

Measuring e-service quality and its importance to customer satisfaction and loyalty: an empirical study in a telecom setting

Ronggang Zhou^{1,2} · Xiaorui Wang¹ · Yuhan Shi¹ · Renqian Zhang¹ · Leyuan Zhang³ · Haiyan Guo³

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Abstract The important influence of e-service quality (e-SQ) on customer satisfaction and loyalty has been demonstrated in many contexts, but has not been examined in telecom settings yet. The current study aimed to construct a measurement scale for e-SQ in telecom settings, as well as to investigate the relationship between e-SQ, customer satisfaction, and customer loyalty. In this study, we analyzed self-reports from 9249 respondents (74.55% were male) between the ages of 19 and 45. A scale consisting of five user experience dimensions (functional completeness, performance, interface and interaction quality, content and information, support or service) was developed to measure e-SQ in the telecom industry. The scale was proven reliable and valid. The analysis confirmed a positive relationship between e-SQ, customer satisfaction and loyalty. In addition, e-SQ was found to be a core predictor of customer satisfaction and customer loyalty. Moreover, customer satisfaction emerged as the strongest predictor of customer loyalty.

Keywords E-service quality (e-SQ) · Customer satisfaction · Customer loyalty · User experience · Telecom setting

✉ Ronggang Zhou
zhrg@buaa.edu.cn

¹ School of Economics and Management, Beihang University, Beijing, People's Republic of China

² Beijing Advanced Innovation Center for Big Data and Brain Computing, Beihang University, Beijing, People's Republic of China

³ China Mobile Research Institute, Beijing, People's Republic of China

1 Introduction

Over the past decade, the use of internet has grown exponentially, and its influence is highly visible in many industries [1]. Customers can easily access services through e-channels almost at any time and place, and thus this convenient service method is rapidly replacing traditional service channels [2]. Therefore, many services have embraced online channels. For individual telecom businesses, an increasing number of people are choosing electronic channels to complete service or commerce transactions [3–5], and this activity has become increasingly common among mobile users.

Quality is the key element to business achievements [6]. According to the definition of [7], service quality is “the overall evaluation of a specific service firm that results from comparing that firm’s performance with the customer’s general expectations of how firms in that industry should perform”. Service quality plays an essential role in achieving important goals, including developing trust, improving satisfaction, and cultivating loyalty [8], which are recognized as vital factors in business competitiveness and success. For this reason, service quality has been studied extensively in traditional telecom service settings, and some scales for measuring it have been constructed (e.g., [3, 9]). However, online service is different from service in traditional service environments [10]. Firstly, the human element is absent in e-channels: interactions or communications between customer and business mostly rely on computers or mobiles [6]. From human–computer interaction (HCI) perspective, the factors influencing online service quality, or e-service quality (e-SQ), are quite different from those in the traditional physical service channels. Secondly, compared to a physical service environment, online service customization is not direct [6]. Sufficient customer information should be gathered and processed to customize service online. Thus, studies of telecom service quality in the traditional service environment may not be suitable for an online service context. For example, Gautam [3] found that the employee performance emerged as the most important determinant of traditional telecom service quality, and obviously this finding was not applied for the online services.

Currently, user experience (UX) emerges as an increasing important component in HCI, and it is tightly related to service quality. It goes beyond traditional usability and contains affective aspects such as positive feelings interacting with products, desire to reuse or recommendation and so on [11, 12]. So, UX has been reported in many fields as vital, even decisive, factors in user behavior [13, 14]. Customer satisfaction and loyalty are both outcomes of positive UX, which means UX is an important research area. Therefore, one of aims of the current study tends to construct measurement scale and to discuss e-service quality from the perspective of UX, and we especially try to collect evaluations and opinions from experienced consumers.

The current studies related to e-SQ mainly focus on traditional e-service such as e-retailing and e-banks. E-service satisfaction and loyalty in telecom are vital for the industry as well, for which mobile technology is far more than voice communication and text messages, and e-service in telecom is quite different from that in traditional e-commerce [15]. In addition, telecom industry is a fast developing and competitive

industry with a high cost of attracting new customers [4, 16]. Therefore, new customer acquisition is becoming more difficult than ever because potential subscribers now have more alternatives according to their perceived performance and service quality [15]. So it is essential to consider customer satisfaction and loyalty as strategic priorities. However, e-SQ frames in the traditional e-commerce (e.g. e-store and e-bank) website may not be suitable in telecom context, since service features make e-service in telecom industry different from the e-service in traditional e-commerce. Firstly, unlike services in the traditional e-commerce website where physical products dominate the market, e-service website in telecom is driven by proliferating range of virtual products and personalized services [5]. Thus, though customers have multiple channels (e.g., websites, phone calls, text messages, APPs, and service desks) to access services, the convenient online channel has obvious advantages over traditional ones. In China, this results in more and more telecom customers' turning to this kind of convenient online e-service, and it can help telecom companies to reduce operating cost. Secondly, although customers could complete commerce transactions such as purchasing new phones and applying for new cell phone numbers, most transactions on the website have no physical products and customers are self-serviced. For example, customers could help themselves in charging fees, checking usage (data, message, call duration, etc.), purchasing call or data packages, and buying or changing service plans. In addition, customers could also turn to online customer representatives for help whenever they have problems. As one of the biggest telecom companies in China, China Mobile aims to understand how customers use its website, and hence the UX relative to its website is more important. In conclusion, improving online customer satisfaction and loyalty is very important for improving service quality in the telecom industry. However, the scales to measure customer perceived e-SQ should be constructed firstly, and the relationship between e-SQ and customer satisfaction and loyalty should be examined. But to the best of our knowledge, such kind of research is still in its infancy. Hence, this study aims to construct a reliable and valid scale to measure website e-SQ from the perspective of UX in telecom settings, as well as to investigate its impact on customer satisfaction and loyalty. This study may also serve as a base for the e-SQ study in other industries which share similar features with the telecom industry.

