability (rho_c = 0.991) and reliability of average variance extracted (rho_a = 0.990) values indicated excellent internal consistency, while the AVE (0.811) and Cronbach's alpha (0.990) values indicated high reliability of the measurement model.

Table 4.
Fornell and Larcker Criterion.

Variables	ESRLQ	CEX	PVA	CL
E-Commerce Seller Reverse Logistics Quality (ESRLQ)	**0.900**			
Customer Experience (CEX)	0.872	**0.935**		
Perceived Value (PVA)	0.844	0.926	**0.935**	
Customer Loyalty (CL)	0.789	0.852	0.884	**0.927**

From Table 4, it was found that the highest correlation value was found between perceived value and customer experience at 0.926, followed by the correlation between E-commerce seller reverse logistics quality and customer experience (0.872). In addition, customer loyalty also had a strong relationship with perceived value (0.884) and customer experience (0.852). When analyzed according to the Fornell and Larcker Criterion, it was found that the square root of the average variance extracted (AVE) value on the diagonal was higher than the correlation value between other variables in the model, which confirmed that all variables had clearly different discriminating power.

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4.3. Finalized Model and Hypothesis Analysis

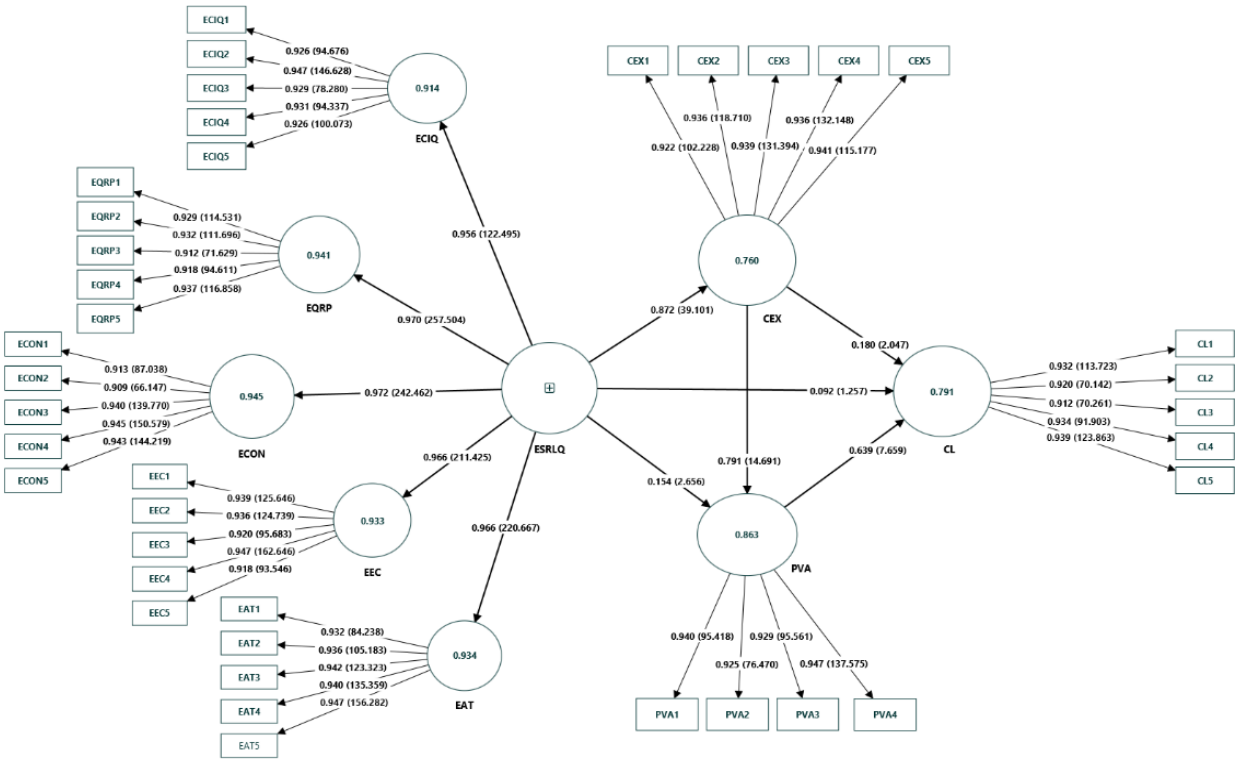

Figure 2.
Finalized Model.
Note: ESRLQ = E-Commerce Seller Reverse Logistics Quality, ECIQ = Communication and Information Quality, EQRP = Quality of Return Process, ECON = Convenience, EEC = Empathy and Customization, EAT = Automation and Transparency, CEX = Customer Experience, PVA = Perceived Value, CL = Customer Loyalty, the numbers on the paths outside parentheses represent path coefficients, the numbers on the paths inside parentheses represent t-values, and the numbers inside the circles represent R^2 or coefficient of determination.

Table 5.
Hypothesis Testing.

Hypotheses	Standardized Estimates	t-value	P values	Result
H1: ESRLQ → CL	0.092	1.257	0.209	Rejected
H2: ESRLQ → CEX → CL	0.157	2.051	0.040	Accepted
H3: ESRLQ → PVA → CL	0.099	2.502	0.012	Accepted
H4: ESRLQ → CEX → PVA → CL	0.441	0.767	0.000	Accepted

Note: ESRLQ = E-Commerce Seller Reverse Logistics Quality, CEX = Customer Experience, PVA = Perceived Value, CL = Customer Loyalty.

