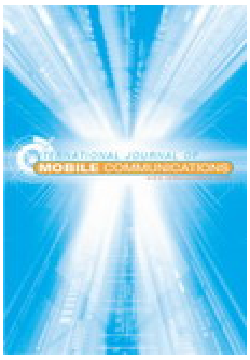

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Ching-Chan Cheng, Ming-Chun Tsai, Ya-Yuan Chang, Cheng-Ta Chen

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How to measure customers' perceived service quality of smart restaurants?

Ching-Chan Cheng

Department of Food and Beverage Management,
Taipei University of Marine Technology,
No. 212, Sec. 9, Yen Ping N., Taipei City, 111, Taiwan
Email: cccheng@mail.tumt.edu.tw

Ming-Chun Tsai*

Department of Artificial Intelligence,
CTBC Business School,
No. 600, Sec. 3, Taijiang Blvd., Annan District,
Tainan City, 709, Taiwan
Email: mctsai@ctbc.edu.tw
*Corresponding author

Ya-Yuan Chang

Department of Hospitality Management,
Ming Chuan University,
No. 5 De Ming Rd., Gui Shan District,
Taoyuan City, 333, Taiwan
Email: yychang@mail.mcu.edu.tw

Cheng-Ta Chen

Department of Food and Beverage Management,
Taipei University of Marine Technology,
No. 212, Sec. 9, Yen Ping N., Taipei City, 111, Taiwan
Email: allanchen@mail.tumt.edu.tw

Abstract: Smart restaurants are a new type of restaurant that can be applied to restaurant halls and kitchens through the use of the internet of things (IoT) and communication technology, which can be used to reduce the service contact between service staff and customers during COVID-19. Effective evaluation of the service quality of various restaurants is a primary task for the restaurant industry, but previous restaurant service quality scales cannot fully measure the service quality of smart restaurants. Based on the above reasons, this study developed a smart restaurant service quality scale (SRSERV scale) through rigorous research procedures. The SRSERV scale had considerate service, responsiveness, fun and novelty, reliability, service efficacy, and empathy dimensions, with a total of 30 items. The implications of these dimensions were fully discussed in this study. The SRSERV scale could allow smart restaurant operators to accurately measure the service quality of smart restaurants to improve service quality.

Keywords: smart restaurant; service quality; service quality scale.

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Biographical notes: Ching-Chan Cheng is an Associate Professor of the Department of Food and Beverage Management at Taipei University of Marine Technology (Taiwan). He received his PhD degree from the Department of Technology Management, Chung Hua University. His research interests focus on marketing management, consumer behaviour and service quality management.

Ming-Chun Tsai is a Professor of the Department of Artificial Intelligence at CTBC Business School (Taiwan). He received his PhD degree from the National Chiao Tung University. His research interests focus on service marketing, service quality management, performance evaluation and research methods.

Ya-Yuan Chang is an Assistant Professor at the Department of Hospitality Management at Ming Chuan University (Taiwan). She received her PhD degree from the Department of Business Administration at National Chung Hsing University. Her research interests focus on service quality management, marketing management and consumer behaviour.

Cheng-Ta Chen is an Associate Professor at the Department of Food and Beverage Management, Taipei University of Marine Technology (Taiwan). He received his PhD degree from the Graduate Institute of International Business Administration from Chinese Culture University. His research interests focus on service quality management, marketing management and consumer behaviour.

1 Introduction

In recent years, the application of information technology (IT), internet of things (IoT), and artificial intelligence (AI) has been seen in many hospitality services, such as reception, cleaning, taking orders, delivering food, and checking out, thereby solving the labour shortage problem in the hospitality industry (Ghosh et al., 2015; Wu and Cheng, 2018; Lee et al., 2018). Since 2020, the COVID-19 pandemic has severely impacted the restaurant industry, and contactless services have become valued by restaurant customers, thus promoting the application of IT in the restaurant industry (Gursoy and Chi, 2020; Chuah et al., 2021). A smart restaurant is a new type of restaurant that uses the latest technology (such as IoT and communication technology) for making reservations, ordering food, and storing customer records (Ghosh et al., 2015). Through the application of IoT and communication technology in restaurant halls and kitchens, smart restaurants can greatly reduce human errors, improve work efficiency, and provide feedback on customers' comments, thereby increasing restaurant profits (Jakhete and Mankar, 2015). Human-computer interaction (HCI) emphasises the integration and interaction of psychology and other social sciences with computer science and related technical fields, with the goal of making IT both useful and usable (Carrol, 1997; Olson and Olson, 2003). According to HCI, smart restaurants must focus on the interaction between restaurant customers and IT.

At present, there have been many successful cases of smart restaurants in advanced countries in Europe and Asia, as well as in the United States (Lee et al., 2018; Inamo Restaurant, 2019; Zhao and Pan, 2020; Chuah et al., 2021). For example, some smart restaurants use face recognition to provide customers with ordering advice (Wu and Cheng, 2018) and provide unmanned and technological dining experiences to customers, while using technology in the kitchen to save manpower and improve work efficiency (Zhao and Pan, 2020). As smart restaurants can greatly improve the efficiency of customer service and bring customers a unique service experience, it is necessary for smart restaurant operators to understand customers' perceptions of the service quality of smart restaurants, as the basis for optimising service.