The contents of this paper is organized as follows. Section 2 reviews the literature on e-SQ and its influence on customer satisfaction and loyalty, and then defines the aims of this study. In Sect. 3, we present the materials used and the methods employed for the research, after which we examine the validity and reliability of the questionnaire used to measure perceived e-SQ in telecom settings. We further investigate how UX factors affect customer satisfaction and loyalty in Sect. 4. Finally, we provide the findings, limitations and suggestions for future research in the last section.

2 Literature review and research aims

2.1 E-service quality measurements

The concept of e-SQ is derived from internet marketing and traditional service quality literature [17]. E-SQ can be defined as “the extent to which a website facilitates efficient and effective shopping, purchasing, and delivery of products and services” [18]. Before discussing e-SQ, an examination of the service quality (SERVQUAL) scale is required, because most of existing e-SQ studies are based on SERVQUAL [19]. The SERVQUAL scale was firstly developed with ten dimensions by Parasuraman et al. in 1985 [7, 19]. In 1988, they modified the scale and reduced it to five dimensions (tangibles, reliability, responsiveness, assurance and empathy) [7], and it has been widely used in many different contexts for measuring service quality. We found several researchers who have investigated factors influencing service quality and customer satisfaction in traditional telecom service channels (e.g., [20, 21]). As for the dimensions for measuring service quality in telecom, Almosawi [9] identified payment and savings (such as offers, rents, and charges) and communication (such as customer service, friendly employees, user-friendly websites) as the factors influencing customer service quality perception. Hosseini et al. [15] argued that customers formed their service quality perception based on seven dimensions: network quality, value-added service, pricing plans, employee competency, billing system, customer service, and service convenience. In a study of telecom service in India [3], the author found that customer service quality perceptions were driven by employee performance, transmission quality, competitiveness, support attributes, reliability, credibility, operational efficiency, and convenience. Although the dimensions proposed by these authors varied, we found that all involved employee performance.

With the increasing use of the e-service channel in various industries, the importance of e-SQ has been recognized by many researchers. Many measurement scales have been developed to adapt to different e-service contexts. In previous studies, the SERVQUAL scale was used in the context of e-service by rewording its items; however, this adaptation has been criticized because characteristics of e-service distinguish it from traditional service [22]. As mentioned earlier, the outstanding aspects of e-service are the absence of human and other traditional tangible elements. In addition, customers usually engage in self-service through e-service and can control the business process [19]. Thus, measuring e-SQ is quite different from measuring traditional service quality in physical environments, and clearly the SERVQUAL scale mentioned above is not suitable.

Moreover, the UX concept is also tightly related to service quality. UX includes but goes beyond traditional usability and can be described as the “person’s perception and responses resulting from the use and/or anticipated use of a product” [23]. The key distinction between UX and service quality is the emotions involved in the UX [24]. In this study, we describe UX as the subjective reflection of service quality from users. Though experts have different points of view on UX, it is generally agreed that (1) the amount of interactions with the product can affect UX, and (2) the

interactive experience of a user is affected by perceived usability, interface aesthetics and the extent to which user needs are met [23]. It is reported that UX is a vital, even decisive, factor in user behavior [13, 14]. Customer satisfaction and loyalty are both outcomes of positive UX, which means that UX is an important research area. Many researchers have confirmed a positive relationship between UX and customer satisfaction [25–27]. A better or higher-level experience leads to increased satisfaction and an increased number of completed purchases for online shopping [14, 28]. For this reason, many researchers discuss e-SQ from the perspective of UX.

Dabholkar et al. [29] first studied e-SQ measurement and constructed a six-dimension e-SQ scale. Subsequently, many other researchers developed and presented various models for e-SQ. Most of the dimensions for measuring e-SQ are based on a modified SERVQUAL [19] scale. Zeithaml et al. [30] modified SERVQUAL to meet the e-service context and proposed a seven-dimension e-SQ scale for online retailing: efficiency, reliability, fulfillment, privacy, responsiveness, compensation, and contact. Zeitham et al. stated in an e-service study that some dimensions of the traditional SERVQUAL could be used in an e-service context, but additional dimensions, especially those related to technology, must be taken into consideration [19, 31, 32]. Zeithaml et al. [30] developed an eleven-dimension scale based on the seven-dimension scale. Later, Parasuraman et al. [18] modified it to seven dimensions, with four core dimensions (efficiency, system availability, fulfillment, and privacy) and three recovery dimensions (responsiveness, compensation, and contact) [19, 33]. We can see that the four core dimensions mostly emphasized technological aspects of e-service; although customer service dimensions were also involved, they differed from those used in the traditional SERVQUAL. Timely and effective communications were emphasized, while employee factors were removed. The same observations can be made by examining scales in multiple previous studies (e.g., [19, 22, 34–36]). In addition, we found that most of the scales in these studies were applied through questionnaires that aimed to capture the perspective of UX.

Though the descriptions were somewhat different in previous studies, they mostly emphasized the e-SQ dimensions of websites, followed by customer service and security. The website UX dimensions were mainly related to website design, information and technological support. As the primary communication interface, websites should be well-designed and easy to use so that customers can efficiently navigate them. The information provided on the websites must be updated and reasonably arranged. Technological support was also important for websites' reliability such as avoiding crash or interruptions. As in traditional service systems, online customer service was also important for e-SQ. For example, although timely response was also addressed in traditional SERVQUAL, it is especially important in online customer service because it is easier for customers to turn to another service provider in the online context [37]. In addition, for services involving physical products, product delivery, returns and guarantees should be included in the e-SQ scales (e.g., [30]). In almost all of these studies, security or privacy was included in the e-SQ scales, although in some studies, security and privacy were found to have only a slight influence on e-SQ or repurchase intention (e.g., [2]).