The finalized model, shown in Figure 2, illustrates how e-commerce seller reverse logistics quality (ESRLQ) significantly influences customer experience (CEX, R^2=0.760), and perceived value (PVA, R^2=0.863), and insignificantly influences customer loyalty (CL, R^2=0.791). ESRLQ is significantly impacted by communication and information quality (β=0.959, t=122.495), quality of return process (β=0.970, t=257.504), convenience (β=0.972, t=242.462), empathy and customization (β=0.966, t=211.425), and automation and transparency (β=0.966, t=220.667). Path coefficients indicate the strength of relationships, while t-values confirm significance. From Table 5, it is found that H1: ESRLQ does not affect CL ($\beta = 0.092$, $t = 1.257$, $p = 0.209$), resulting in this hypothesis being rejected. However, Hypotheses (H) 2 and 3 found that CEX and PVA acted as mediating variables between e-commerce seller reverse logistics quality and customer loyalty with statistically significant significance

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(H2: β = 0.157, t = 2.051, p = 0.040; H3: β = 0.099, t = 2.502, p = 0.012). In addition, Hypothesis H4 found that ESRLQ affects CL through the mediating variables CEX and PVA together (β = 0.441, t = 0.767, p < 0.001), and the transmission of these mediating variables CEX and PVA together resulted in the highest standardized estimate.

Table 6.
Direct Effect, Indirect Effect, Total Effect.

Variables	CEX			PVA			CL		
	DE	IE	TE	DE	IE	TE	DE	IE	TE
ESRLQ	0.872***	-	0.872***	0.154**	0.690***	0.844***	0.092	0.696***	0.789***
CEX	-	-	-	0.791***	-	0.791***	0.180*	0.506***	0.686***
PVA	-	-	-	-	-	-	0.639***	-	0.639***

Note: ESRLQ = E-Commerce Seller Reverse Logistics Quality, CEX = Customer Experience, PVA = Perceived Value, CL = Customer Loyalty.

From Table 6, it was found that ESRLQ had a significant direct effect on CEX (β = 0.872, p < 0.001) and a moderate direct effect on PVA (β = 0.154, p < 0.01), while it had an indirect effect on PVA through CEX (β = 0.690, p < 0.001), resulting in a higher total effect of ESRLQ on PVA (β = 0.844, p < 0.001). In addition, ESRLQ had no direct effect on CL (β = 0.092, p > 0.05), but had significant indirect effects through CEX and PVA (β = 0.696, p < 0.001), resulting in a strong total effect on CL (β = 0.789, p < 0.001). In addition, CEX had a direct effect on PVA (β = 0.791, p < 0.001) and CL (β = 0.180, p < 0.05), reinforcing the role of CEX as an important mediating variable, while PVA had a direct influence on CL (β = 0.639, p < 0.001).