For all types of restaurants, service quality is a key factor that cannot be overlooked (Stevens et al., 1995). However, how to accurately measure customers' perceptions of service quality has been crucial for the restaurant industry (Cheng et al., 2019). Stevens et al. (1995) constructed a dining service quality scale (DINESERV scale) to measure the service quality of traditional restaurants. However, the service content and features of smart restaurants are relatively novel and unique, leading to the inability of the DINESERV scale to fully evaluate the service quality of these new restaurants. Previous scholars have proposed various new restaurant service quality scales based on the DINESERV scale through rigorous research procedures (Cheng et al., 2019; Uslu and Eren, 2020; Tuncer et al., 2021) to identify the service quality of various restaurants. With the continuous development of IT and IoT technologies, smart restaurants have emerged to provide customers with unique experiences that are different from traditional restaurants (Jakhete and Mankar, 2015; Ghosh et al., 2015; Wu and Cheng, 2018). However, the unique service of these smart restaurants cannot be evaluated by the existing restaurant service quality scales, and few studies have explored the service quality evaluation of smart restaurants. Therefore, it is important to construct a new service quality scale for smart restaurants, so as to improve the service quality.

According to the resource-based theory (RBT), a company can gain a sustainable competitive advantage by shaping special capabilities and choosing strategies that make full use of resources and capabilities (Cheng et al., 2021). Therefore, in order to gain a competitive advantage in the restaurant market, a smart restaurant must accurately evaluate service quality and properly allocate service resources based on the evaluation results of service quality. Parasuraman et al. (1985) proposed a conceptual model of service quality (referred to as the PZB model) to explain the main reasons for why an enterprise's service quality cannot always meet customer needs. In addition, Parasuraman et al. (1985) defined service quality as the gap between perceived service and expected service in the PZB model. According to RBT and the PZB model, in order to enhance the service competitiveness of restaurants, restaurant operators need to understand customers' expected service and perceived service through service quality measurement, so as to identify the advantages and disadvantages of restaurant service quality, and then pay attention to service deficiencies that should be urgently improved (Cheng et al., 2019). At present, smart restaurants are in a stage of rapid growth, and market competition is becoming increasingly intense. According to RBT, the PZB model, and HCI, a smart restaurant service quality scale could help operators to rationally allocate resources, thereby enhancing service quality and market competitiveness.

Many restaurants have applied intelligent service technology to improve restaurant service efficiency and create a unique service experience for customers. It can be seen that smart restaurants must do a good job in service quality management. Therefore, effectively measuring customers' perception of the service quality of smart restaurants is important for smart restaurant operators to improve their service quality. However, academia has yet to develop measurement tools to evaluate the service quality of smart restaurants. Based on the above research motivation, this study developed a smart restaurant service quality scale (SRSERV scale) to evaluate the performance of various service quality attributes of smart restaurants and serve as guidance for optimising restaurant service. In practice, the SRSERV scale could enable smart restaurant operators to clearly identify the service quality performance of smart restaurants from the customers' point of view. Theoretically, the SRSERV scale can be used as a reference for the development, application, and extension of theory related to the service quality of the hospitality industry.

2 Literature review

2.1 Development and application of smart restaurants

The application of science and technology in the tourism and hospitality industry is constantly improving. The proliferation of smart technologies offers a variety of content to capture the minds of consumers (Lee and Kim, 2023). In order to solve the current shortage of manpower in the hospitality industry, IoT, communication technology, and AI-related technologies have been widely applied to various services, such as greeting, reception, cleaning, taking orders, delivering food, and bill payment, in recent years (Ghosh et al., 2015; Wu and Cheng, 2018). The development of smart restaurants can reduce human errors and provide customers' opinions and feedback through the application of IoT and communication technology in restaurant lobbies and kitchens, thus improving the profitability of restaurants (Jakhete and Mankar, 2015).

At present, there have been many successful cases of smart restaurants in European and Asian countries, as well as in the United States (Inamo Restaurant, 2019; Zhao and Pan, 2020; Chuah et al., 2021). Haidilao built a smart restaurant in Beijing in 2018, proving that people and machines can divide their work effectively. In Haidilao's smart restaurant, the waiting customers can play interactive games through stereo surround projection and experience unique unmanned and technological services, including electronic ordering, robot food delivery, silent wall projections of different themes, and a customised seasoning system. The kitchen has automatic temperature adjustments for its induction cookers and intelligent storage, and uses a robot arm instead of manpower to prepare vegetables (Zhao and Pan, 2020). Moreover, the smart restaurant jointly opened by KFC and Baidu in Beijing can provide ordering suggestions for old and new customers through face recognition technology and analysing customers' past ordering records (Wu and Cheng, 2018). In London, Inamo Restaurant applies interactive projection technology on dining tables to provide customers with a unique dining experience (Inamo Restaurant, 2019). In Taiwan, the development of smart restaurants has also been quite rapid in recent years, and there have been many successful cases (Sushi Express, 2020; Chuah et al., 2021). Through the application of IoT and communication technology, the services provided by smart restaurants can greatly reduce the contact between service personnel and customers.