According to these previous studies, we took website factors such as website design, information and technological support as the most important attributes for

increasing e-SQ. Customer service was also important when constructing our scale, and we concentrated on the effectiveness and timeliness of the online service. We did not involve security in our scale, because in this study we hold the opinion that security should be assumed when discussing e-SQ. In addition, although the service provider should ensure website security, customers may not notice the security or may take it for granted [22]. In the literature we collected, we did not find studies focused on e-SQ in telecom, but several studies on traditional or general service quality in telecom considered the website as an influencing factor (e.g., [9]). As online service has been quickly developing and replacing traditional service, study on e-SQ in telecom is urgently required.

To measure UX, a self-report based survey is one of the most common and useful methods [38], and several well-known subjective usability questionnaires have been developed, including the System Usability Scale [39], the Software Usability Measurement Inventory (SUMI) [40, 41], and the Post-Study System Usability Questionnaire [42, 43]. Some studies have used questionnaires designed for a specific context to collect customers' assessments or attitudes towards online service (e.g., [1, 22]). However, these questionnaires have been developed to be commonly used for all products or for a specific industry or context, without considering the particularity of e-service websites used in the telecom field. In addition, web survey has become an effective and efficient way to collect user feedback with a large sample size. Nevertheless, it is important to develop a reliable web survey questionnaire that imposes a minimal burden on respondents [44]. Based on previous studies, we proposed a framework for understanding and evaluating UX with a telecom e-service website. One aim of this study was to examine the reliability of a proposed e-service website UX scale according to this framework.

2.2 The importance of e-SQ to customer satisfaction and loyalty

According to Oliver's study [45], customer satisfaction is defined as the customer's fulfillment response: a judgment that a product or service provides a pleasurable level of consumption-related fulfillment [46, 47]. The relationship between e-SQ and customer satisfaction has also been addressed in many previous studies, which have mainly found that perceived e-SQ has a strong positive influence on customer satisfaction [8, 10, 37, 47–50]. However, other studies have found no significant relationship between e-SQ and customer satisfaction (e.g., [51]). A higher level of e-SQ significantly increases customer satisfaction and consequently, increases customer loyalty [10, 52]. Customer loyalty is the customers' intention to return to the website and to make positive recommendations to others [10]. Many studies have reported a significant relationship between customer satisfaction and customer loyalty [2, 8, 10, 47, 53]. Blut et al. [2] presented a conceptualization of e-SQ rooted in means-end chain theory. According to this framework, the awareness or evaluation of overall e-SQ leads to customer satisfaction, repurchase intention and word-of-mouth outcomes. In a subsequent study, they constructed a contextual model for understanding e-SQ, in which they confirmed the relationship between overall e-SQ, customer satisfaction and repurchase intention. According to this contextual model,

overall e-SQ influences both customer satisfaction and repurchase intention, and repurchase intention is further affected by customer satisfaction. In telecom industry, customer loyalty is very important because customer retention determines the success and survival of service providers, due to the fierce competition and high cost of attracting new customers [4]. Calvo-Porrall and Lévy-Mangin [13] found service value had a strong influence on customer satisfaction and loyalty in traditional telecom service. The relationships between e-SQ, customer satisfaction and customer loyalty should also be examined in online telecom service. Positive experience of e-SQ can induce higher customer satisfaction and loyalty. There are two dimensions in customer loyalty: behavioral loyalty and attitudinal loyalty. Behavioral loyalty refers to a customer's behavior in terms of repurchase due to their liking of a particular brand or service; attitudinal loyalty is the emotional and psychological state of the customer that is reflected in an intention to repurchase and to recommend the product to others [10]. Researchers have used different dimensions when measuring customer loyalty. In a study based on a 2012 e-retailing market research report from China, Zhang et al. [1] measured customer loyalty with dimensions capturing the willingness to repurchase and to recommend to others. Lin and Wang [54] measured customer loyalty in a mobile commerce context from the perspective of repurchase willingness and changing intention. However, in other studies, researchers measured customer loyalty only with the repurchase intention [2, 47]. From UX perspective, Sauro [55] agreed that either repurchasing intention or recommending intention can be used as a measurement of customer loyalty. As for a way of recommending intention, The Net Promoter Score (NPS), notably, has been widely used to measure customer loyalty. The NPS is calculated according to scores from a question like "How likely are you to recommend [product or service] to a friend or colleague?", and it can effectively measure customers' intention to recommend [55, 56]. This type of question was found to be the best or second-best predictor of repurchase behavior or referrals in many industries [55]. Customers' intention to recommend with NPS score has been used in many studies as a measurement of customer loyalty (e.g., [57]). Thus, in this study, we collected the respondents' willingness to recommend to others by asking the question "I would recommend the website to relatives or friends" in the questionnaire and took the response as a measurement of customer loyalty. With regards to customer satisfaction, asking customers about their satisfaction toward a brand or organization is the broadest measure of customer satisfaction [55], and asking customers to rate how satisfied they are using a rating scale is an effective method which is widely used in customer satisfaction researches (e.g. [58]). Therefore, in this study, the item "Overall, I am satisfied with my use of the current website" was used in the questionnaire as a satisfaction measurement in the context of telecom settings.