5. Discussion

The findings of the H1 hypothesis test showed that the quality of reverse logistics of e-commerce sellers has no direct positive effect on customer loyalty. Nevertheless, the relationship between the quality of reverse logistics and customer loyalty is influenced indirectly by mediating variables, namely customer experience and perceived value [3, 21, 22]. These findings indicate that customers' loyalty to a seller is not determined by the quality of the return process, but rather customers assess the process for the experience and perceived value gained from it Anh and Khoa [4] and Do, et al. [6]. If the return experience meets their expectations regarding convenience, transparency, and problem-solving capability, customers are more likely to trust the seller and make repeated purchases from it Ngah, et al. [5]; Grewal, et al. [14] and Grewal, et al. [15]. Meanwhile, perceived value, incorporating the belief that the returns experience is justifiable, meaningful, and easy to accomplish, is yet another driver of customer trust and loyalty toward the seller [6, 8]. The extension of e-commerce reverse logistics further falls on the grounds of a quality return process not having a direct influence on customer loyalty, but that the perception of such a process from the customer creates a good experience which provides value on their end making it favorable enough to buy from the same seller again [2, 9]. Findings of this study further motivate sellers to reshape their reverse logistics strategies with emphasis on not just the pace and efficiency of the return procedure but also on exceptional experience and value addition to buyers that drive long lasting loyalty [1-3, 7].

On the other hand, the outcome results of the H2 hypothesis testing indicate that customer experience is a statistically significant mediating variable, as seen from the correlation between the quality of seller reverse logistics that is a key factor in customer loyalty, supported by several previous research studiesHui, et al. [3] and Anh and Khoa [4] that explain that the quality of good reverse logistics will lead to better experiences such as ease of return, transparent information, and fast resolution of customer complaints [2, 5]. Customers that experience the return process positively are more likely to trust and develop a long-term relationship with the seller and exhibit brand loyalty [1, 6, 27, 37]. The findings of the analysis also reinforce the argument that not only can the use of digital

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technologies in interface settings, such as real-time status notification systems and automatic return approvals, boost customer experience and decrease errors Do, et al. [6] but also increase customers' confidence into using the original seller services [9]. The study also confirms that customer experience contributes significantly to satisfaction. Furthermore, it impacts perceived value, which is another factor to stimulate customers to return and make a new purchase [8].

The results of testing the H3 hypothesis also showed that perceived value acts as a mediating variable between the quality of reverse logistics of e-commerce sellers and customer loyalty with significant statistical results, which is in line with the findings of Hui, et al. [3] which explained that when the return process of sellers is efficient, such as having clear, transparent, and easy steps, customers will perceive that the process provides positive value, so that it builds trust that leads to long-term loyalty. Reduction of time, difficulty, and costs of the return process are likely to bring customers back to sellers who can accomplish that [6]. Quick returns and equitable fees elevate customer satisfaction, resulting in improved brand loyalty [5]. Moreover, delivering services above expectations, including free return shipping or automatic refunds, can drive the level of perceived value, cultivating an effective tie between customers and sellers [2, 4]. These studies also align with the notion that perceived value is established firmly upon the service experience throughout the complete purchase cycle rather than just the price or quality of the product itself. Here, return and reverse logistics are involved [4]. If customers believe that the seller's return process is convenient and valuable, they will likely show their support for the brand by making repeat purchases and referring the brand to others [6, 9]. Nevertheless, it also underscores the importance of sellers who can provide value-added services, such as comprehensive information and automated technologies, as they will also hold a competitive edge in the e-commerce market [4, 7, 14, 16]. Thus, enhancing aspects of reverse logistics that improve customer perception of value by optimizing reverse supply chains will be a critical strategy to ensure long-term customer loyalty [6, 14, 15].