2.2 Service quality of smart restaurants

According to Churchill and Surprenant (1982), service quality is the result of the comparison between customers' perceived service and their expected service, and this gap affects their overall satisfaction. Parasuraman et al. (1985) agreed with Churchill and Surprenant (1982) that service quality is based on the gap between customers' perceived service and their expected service. In the PZB model, Parasuraman et al. (1985) mentioned the five gaps in the service process leading to poor service quality. Among them, gap 1 to gap 4 are the main obstacles for service providers to provide services, and also the main reason for forming gap 5 (the gap between perceived service and expected services). Markovic et al. (2010) defined restaurant service quality as the gap between customers' perceived service after dining and their expected service before dining. Based on the above definition, this study defined the service quality of smart restaurants as the gap between customers' perceived service after dining and their expected service before dining.

In terms of the service quality of smart restaurants, Haidilao's smart restaurants provide large 3D screens for the waiting customers to play interactive games via their smartphones, as well as unique unmanned service experiences such as electronic ordering, robot food delivery, wall projections of different themes, and customised seasoning services (Zhao and Pan, 2020). KFC's smart restaurant orders food for old and new customers through face recognition technology (Wu and Cheng, 2018). In Inamo Restaurant, dining tables use interactive projection technology to provide customers with a unique dining experience (Inamo Restaurant, 2019). In Taiwan, Magic Touch has introduced an intelligent service system that provides customers with intelligent ordering, Shinkansen conveyor belt delivery, inquiries into ordering records and consumption details, the tracking of food delivery statuses, and electronic checkout (Sushi Express, 2020). The services provided by the above smart restaurants are obviously different from those provided by traditional restaurants.

2.3 Service quality scale related to smart restaurants

Parasuraman et al. (1988) developed a service quality scale (SERVQUAL scale), which is regarded as a classic tool for evaluating the service performance of a company. Later, Parasuraman et al. (1991) noted that although the SERVQUAL scale may not be fully applicable to all service industries, it can still provide a guiding direction for the design of service quality questionnaires in different service industries. With the development of the Internet and e-commerce, Zeithaml et al. (2002) proposed the e-SERVQUAL scale to measure website service quality. Parasuraman et al. (2005) modified the e-SERVQUAL scale to construct online service quality scales, including the e-core service quality scale (E-S-QUAL) and the e-recovery service quality scale (E-RecS-QUAL). Regarding the evaluation of restaurant service quality, Stevens et al. (1995) developed the DINESERV scale based on the SERVQUAL scale. The DINESERV scale has been widely used in the evaluation of restaurant service quality by previous scholars (Cheng et al., 2019). However, the DINESERV scale cannot fully measure the service quality of new restaurants in recent years; hence, some researchers have integrated the service characteristics of different types of restaurants and developed various restaurant service quality scales (Cheng et al., 2019; Uslu and Eren, 2020; Tuncer et al., 2021).

Lee et al. (2018) proposed a model integrating perceived usefulness, perceived ease of use, trust, interaction, and output quality to explore the intention to use restaurant service robots. Their study verified that the item of perceived usefulness and perceived ease of use has reference value for measuring the system and information quality of a restaurant's IT or system. In addition, DeLone and McLean (2003) proposed the updated information systems success model (UISSM) and suggested that the system quality, information quality, and service quality of information systems have a positive impact on users' intention to use and their satisfaction. Based on the above findings, the service quality attributes of smart restaurants involve the same information system quality and e-service attributes. Therefore, the development of the SRSERV scale referred to the above service quality scale and information system behaviour model.