2.3 The aims of this study

With the rapid growth and wide use of the internet, traditional studies on service quality have extended to the contexts of e-service. In telecom settings, assessing

online services quality has become an increasingly common activity. Service quality in traditional telecom settings has been frequently studied, but e-SQ for telecom firms needs further study. Since e-SQ measurements are quite different from those used in a traditional physical service environment [6, 10, 19]. Furthermore, many previous researchers have found positive relationships between e-SQ, customer satisfaction and customer loyalty, and these relationships need to be re-examined in the context of telecom settings.

In general, by using a web survey to collect respondent's feedback with a large sample size, the aims of this study were as follows: (1) To examine the validity and reliability of a five-dimension questionnaire for measuring UX e-SQ in telecom settings; (2) To investigate how customers' perceived e-SQ affects customer satisfaction and loyalty.

3 Materials and methods

3.1 Questionnaire measures

With a structured online questionnaire, a web survey was conducted with the specific aim of studying the UX elements that influenced user satisfaction and loyalty with an e-service website in the telecom field. Totally, the web survey consisted of nineteen quantitative closed questions and two qualitative open-ended questions. The first pair of items (i.e. the 1st item and the 2nd item) were used to gather users' responses to e-services with all channels (i.e. the first closed item "I am satisfied with my use of China Mobile electronic channels (WEB, SMS, APP, and WAP) for checking or handling services" (*scored 1 strongly disagree to 5 strongly agree*), with the 2nd optional open-ended item "Please enter the reason for your answer"). Then, the closed items between the 3rd and 20th items were used to obtain users' responses towards the e-services website in components of satisfaction, evaluation, and intention to recommend. The last item was used as an open-ended question for gathering users' comments or suggestions regarding the website. Because this study specially aimed to examine the reliability of e-service website-related UX, as well as to investigate how UX-related factors affect satisfaction and intention to recommend, thus only the responses to the closed questions relative to e-service website were included in this study. These measures as well as demographic information and prior e-service website usage are presented below.

3.1.1 E-service quality questionnaire

For UX practice addressing e-channels in the telecom field, we created a UX evaluation index with an original scale. In this framework, five components or factors of UX with the initial questionnaire items were identified to understand UX when using e-channels for services: (1) the functional completeness of the website (i.e. "The website provides all the functions that I need"), (2) the performance

of the website (i.e. “The web page loads quickly”, and “The website does not crash, get interrupted, fail or flash back when loading”), (3) the quality of the interface and interactivity of the website (i.e. “The interface is aesthetically pleasing”, “The website is easy to use”, “The procedures or steps were simple and clear when using, for example for services”, “The navigation or structure of the homepage is clear, and I can use it to find my target quickly”, and “The important functions or content were presented well in a prominent place on the site”), (4) the quality of content and information (i.e., “The types of products (e.g., mobile terminals, cell No.) provided by the site are plentiful, and it can satisfy my needs”, “Important information such as charges and promotions is correct, and there is no out-of-date information on the site”, “I can find what I need by searching the website”, “The text introducing mobile services and promotions is clear and understandable”, and “The types of services provided by the site are plentiful and satisfy my needs”), and (5) the quality of online customer support or service (i.e., “I obtain a timely response from online customer service when I ask for help”, “The online customer service representatives on the website can always solve my problems effectively”, and “The guides across the different mobile service pages are well designed and help me find important information that I need”). Respondents were required to score each item on a 5-point scale (1 *strongly disagree* to 5 *strongly agree*).

3.1.2 Measures of customer's satisfaction and loyalty

In addition to the items used to scale the quality of customers' perceived UX of the website, the items “Overall, I am satisfied with my use of the current website” and “I would recommend the website to relatives or friends” were used to assess the respondent's satisfaction and loyalty towards the website, respectively. Respondents scored these statements on a five-point scale from 1 (*strongly disagree*) to 5 (*strongly agree*).

3.1.3 Demographic measures and prior e-service website usage

In the next section of the questionnaire, demographic information, including age group, gender, and province of residence, were collected. With respect to age group, respondents were asked to select their age information within five categories (i.e., 1 = 18 years old or below; 2 = 19–25 years old; 3 = 26–35 years old; 4 = 36–46 years old; 5 = 46 years old or above). Then, two items were used to measure the respondents' prior electronic channel use behaviors, including “the frequency with which you accessed the website (i.e., 4 = at least one time per day, 3 = at least one time per week, 2 = at least one time per month, 1 = less than one time per month, 0 = not sure)”. The respondent then responded “Yes” or “No” to indicate “which channels (i.e., WEB, SMS, APP, and WAP) do you use frequently for checking or handling services (multiple choice)”. At the end of the survey, respondents were encouraged to input their cell phone number, and some respondents would be selected randomly to win a free 10 CNY telephone credit as an incentive.

3.2 Respondents

This study was reviewed and approved by the user research committee for the protection of subjects at China Mobile Research Institute. Survey questionnaires were placed on the homepage of an e-service website in telecom settings where visitors could choose to participate or decline to participate. Written background information for the survey was provided, and potential respondents were informed that they would not be penalized if they chose not to participate and that their responses would be used only for analysis and research purposes, without any individual response and/or identifying information being used in any report or presentation. The voluntary decision to complete the questionnaire was considered to be an agreement to participate in the research, and the respondents were thus not asked to sign a formal informed consent. In addition, some identifying data, such as respondents' detailed mail address, occupation, and name, were not collected in this survey. This survey was conducted by the researchers, and all response data were collected through their own website system. Only the researchers who participated in this project could use these data for analysis.