The test results of H4 suggests that the customer experience and value perception can function as the statistically significant intervening variables between the quality of reverse logistics of e-commerce sellers and customer loyalty (H4); in other words, the effective management of reverse logistics brings about an effective customer experience, which further directly affects value perception and customer loyalty in the long term [1, 2, 6]. When customers get easy, swift, and transparent return services, they are likely to be content and trust the seller. Moreover, a positive experience of the returning process is likely to lead to perceived value and perceived professionalism of the seller [4, 6]. Increasing the likelihood of recurring purchases from the same seller. This finding is in line with previous studies showing that simple and efficient returns enhance customers' trust in, and long-term relationships with, sellers [5, 6]. The research also indicates that customers consider fast and reasonable fees and good support from the seller as valuable services in the quality of reverse logistics and that value perception is quite essential to the relationship between reverse logistics quality and customer loyalty. That promotes the behaviors of doing repeat business and making recommendations to others [6, 8, 9]. It has also been recognized that the integration of technology to facilitate the return process, such as real-time status notifications and automated refunds, improves customers' experience and heightens satisfaction with the return process [2, 14, 15].

5.1. Research Implication and Future Research Directions

The research results can be classified into two points: management and academics implications. For the reverse logistics development with more focus, the sellers on e-commerce platforms, in management terms, need to improve the quality of reverse logistics from the following aspects: convenience, transparency, and the use of technology to improve customer experience. To eliminate errors in the returns process, a business must establish digital systems and automation, for example, notification of status in real time, automatic refunds, or accurate assessment of requests for return, to speed up the process and the return process and earn customer trust. Furthermore, to decrease dissatisfaction and increase consumers` trust in the site, clear and fair return conditions should be set out. It may even

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make sense for businesses to offer value-added services, such as home return services or tailored product advice, to help mitigate return issues. Academically, this study contributes to the literature in terms of exploring the mediating role of customer experience and perceived value as important mechanisms linking the two concepts: reverse logistics quality and customer loyalty. The findings also validate the notion that customer satisfaction is not just about the returns process itself but about the impression that the process is valuable and seamless.

5.2. Future Research Directions

The relationship between reverse logistics quality and customer loyalty may be a point for adding further knowledge to a related research field, and the research scope should be extended in many dimensions. In particular, a comparative study that can compare platforms, such as marketplace platform and direct-to-consumer platform, can be designed in order to analyze to what extent the type of return policy can affect customer behavior differently. Next, the internal psychological and behavioral drivers of value perception and loyalty among customers, like emotion, trust, or switching intention, related to the return process should be examined. Finally, the study should consider the influence of cultural factors and country-level factors, for example by analyzing customer behavior in developed markets and emerging markets to identify differences in terms of the return process and after-sales service expectations. Also, the role of technologies like digital and Blockchain in enhancing the transparency and efficiency of the reverse logistics system and the possibility of implementing circular logistics concepts to establish an eco-friendly system with lower prices for the sellers are recommended for researching. Finally, the long-term consequences of return policies on customer loyalty need to be investigated. This issue can be addressed by using behavioral data from e-commerce platforms rather than questionnaire data, thus generating accurate and business-oriented results.

6. Conclusion

The purpose of this study is to investigate the impact of e-reverse logistics quality, customer experience, perceived value, and customer loyalty on Thai e-commerce platforms. The results showed that e-reverse logistics quality did not directly influence customer satisfaction but acted as an indirect relation through experience and perceived value. Convenient, fast and transparent returns services are perceived as adding value to the return process, which fosters customer loyalty. Taking a practical approach, sellers must create e-reverse logistics quality by leveraging technologies like digital, automation, and Blockchain to create transparency, eliminate errors, and create trust in the return process. Also, by improving fair return conditions and offering additional services, such as return collection at home, customer experience can be improved. More studies are needed to investigate differences in e-reverse logistics quality occurring in various types of e-commerce platforms, investigate psychological factors such as trust and intention to switch platforms, and use big data and machine learning to study the longer-term effects of returns on customer behavior to develop both effective and sustainable approaches for e-commerce businesses.

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Transparency:
The authors confirm that the manuscript is an honest, accurate and transparent account of the study that no vital features of the study have been omitted and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Competing Interests:
The authors declare that they have no competing interests.

Authors' Contributions:
All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

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