3 Methodology

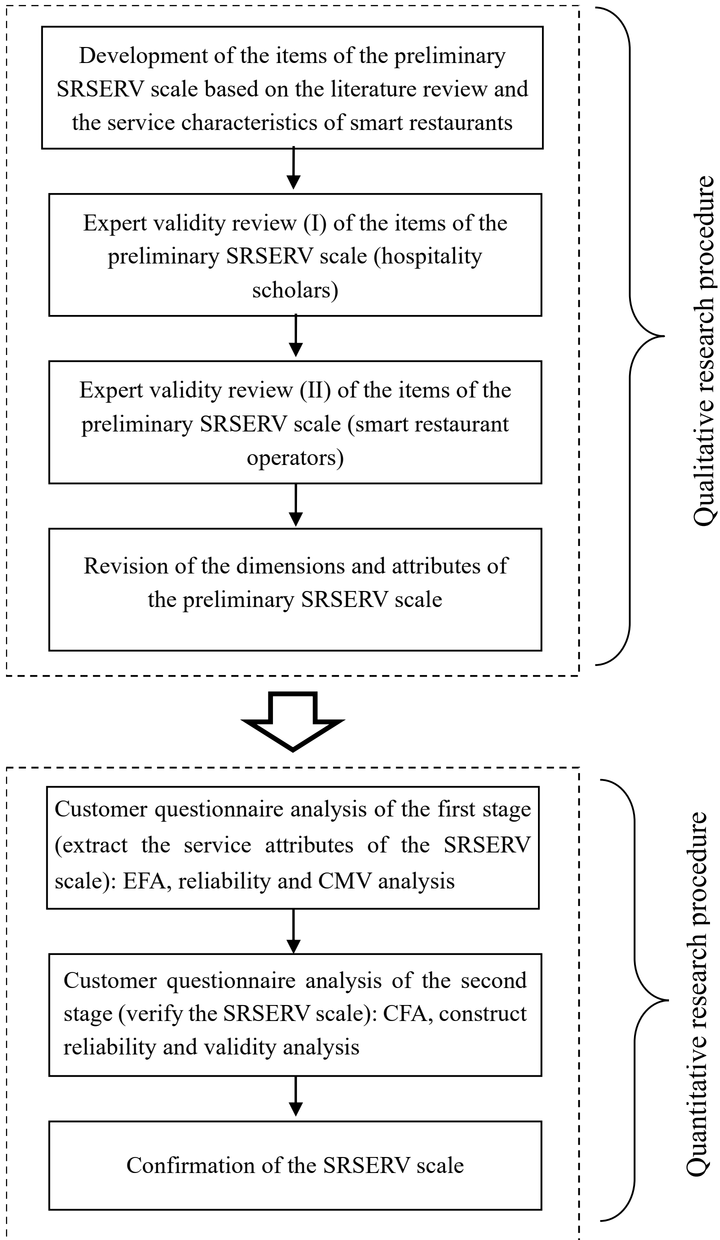
3.1 Development process of the SRSERV scale

This study aimed to construct the SRSERV scale through rigorous research procedures by referring to the development process of scales proposed by previous scholars (Churchill, 1979; Cheng et al., 2019). In the qualitative research procedure, this study referred to the related literature on smart restaurants and service quality, the service characteristics of smart restaurants, and expert opinions to design the items of the SRSERV scale. In the quantitative research procedure, this study collected customer questionnaires in two stages to extract and verify the service attributes of the SRSERV scale (Figure 1).

3.2 The development and design of the SRSERV scale items

The DINESERV scale is an instrument to evaluate restaurant service quality, and it has also become the basis for developing new scales for restaurant service quality (Cheng et al., 2019; Uslu and Eren, 2020; Tuncer et al., 2021). The service characteristics and attributes of smart restaurants are related to the quality of their information systems and electronic services; hence, some items of the E-S-QUAL, E-RecS-QUAL, and UISSM were also worthy of reference in the design of the SRSERV scale. To sum up, in the qualitative research procedure of the SRSERV scale development, this study collected the preliminary items of the SRSERV scale based on the DINESERV scale and referred to E-S-QUAL, E-RecS-QUAL, UISSM, restaurant information system literature, and smart restaurant service characteristics. This study revised and confirmed the items of the preliminary SRSERV scale based on the suggestions of expert interviews. Then, in the quantitative procedure, this study collected two-stage customer questionnaires to extract new dimensions and attributes of the SRSERV scale using exploratory factor analysis (EFA), and then verified the construct reliability and validity of the SRSERV scale using confirmatory factor analysis (CFA). The questionnaires in the first and second stages were measured by a five-point agreement scale and a five-point satisfaction scale, respectively.

Figure 1 Development process of the SRSERV scale



3.3 Questionnaire collection

In the quantitative procedure of the SRSERV scale construction, smart restaurants were selected in this study through field visits and experts' evaluation based on the definition of smart restaurants by previous scholars (Ghosh et al., 2015; Jakhete and Mankar, 2015; Wu and Cheng, 2018). This study used a two-stage customer questionnaire to extract the dimensions and attributes of the SRSERV scale, and then verified the applicability of the SRSERV scale in smart restaurants at different price levels, respectively. In this study, customers over 18 years of age in smart restaurants in Taipei City and New Taipei City were selected as subjects. The first and second stages of the customer questionnaires were distributed outside the smart restaurants from 21 January to 28 February 2021 and 20 March to 30 April 2021, respectively, using a mixed sampling method of systematic sampling (fixed time intervals) and purposive sampling (excluding non-subjects by visual inspection). In the first stage, 640 customer questionnaires were distributed. After excluding invalid questionnaires, 573 valid questionnaires were returned, with an effective recovery rate of 92.42%. Among the 573 customers, most of them were women (53.93%), 21–30 years old (39.62%), had university or college degrees (57.59%), were unmarried (54.45%), were service industry practitioners (38.39%), had a monthly income of NTD 20,001–40,000 (39.62%), and dined at smart restaurants three to five times per year (40.14%). In the second stage, 680 customer questionnaires were distributed. After deducting invalid questionnaires, 633 valid questionnaires were returned, with an effective recovery rate of 93.09%. Among the 633 customers, most of them were women (55.13%), 21–30 years of age (40.75%), had university or college degrees (59.87%), were unmarried (57.98%), were service industry practitioners (36.02%), had a monthly income of NTD 20,001–40,000 (38.86%), and dined at smart restaurants three to five times per year (38.86%). Among them, 307 questionnaires were collected from medium and high-priced smart restaurants (the average spending per person was over NTD 500), and 326 questionnaires were collected from affordable smart restaurants (the average spending per person was below NTD 500).