The survey was conducted during March and April 2014. A total of 115,502 website visitors responded to the questionnaire. To ensure that the responses were reliable for testing the research aims of the current survey, the following empirical criteria were identified by pilot tests and research team for selecting valid closed-ended responses: (1) if all items were answered in less than 30s or with the same score, the respondent's response was considered to not have read or answered the questions carefully, and all his or her responses were excluded; (2) if one or more closed items were not answered, the respondent's responses were excluded; (3) if responses were completed with no cell phone number or with the same cell phone number, all related responses were excluded since this survey encouraged respondents to enter their cell phone numbers based on the incentive to win a phone credit. In total, 20,040 respondents met the requirements; 4.55% of them ($n=911$) were aged 18 years or younger and 5.49% ($n=1101$) were aged 46 years or older. Given that we could not prevent minors from answering the questionnaire, and could not obtain formal informed consent from their guardians, the responses of those who answered aged ≤ 18 years (4.55%, $n=911$) were not included in the subsequent analyses. Since we were unable to collect the precise ages of the oldest, and the ages within the group of ≥ 46 years may differ more significantly than that within other groups, the responses of those who selected aged ≥ 46 years were also excluded in the subsequent analyses. We intended to collect opinions from consumers who had transactions experience on the website, so those who stated had not used the website for services ($n=5967$; 29.8%) were excluded. In addition, to focus on active users' responses, we also excluded respondents who reported that they visited the website less than once per month ($n=737$; 3.7%), or were "not sure how frequently they accessed the website" ($n=6209$; 31%). Thus, responses from 9249 respondents were used in this study (Table 1); 74.55% of them were male and 25.45% were female. With respect to age group, 31.53% were aged 19–25 years, 49.89% were aged 26–35 years, and 18.58% were aged 36–45 years. All respondents were from the thirty-one provinces in China, but the distribution was not balanced for this variable. Therefore, we only considered the two main demographic measures of age group and gender in this study, as well as the variable of prior website usage behavior.

Table 1 Respondents' demographic profiles and visits (N = 9249)

Measures	Frequency	Percentage
Age group by gender		
<i>19–25 years</i>		
Male	1987	68.1
Female	929	31.9
<i>26–35 years</i>		
Male	3486	75.6
Female	1128	24.4
<i>36–45 years</i>		
Male	1422	82.7
Female	297	17.3
Prior behavior in terms of website visits		
<i>At least one time per month</i>	1585	17.1
<i>At least one time per week</i>	4624	50.0
<i>At least one time per day</i>	3040	32.9

4 Results

4.1 Validating the scales

We first conducted an exploratory factor analysis to test whether the key components of the UX questionnaire—functional completeness, website performance, interface and interaction quality, content and information quality, and online support or service quality—could be extracted. The 16 items (see Table 2) used to measure e-service UX quality were subjected to a principal component analysis with orthogonal varimax rotation to explore the factor structure in the initial evaluation framework. A preliminary analysis showed that the inter-item correlation was between $r=0.310$ and $r=0.641$, indicating that no items that did not correlate with any other items or had a correlation coefficient >0.9 . Therefore, the initial items are clearly differentiated and not redundant. The Kaiser–Meyer–Olkin measure of sampling adequacy (0.96), Bartlett's test of sphericity ($Chi\ square = 82,056.9$, $df = 120$, $p < 0.001$), and the determinant of the matrix (<0.001) all indicated that the correlation matrix was appropriate for such an analysis. We then used the five-component solution to run the principal component analysis and found that it explained 71.0% of the variance. Each item was categorized in the corresponding component as expected, i.e., the items in the first factor were related to *Perceived Quality of Interface and Interaction* (i.e., items 7–10 and 14), the items in the second factor related to *Perceived Quality of Content and Information* (i.e., items 11–13, 15, and 16), the items that loaded on the third factor were related to *Perceived Quality of Online Customer Support or Service* (i.e., items 17–19), the items that loaded on the fourth factor were related to *Perceived Website Performance* (i.e., items 5–6), and only item 4 loaded on the factor of *Perceived Functional Completeness*. Items that met the following two criteria were included: 0.40 was used as a cut-off point for item communality,

Table 2 Descriptive statistics for the E-service UX quality questionnaire items

Items	Mean	SD	Skew	Kurtosis	Loading
<i>Perceived functional completeness</i>					
4 The website provides all the functions that I need	3.93	0.96	-1.06	1.08	(8.6%) 0.87
<i>Perceived website performance</i>					
5 The web page loads quickly	3.73	1.04	-0.72	0.06	(12.8%) 0.78
6 The website does not crash, get interrupted, fail or flash back when loading	3.72	1.08	-0.71	-0.07	0.85
<i>Perceived quality of interface and interaction</i>					
14 The important functions or content were presented well in a prominent place on the site	4.02	0.94	-1.18	1.51	Excluded
8 The website is easy to use	4.00	0.96	-1.12	1.18	0.78
10 The navigation or structure of the homepage is clear, and I can use it to find my target quickly	3.99	0.98	-1.09	0.96	0.72
9 The procedures or steps were simple and clear when using, for example for services	3.96	1.01	-1.07	0.81	0.76
7 The interface is aesthetically pleasing	3.91	0.92	-1.08	1.31	0.68
<i>Perceived quality of content and information</i>					
15 The text introducing mobile services and promotions is clear and understandable	3.91	1.01	-0.99	0.69	Excluded
16 The types of services provided by the site are plentiful and satisfy my needs	3.85	1.06	-0.99	0.51	0.50
12 Important information such as charges and promotions is correct, and there is no out-of-date information on the site	3.81	1.09	-0.86	0.16	0.77
13 I can find what I need by searching the website	3.67	1.04	-0.67	0.01	0.58
11 The types of products (e.g., mobile terminals, cell No.) provided by the site are plentiful, and it can satisfy my needs	3.64	1.11	-0.71	-0.14	0.74
<i>Perceived quality of customer support or service</i>					
19 The guides across the different mobile service pages are well designed and help me find important information that I need	3.96	0.92	-1.06	1.28	Excluded
17 I obtain a timely response from online customer service when I ask for help	3.87	1.04	-0.98	0.61	0.85
18 The online customer service representatives on the website can always solve my problems effectively	3.82	1.04	-0.89	0.46	0.83