4 Results

4.1 Qualitative research procedures for the SRSERV scale construction

4.1.1 A search for the preliminary items of the SRSERV scale based on related literature

The SRSERV scale was conducted based on the DINESERV scale. After related literature and cases on subjects such as e-service quality, information systems, electronic ordering systems, and smart restaurants were classified (DeLone and McLean, 2003; Ghosh et al., 2015; Jakhete and Mankar, 2015; Lee et al., 2018; Wu and Cheng, 2018; Inamo Restaurant, 2019; Gursoy and Chi, 2020; Sushi Express, 2020), a total of 122 items related to the service quality of smart restaurants were summarised. Then, five experts (three hospitality scholars and two smart restaurant operators) were invited to review the items. Items with similar or repeated attributes, those with low relevance to the theme, and those that customers could not evaluate were combined with others or deleted. The resulting preliminary SRSERV scale contained seven dimensions, including tangibility, considerate service, responsiveness, reliability, assurance, empathy, and fun, with a total of 46 items.

4.1.2 Expert interview (I): interviews with hospitality scholars

In order to ensure the SRSERV scale had expert validity, the dimensions and attributes of the preliminary SRSERV scale were checked based on the suggestions in two stages of expert interviews. First, this study commissioned seven scholars of hospitality service quality to check the dimensions and attributes of the preliminary SRSERV scale. According to the suggestions of the above experts, a total of eight items were deleted because they were not the main services provided by smart restaurants or did not meet the needs of smart restaurants (such as intelligent parking lots and special appearances, delivery services, special services for the disabled or the elderly, etc.). In addition, according to the suggestions of the experts, 'providing customer ordering suggestions based on past ordering records' and 'providing preferential ordering suggestions' were combined into 'the ordering system of the smart restaurants can provide customers with ordering suggestions'. Furthermore, the experts assisted in modifying the semantics of 19 items to increase the clarity of the meanings. Finally, the experts added two new items in the dimension of considerate service, including 'the online reservation system of smart restaurants can automatically remind customers on the day of the reservation' and 'the ordering system of the smart restaurants is mobile, marking it is convenient for customers to read the menu and place orders'. According to the above expert interviews, the preliminary SRSERV scale contains seven dimensions, including tangibility, considerate service, responsiveness, reliability, assurance, empathy and fun, with a total of 39 items.

4.1.3 Expert interview (II): interview with smart restaurant operators

Next, this study commissioned five smart restaurant operators to review the dimensions and attributes of the SRSERV scale according to their practical experience. Four items were deleted due to being similar (e.g., having unique memories is similar to unforgettable memories), items that customers could not answer (e.g., manpower scheduling and cost saving), and services that most smart restaurants cannot fulfil (e.g., intelligent recycling stations and reservation systems). Another four items were combined into two items, including: the merging of 'The entertainment facilities are not boring' and 'The service content is interesting', and that of 'Service system makes customers feel convenient' and 'Providing convenient electronic ordering service'. Furthermore, the experts helped to modify the semantics of the four items to make them better align with the current situation. After two stages of expert interviews, the preliminary SRSERV scale contains seven dimensions, including tangibility, considerate service, responsiveness, reliability, assurance, empathy and fun, with a total of 33 items.

Finally, this study collected 56 pretest questionnaires and then used them to check the reliability coefficient of the seven dimensions in the SRSERV scale. This study found the Cronbach's alpha of the seven dimensions all exceeded 0.7, showing that all dimension of the SRSERV scale were reliable.

4.2 Quantitative research procedures for the SRSERV scale construction

4.2.1 Extraction of the dimensions and attributes of the SRSERV scale

This study utilised EFA to extract new dimensions and attributes from the SRSERV scale. In EFA, principal component analysis was employed to reduce the items, and the maximum variation method was used to rotate the axis. The items with factor loadings less than 0.5 were eliminated. The 573 questionnaires collected in the first stage were used to reduce the 33 items in the preliminary SRSERV scale through the first EFA. The Kaiser-Meyer-Olkin (KMO) value was 0.959 and Bartlett's test of Sphericity was

10,400.267 (P = 0.000), indicating the data structure of the questionnaire was suitable for factor analysis. Six factors were extracted from the first EFA, but three items (items 13, 19, and 31) were found to have a factor loading less than 0.5, suggesting these three items were less representative and could be deleted. This study used the remaining 30 items for the second EFA. In the results of the second EFA, six factors were extracted, and the factor loadings of all items were greater than 0.5, indicating the items were all representative for the SRSERV scale. The Cronbach's alpha of each factor exceeded 0.7, indicating these six factors had a good consistency. According to the characteristics of the items loaded by each factor, this study named these six factors as considerate service, responsiveness, fun and novelty, reliability, service efficacy, and empathy, with a total of 30 items. The overall explanatory variance of these six factors (new dimensions) was 65.266% (see Table 1).

Table 1 Extraction of the dimensions and attributes of the SRSERV scale by EFA (n = 573)

	Dimensions					
Items	*Considerate service (α = 0.899)*	*Responsiveness (α = 0.858)*	*Fun and novelty (α = 0.851)*	*Reliability (α = 0.845)*	*Service efficacy (α = 0.848)*	*Empathy (α = 0.803)*
Considerate service 5 (a1)	0.735					
Tangibility 3 (a2)	0.730					
Considerate service 7 (a3)	0.714					
Considerate service 4 (a4)	0.713					
Considerate service 8 (a5)	0.686					
Considerate service 6 (a6)	0.674					
Considerate service 9 (a7)	0.656					
Tangibility 2 (a8)	0.641					
Responsiveness 15 (b1)		0.730				
Responsiveness 14 (b2)		0.722				
Responsiveness 13 (b3)		0.671				
Responsiveness 12 (b4)		0.653				
Responsiveness 16 (b5)		0.614				
Fun 29 (c1)			0.840			
Fun 30 (c2)			0.761			
Fun 28 (c3)			0.757			
Considerate service 10 (c4)			0.672			
Reliability 24 (d1)				0.752		
Reliability 25 (d2)				0.667		
Reliability 23 (d3)				0.625		
Reliability 21 (d4)				0.613		
Assurance 26 (d5)				0.542		
Responsiveness 19 (e1)					0.717	
Responsiveness 18 (e2)					0.694	

Table 1 Extraction of the dimensions and attributes of the SRSERV scale by EFA (n = 573) (continued)

Items	*Dimensions*					
	Considerate service (α = 0.899)	*Responsiveness (α = 0.858)*	*Fun and novelty (α = 0.851)*	*Reliability (α = 0.845)*	*Service efficacy (α = 0.848)*	*Empathy (α = 0.803)*
Reliability 20 (e3)					0.643	
Reliability 22 (e4)					0.592	
Tangibility 1 (e5)					0.557	
Empathy 31 (f1)						0.755
Empathy 32 (f2)						0.728
Empathy 33 (f3)						0.724
Cumulative explained variance	16.277%	27.161%	37.653%	47.829%	57.695%	65.266%

In this study, Harman's single-factor test, proposed by Podsakoff and Organ (1986), was used to test the existence of common method variance (CMV) in the SRSERV scale. The principal component analysis of the 30 items in the SRSERV scale found that the explanatory variance of the first component was 40.427% (not more than 50%), indicating the customer questionnaire did not have CMV.

4.2.2 Verification of the SRSERV scale

In order to verify the construct reliability and validity of the SRSERV scale, 633 customer questionnaires were collected in the second stage, and the factor loadings of each dimension were used to calculate the construct reliability (CR) and construct validity (including the convergence validity and discrimination validity) of each dimension. Among the 633 respondents, 307 respondents dined at medium- and high-priced smart restaurants, and 326 respondents dined at affordable smart restaurants. The CFA results indicated that the structure of the SRSERV scale had a good overall fit. This study found that the factor loading of each item was significant ($P < 0.001$), the CR value of all dimensions exceeded 0.7, and the average variance extracted (AVE) of all dimensions exceeded 0.5 (see Table 2), suggesting the dimensions of the SRSERV scale all had good construct reliability and convergence validity based on the standard proposed by Fornell and Larcker (1981). Furthermore, the square root of the AVE value for all dimensions of the SRSERV scale was higher than the correlation coefficient between other dimensions, proving that all dimensions of the SRSERV scale had good discriminant validity (Fornell and Larcker, 1981).

Table 2 Verification of the SRSERV scale for smart restaurants at different prices

Dimensions		*Items*	*Medium and high-priced restaurants (n1 = 307)*			*Affordable restaurants (n2 = 326)*		
			Factor loading	*CR*	*AVE*	*Factor loading*	*CR*	*AVE*
a	Considerate service	a1	0.74***	0.914	0.571	0.78***	0.911	0.561
		a2	0.78***			0.75***		
		a3	0.81***			0.77***		
		a4	0.73***			0.73***		
		a5	0.76***			0.74***		
		a6	0.73***			0.74***		
		a7	0.77***			0.76***		
		a8	0.72***			0.72***		
b	Responsiveness	b1	0.76***	0.860	0.552	0.80***	0.890	0.618
		b2	0.78***			0.81***		
		b3	0.69***			0.78***		
		b4	0.76***			0.78***		
		b5	0.72***			0.76***		
c	Fun and novelty	c1	0.80***	0.866	0.617	0.82***	0.850	0.587
		c2	0.83***			0.75***		
		c3	0.75***			0.79***		
		c4	0.76***			0.70***		
d	Reliability	d1	0.76***	0.860	0.551	0.74***	0.865	0.563
		d2	0.71***			0.75***		
		d3	0.73***			0.78***		
		d4	0.78***			0.74***		
		d5	0.73***			0.74***		
e	Service efficacy	e1	0.75***	0.860	0.551	0.76***	0.881	0.897
		e2	0.73***			0.77***		
		e3	0.79***			0.84***		
		e4	0.72***			0.75***		
		e5	0.72***			0.74***		
f	Empathy	f1	0.83***	0.852	0.657	0.85***	0.892	0.734
		f2	0.76***			0.88***		
		f3	0.84***			0.84***		
n1 = 307: chi-square/d.f. = 1.700, GFI = 0.87, AGFI = 0.85, NFI = 0.97, NNFI = 0.99, CFI = 0.99, IFI = 0.99, RMSEA = 0.048, RMR = 0.036								
n2 = 326: chi-square/d.f. = 1.629, GFI = 0.88, AGFI = 0.86, NFI = 0.98, NNFI = 0.99, CFI = 0.99, IFI = 0.99, RMSEA = 0.044, RMR = 0.034								