and a cut-off point of 0.40 was used for item loading values (i.e., an item had to have an item-to-factor correlation > 0.40 and could not load > 0.40 on another factor) [59]. The analysis indicated that item communalities ranged from 0.60 to 0.89 and factor loadings ranged from 0.55 to 0.85. Item 14 also loaded on the content axis with a loading value of 0.50, and items 15 and 19 also loaded on the interface factor with loading values > 0.4 . Therefore, based on the established criteria, items 14–15, and 19 were excluded from the initial questionnaire. Again, we used the five-component solution to repeat the principal component analysis procedure using the remaining thirteen items, which in total explained 74.4% of the variance. Again, the item(s) used to measure the corresponding UX factors were extracted as expected, and the dimensions relative to the website's function, performance, interface, content and service explained from 8.6 to 21.6% of the variance, Table 2 shows the items' descriptive statistics and results from the second principal component analysis. To check the reliability of each variable or subscale (except for perceived functional completeness), an internal consistency analysis (Cronbach's α) was conducted. The results for each e-SQ component measured indicated that these dimensions had good internal reliability: $\alpha=0.72$, $\alpha=0.85$, $\alpha=0.80$, and $\alpha=0.87$ for performance, interface, content, and service, respectively. These psychometric analyses showed that the self-reported e-SQ measures used in this paper were valid and reliable.

4.2 Correlations between variables

The means and the zero-order correlation coefficients for the various measures are shown in Table 3. Overall, the means of the scales indicated that respondents had positive satisfaction ($M=4.09$) and intention to recommend ($M=4.19$), and that they tended to positively evaluate the e-service website quality across the five UX dimensions (averaged scores varied from 3.72 to 3.97). All of the main study variables were found to be positively correlated with each other. Overall, demographics and prior visit behavior were significantly correlated with customer satisfaction and intention to recommend, with the exception of age group, which had no significant association with recommending; however, the correlation coefficients were very small.

4.3 Predictors of customer satisfaction and customer loyalty: regression analyses

To answer the second question of the study, hierarchical multiple linear regression analyses were used to assess the contribution of perceived e-SQ measures, along with demographic measures (i.e., gender and age group) and prior e-service website usage, in predicting customer satisfaction and intention to recommend. By controlling the influence of other variables, this approach allowed us to assess the predictive utility of each type of predictor. In the two-step hierarchical regression analyses with respect to customer satisfaction, the variables of gender, age group and prior usage were added in step 1, and the five perceived e-SQ variables (i.e., functional

Table 3 Zero-order correlations between the study variables (N = 9249)

Variables	1	2	3	4	5	6	7	8	9	Mean (SD)
1. Overall satisfaction	–									4.09 (0.78)
2. Intention to recommend	0.63***	–								4.19 (0.95)
3. Functional completeness	0.56***	0.49***	–							3.93 (0.96)
4. Perceived performance	0.46***	0.45***	0.40***	–						3.72 (0.94)
5. Interface and interaction	0.62***	0.65***	0.54***	0.55***	–					3.97 (0.80)
6. Content and information	0.55***	0.61***	0.55***	0.49***	0.70***	–				3.74 (0.85)
7. Support or service	0.49***	0.59***	0.44***	0.45***	0.58***	0.64***	–			3.84 (0.98)
8. Gender	0.04**	0.06***	0.06**	0.01	0.05***	0.07**	0.02	–		–
9. Age group	0.02*	0.01	0.05***	0.05***	0.02	0.02	0.02*	–0.12***	–	–
10. Prior usage	–0.03**	–0.04***	0.01	–0.01	–0.03**	–0.01	–0.01	0.15***	0.04***	–

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 4 Regression analysis: predicting users' satisfaction and loyalty towards the website (N = 9249)

Step and predictors	Customer satisfaction		Intention to recommend		
	Step 1 β	Step 2 β	Step 1 β	Step 2 β	Step 3 β
1. Gender	0.049***	0.004	0.072***	0.028***	0.027***
Age group	0.026*	-0.006	0.012	-0.014	-0.012
Prior usage	-0.033***	-0.017*	-0.050***	-0.032***	-0.027***
2. Functional completeness		0.274***		0.110***	0.033***
Perceived performance		0.112***		0.064***	0.033***
Interface and interaction		0.311***		0.301***	0.214***
Content and information		0.065***		0.162***	0.143***
Support or service		0.092***		0.229***	0.203***
3. Customer satisfaction					0.279***
R^2	0.003	0.479	0.007	0.513	0.554
ΔR^2	0.003	0.476	0.007	0.507	0.041
F_{change}	10.818***	1691.479***	20.619***	1923.567***	840.262***

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

completeness, perceived website performance, quality of interface and interaction, quality of context and information, and online customer support or service) were entered in step 2. Given that the predictors were entered into the predictive model as a bundle, the estimation of their significance might have been affected by multicollinearity. Therefore, VIF values of the regression analyses should be examined and the results did not suggest issues of multicollinearity (VIF ranges from 1.019 to 2.510). The results are summarized in Table 4. The results showed that the five perceived e-SQ variables explained 47.6% of the variance in customer satisfaction with the website ($F_{\text{change}}(5, 9240) = 1691.5, p < 0.001$), with all five variables emerging as significant predictors. As for predicting customer's intention to recommend, a three-step hierarchical regression analysis was performed using demographic measures, perceived e-service website quality, and customer satisfaction. The results in step 2 indicated that the five perceived e-SQ dimensions explained 50.7% of the variance ($F_{\text{change}}(5, 9240) = 1923.6, p < 0.001$). In step 3, the addition of customer satisfaction resulted in a significant increment to the variance explaining customer's intention to recommend ($F_{\text{change}}(1, 9239) = 840.3, p < 0.001$) and emerged as the strongest predictor ($\beta = 0.279, t = 29.00, p < 0.001$). Similarly, VIF did not suggest multicollinearity issues either (VIF ranges from 1.019 to 2.578). Furthermore, all coefficients of the five dimensions in step 3 are smaller than that in step 2, which suggests consumer satisfaction mediates the factors from the survey and customer loyalty.