Note: ***$P < 0.001$

4.4 *Confirmation of the formal SRSERV scale*

After a series of rigorous research procedures mentioned above, the formal SRSERV scale contained six dimensions, including considerate service, responsiveness, fun and novelty, reliability, service efficacy, and empathy, with a total of 30 items (see Table 3).

Table 3 The formal SRSERV scale

Dimensions		*Items*
Considerate service	1	There are intelligent calling devices on the dining tables of this smart restaurant for customers to call the service personnel.
	2	The ordering system of this smart restaurants is mobile, marking it is convenient for customers to read the menu and place orders.
	3	The IT system of this smart restaurants could support multiple languages.
	4	This smart restaurant has a variety of mobile payment devices to facilitate customers' checking out quickly.
	5	This smart restaurant provides operating instructions or special guidance for IT equipment.
	6	The ordering system of this smart restaurants can provide customers with ordering suggestions.
	7	Consumers can know the content or source of ingredients more clearly and completely through the ordering system.
	8	The IT system interface of this smart restaurant is easy to understand and attractive.
Responsiveness	9	This smart restaurant can interact and communicate well with customers.
	10	Customers' questions can be answered and solved professionally through IT equipment of this smart restaurant.
	11	When an error occurs, the customer can quickly correct the error through the application of IT equipment.
	12	Customers of this smart restaurant can quickly reflect service needs through IT equipment.
	13	Due to the use of IT equipment, the service failure rate of this smart restaurant is very low.
Fun and novelty	14	This smart restaurant uses robots or related technologies to make delicious dishes.
	15	The service content provided by this smart restaurant is interesting.
	16	The dining environment provided by this smart restaurant makes customers feel pleasantly surprised and novel.
	17	The ordering system of this smart restaurant can display or remind customers of the relevant information of the dishes.

Table 3 The formal SRSERV scale (continued)

Dimensions		*Items*
Reliability	18	Due to the use of IT equipment, the service process in this smart restaurant is greatly simplified.
	19	This smart restaurant establishes a good and stable online information system.
	20	Customers can get satisfactory and safe service through information equipment when dining in this smart restaurant.
	21	The information equipment of this smart restaurant is simple and easy to understand
	22	The electronic service in this smart restaurant can meet customer expectations and make customers trust (e.g., the automatic epidemic prevention service through IT during the epidemic)
Service efficacy	23	This smart restaurant can serve faster than traditional restaurants.
	24	The ordering system of this smart restaurant allows customers to improve the efficiency of ordering.
	25	This smart restaurant can provide stable and effective meals and service quality.
	26	This smart restaurant provides customers with an unforgettable dining experiences.
	27	This smart restaurant provides a convenient electronic ordering service.
Empathy	28	During the dining process, this smart restaurant cares about the customers' experiences.
	29	When customers make mistakes in using IT equipment, this smart restaurant shows sympathy and will not blame customers.
	30	When this smart restaurant adopts IT equipment, it puts customers' perception as a priority.

5 Discussion

The global restaurant industry has been impacted by the COVID-19 pandemic, and contactless services through the application of IoT, communication technology, and interactive devices have become valued by customers, which has promoted the development of smart restaurants (Gursoy and Chi, 2020; Chuah et al., 2021). Through the application and integration of IoT and communication technologies, smart restaurants can greatly improve the efficiency of restaurant service and provide customers with a unique service experience. Therefore, the measurement of service quality is important for the service quality management of smart restaurants, showing the importance of having a useful service quality scale. However, the service types and characteristics of smart restaurants are obviously different from those of traditional restaurants (Jakhete and Mankar, 2015; Ghosh et al., 2015; Wu and Cheng, 2018), and the traditional DINESERV scale cannot fully assess the service quality of smart restaurants. This study constructed the SRSERV scale to evaluate the service quality of smart restaurants and provide a reference for smart restaurant operators to upgrade their service quality, deploy service resources, and maintain competitive advantages.

Most of the service attributes of the SRSERV scale were oriented towards reducing personnel contact, and these service attributes conformed to the concept of smart services (Jakhete and Mankar, 2015; Ghosh et al., 2015) that could meet customers' dining service needs during the COVID-19 pandemic (Gursoy and Chi, 2020; Chuah et al., 2021). Although responsiveness, reliability, and empathy echo the characteristics of the DINESERV scale, the responsiveness, reliability, and empathy of the DINESERV scale mainly provide customer service through service personnel, while the responsiveness, reliability, and empathy of the SRSERV scale mostly provide customer service through information system assistance or contactless services. Hence, the service attributes of these dimensions were similar to those of the E-S-QUAL, E-RecS-QUAL, and UISSM scales (DeLone and McLean, 2003; Lee et al., 2018). In recent years, the development and application of IT in restaurants have grown rapidly (Lee et al., 2018; Sushi Express, 2020; Chuah et al., 2021). Whether for new customers or old customers, the considerate service provided by smart restaurants can relieve customers' doubts and unease about the use of technology, indicating considerate service is beneficial to the promotion of smart restaurants. Past studies have confirmed that the application of new IT brings considerable interest and entertainment to restaurant customers (Seyitoğlu and Ivanov, 2020; Chuah et al., 2021); therefore, in smart restaurants, providing interesting services can attract customers' attention, make customers feel pleasantly surprised and novel, and help smart restaurants transmit word of mouth in the future. Furthermore, through the application of new IT, restaurants can also improve the efficiency and quality of their customer service (Chung, 2019; Zhaltyrbayeva et al., 2021; Li et al., 2021). As mentioned above, smart restaurants can greatly improve service efficiency and provide fast, convenient, and stable service quality to customers (Jakhete and Mankar, 2015). To sum up, the six dimensions of the SRSERV scale conformed to the service characteristics of smart restaurants and were consistent with previous service quality scales and information system models.

6 Conclusions

This study constructed the SRSERV scale through rigorous qualitative (literature review and expert interviews) and quantitative (two-stage customer surveys and scale validation) research procedures. The SRSERV scale had good construct reliability, content validity, expert validity, convergence validity, and discriminant validity. The SRSERV scale consisted of six dimensions, including considerate service, responsiveness, fun and novelty, reliability, service efficacy, and empathy, with a total of 30 items. Subsequently, this study defined the six dimensions of the SRSERV scale based on the service characteristics of smart restaurants and previous service quality scales.

- Considerate service: The ability to provide extra or thoughtful services beyond customer expectations through information systems or technologies in smart restaurants.
- Responsiveness: The ability to provide customers with feedback and interactive services through information systems or technologies in smart restaurants.
- Fun and novelty: The ability to provide fun and novel services through information systems or technologies in smart restaurants.

- Reliability: The ability to perform the promised services through information systems or technologies in smart restaurants.
- Service efficacy: The ability to provide efficient, convenient, and stable services through information systems or technologies in smart restaurants.
- Empathy: The ability to care, sense, and sympathise with customers in smart restaurants.

7 Implications

In practice, smart restaurants can greatly improve the efficiency of their customer service and bring customers a unique dining experience. However, the service content and characteristics of smart restaurants are different from those of traditional restaurants. The restaurant service quality scales proposed by previous scholars can no longer fully and effectively evaluate the service quality of smart restaurants. If this problem is not solved, smart restaurant operators will be unable to either effectively evaluate customers' perceptions of restaurant service quality or grasp their service defects to improve service quality. The SRSERV scale can fully show the service characteristics provided by smart restaurants at present. The evaluation results of the SRSERV scale could help smart restaurant operators to effectively allocate resources and improve their service deficiencies under limited resources, so as to enhance their competitiveness in the restaurant market.

The service quality mentioned in the PZB model mostly focuses on the contact service of service personnel, which is different from the contactless service emphasised by smart restaurants based on HCI. In terms of this study's theoretical contributions, since this study defined the service quality of smart restaurants based on the fifth gap of the PZB model, the SRSERV scale could extend the applicability and rationality of the PZB model to the evaluation of the service quality of smart restaurants. In addition, due to the rapid development of IT, smart restaurants can provide services to customers through the assistance of information systems. The construction of the SRSERV scale could extend the theoretical concept of RBT to the intangible service of smart restaurants.

8 Limitations and future research recommendations

Due to the limitations of manpower and cost, in the quantitative research procedure of the SRSERV scale, this study only surveyed customer dining at smart restaurants in Taipei City and New Taipei City to verify the SRSERV scale. This is the first research limitation. In addition, this study used a cross-sectional study to construct the service quality scale for the smart restaurant. With the development of technology, the services provided by smart restaurants may continue to improve. Therefore, the current SRSERV scale constructed in this study may not be able to fully measure the service quality of smart restaurants in the future. This is the second research limitation. This study suggests that future researchers can continuously revise the SRSERV scale or add new evaluation items into the SRSERV scale based on the services provided by smart restaurants in the future. Finally, this study expects that future researchers can use different research methods to identify the service defects of smart restaurants in different regions, thereby improving the service quality and customer satisfaction of smart restaurants.

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