With respect to the contribution of demographics and prior usage, the regression models with only demographics and prior usage were significant in predicting customer satisfaction and intention to recommend, but these three measures explain less than 0.01% of the variance and can be disregarded.

As can be seen in Table 4, the contributions of the five e-service website UX measures in predicting customer satisfaction differed from those in predicting

Table 5 Relative importance of E-service UX dimensions in predicting customer satisfaction and intention to recommend

User experience dimensions	Customer satisfaction (%)	Intention to recommend (%)
Functional completeness	26.9	14.1
Performance	14.0	11.2
Interface and interaction	28.6	28.6
Content and information	16.7	22.4
Support or service	13.8	23.7

recommendation intention. In this study, the analysis of the relative importance of the five predictors (e.g., [60]) was used to compare the validity of the five UX variables across the two regression models for predicting customer satisfaction and recommendation intention in step 2. Using relative weight analyses (RWAs), researchers can decompose the total variance predicted in a regression model (R^2) into weights that accurately reflect the proportions of the various predictor variables (e.g., [60]). In essence, RWAs address the problem caused by correlated predictors by using a variable transformation approach to create a series of new variables that are maximally related orthogonal counterparts of the original predictors to resolve their collinearity [61]. In the current study, the correlations among the five UX measures were significant; therefore, it was appropriate to use RWA to examine the relative importance of these variables. Table 5 provides the percentages of the total R^2 for each dependent variable (i.e., customer satisfaction and recommendation intention) that is explained by the five UX dimensions. For customer satisfaction, perceived interface quality (28.6% of the total R^2) and perceived functional completeness (26.9%) explained the greatest percentage of the variance, followed by perceived content quality (16.7%), perceived performance quality (14%), and perceived service quality (13.8%). With respect to customers' intention to recommend, combining the results for the percentage of variance from the highest to the lowest percentage, i.e., perceived interface quality (28.6%) > perceived service quality (23.7%) and perceived content quality (22.4%) > perceived functional quality (14.1%) and perceived performance quality (11.2%)—the table indicates that a greater percentage of the variance in customers' intention to recommend was explained by perceived interface quality.

5 Discussion

With the fast development of telecom industry, e-SQ is becoming more and more important in improving customer satisfaction and customer loyalty. But e-SQ in telecom is different from that in traditional e-commerce, like e-retailing and e-banks. Thus, e-SQ should be studied and the relationships between e-SQ and customer satisfaction and loyalty should be examined in telecom context. The main aims of the current study were to investigate how to measure website e-SQ from the perspective

of UX in telecom settings and to explore the relationship between e-SQ and customer satisfaction and customer loyalty. Firstly, a structured questionnaire was designed and used in a self-report based survey to collect respondents' perceived quality, general satisfaction and intention to recommend for the website. A five-dimension UX e-service scale including 13 items was constructed, and the analysis showed that the scale was valid and reliable in measuring e-SQ with website in telecom. Secondly, as in many other contexts in previous researches, we found that e-SQ has a positive impact on customer satisfaction and loyalty in telecom settings. Before describing the investigation on the relationships among e-SQ, customer satisfaction and loyalty, we firstly discuss the measurement of e-SQ.

5.1 Measuring website e-SQ in telecom settings

One of the main aims in this study was to construct a measurement scale for customer perceived UX relative to e-SQ in telecom settings, since the measurement of the e-SQ is quite different from quality measurement in traditional service and it is tightly related to context such as industry [2, 58, 62]. To the best of our knowledge, there was no such type of questionnaires or scales specifically for online telecom services.

To assess the perceived e-SQ, an online questionnaire was created. We firstly developed 16 items belonging to five dimensions to collect UX. As in most previous studies on e-SQ, we emphasized attributes relating to the website and to customer service. Security and privacy were not included in our scale because according to many previous studies, security only marginally contributes to the online UX [2]. Udo et al. [63] argued in an online shopping study that internet usage has come to a point where online customer views security or privacy as a basic feature, and we also hold the opinion that security and privacy should be a basic premise when discussing e-SQ. In general, the respondents showed a positive attitude towards the website ($M \geq 3.64$).

A total of 13 items were retained from the initial 16 after validating and refining the scale. The principal component analysis and internal consistency analysis indicated that the scale had good psychometric properties in terms of reliability and validity. Five dimensions were extracted from the scale: functional completeness, website performance, quality of the interface and interaction, quality of content and information, and quality of customer support or service. Items in our scale were mainly attributes of the website (i.e., 4–16) and of customer service (i.e., 17–19). In the four dimensions addressing the website: functional completeness and quality of the interface and interaction were designed to measure the website design; the content and information attempted to measure information on the website, and the website performance was related to the technological support of the website.

This thirteen-item scale explained 74.4% of the total variance, which indicated that it was valid and reliable for measuring e-SQ in the telecom industry. Website design and customer service explained 59.9 and 14.5% of the total variance, respectively. The items for website design (i.e., functional completeness

and quality of the interface and interaction) explain 30.2% of the total variance, followed by items on website information (explained 16.9%) and technological support (explained 12.8%). This result indicated that website design is a vital component of e-SQ. The main reason for this importance may be, as mentioned earlier, the absence of staff and other traditional tangible elements in e-SQ. Although it explains a minor part of the total variance compared with website design, customer service cannot be neglected. Although there were only two items in the customer service scale, the loadings on the two items were 0.85 and 0.83, which were greater than the loadings on most of the items for website design. This result implies that customer service is still an important component in e-service.

Using the tools we developed, UX in the telecom industry can be measured using five dimensions. According to the respondents in this study, website design plays the most important role in e-SQ in the telecom industry, which is consistent with conclusions in previous studies (e.g., [2]), followed by website information, customer service and technological support.

5.2 Predicting customer satisfaction and loyalty for the telecom industry

The second aim of this study was to examine the relationships between e-SQ, customer satisfaction and loyalty, as well as to investigate predictors of customer satisfaction and loyalty in the telecom industry. Zero-order correlation coefficients confirmed positive relationships between e-SQ and customer satisfaction, and this result was consistent with findings in many previous studies [8, 10, 37, 47, 49]. The coefficients also indicated that customer satisfaction had a positive impact on customer loyalty, as we expected. These results can be easily explained because higher perceived e-SQ encourages customers to repurchase or recommend products to others, and customer satisfaction can induce customer loyalty, as is widely acknowledged in various studies.

We also investigated the predictors of customer satisfaction and loyalty, employing hierarchical multiple regression analyses. All five e-SQ dimensions were examined as significant predictors for customer satisfaction and loyalty. In addition, e-SQ can respectively explain 47.6 and 50.7% of the variance for customer satisfaction and loyalty, respectively. With respect to predicting customer loyalty, customer satisfaction emerged as the strongest predictor and also mediated the UX e-SQ factors' influence on customer loyalty. These results were also as expected. According to the definition of customer satisfaction, customers' service quality experience during the online service process would lead them to form a judgment regarding the e-service satisfaction. Therefore, improving website e-SQ is important for telecom companies as it can improve customer satisfaction and retention [64] or it can turn visitors into customers, especially given the rapid development of online services. Demographics have been demonstrated to be important factors affecting e-SQ in some studies (e.g., [65]), but in this study, we found that they could be neglected because they explain less than 0.01% of the variance. Researchers have also found that a higher-level or better experience can induce increased satisfaction [14], but in

our study, previous user experience did not show an important effect in predicting customer satisfaction or loyalty.

5.3 Conclusions, practical implications, and limitations

Overall, in this study, we offer the following findings for the telecom industry: (1) the five-dimension scale that we constructed in this study was valid and reliable in measuring website UX; (2) a positive relationship between e-SQ, customer satisfaction and customer loyalty was confirmed; (3) the e-SQ relative to UX emerged as core predictors in predicting customer satisfaction and customer loyalty; (4) customer satisfaction was a significant predictor of customer loyalty.

The results in this paper provide some managerial implications. Firstly, though it was not discussed a lot in the current study, security and privacy were premised and were basic features in e-service. Secondly, improving e-SQ is very important for improving customer satisfaction, retaining customers and turning visitors into customers. Thirdly, when designing their service websites, telecom companies should pay attention on the interface and interaction because it was shown to be the most important factor in improving customer satisfaction and recommending intention. Increasing functional completeness would also be helpful in improving customer satisfaction. But if the telecom companies intend to achieve more website visitors through improving customers' recommending intention, they should provide better service support to customers, as well as improve the content and information quality. The technical support seemed to be not so vital as other dimensions, but we suggest the website should be browsed smoothly. Although respondents showed a positive response for customer satisfaction ($M=4.09$) and intention to recommend ($M=4.19$), we note that the mean scores for the items leave an obvious room for future improvement.

Although we obtained important and useful conclusions from this study, several limitations should be kept in mind. Firstly, as the sample is derived from one telecom e-service website, the generalizability of the results is limited. Although tests for reliability and validity provided initial support in this article, there still remains the possibility that not all e-service websites will show a consistent pattern. Secondly, the respondents' gender gap in the current study was large (74.55% were male). Though it was similar to the gender distribution of the 20,040 initial filtered respondents (70.8% were male), the generalization of the results should be careful. Thirdly, the number of respondents used for analysis is large, which may make it easier to achieve statistical significance other than the variables' significance. Finally, the study was designed from the perspective of UX. To collect opinions from experienced consumers, criteria including experience were used to filter responses, which induced high response dropping rate. Many previous studies (e.g. [14, 66]) indicated that experience moderates user's opinions and behavior. Consumers having less or no real transactions experience may hold different opinions. The results should be used carefully.

Notwithstanding the limitations, this research can serve as a base for further research on e-SQ, customer satisfaction and loyalty in telecom and other industries sharing similar features. Firstly, future researches can investigate more factors affecting customer satisfaction and loyalty in telecom. For example, as consumers also do commerce transactions such as purchasing new phones on the website, factors investigated in online stores such as delivery, compensation, and assurance may have influence on customers' experience website. Secondly, based on the scale in the current study, scales can be constructed and tested in other industries with further analysis. And there can also be a comparison on mobile service providers within the country and among countries. Thirdly, there are many other e-service channels in telecom industry nowadays (e.g. APPs and applets). We suggest further researches in these e-service channels, and this will contribute to the improving of customer satisfaction and loyalty. Finally, with use of closed responses in web survey, this study can help us understand respondents' answer behavior in a web survey. At the same time, we also investigated the respondents' responses towards open-ended questions (i.e., items 1 and 2, items 3 and 21, as mentioned in Sect. 3.1) in our another study [67]. Future study may focus on investigating user's answering behaviors in web survey regarding e-SQ in a whole framework including closed and open-ended questions, which may contribute to developing a more comprehensive e-SQ measure tool.

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