A multidimensional measure of system quality – an empirical study in context of mobile banking apps in India

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Abstract: With increasing adoption of banking through mobile apps, it is important to understand user's perception of system quality towards these apps. System quality has been identified as one of the system specific factors affecting user acceptance of the information system in IS literature. However, multidimensional nature of system quality has not been explored much and very few studies have focused on measuring system quality in mobile banking apps context. This study identifies sub-dimensions of system quality from literature, and it explores multidimensional nature of system quality and further confirms the validity and reliability of the multidimensional scale of system quality. The dimensions identified are reliability, ease of use, user interface, response time, security and functionality. The paper also confirms whether system quality performs better as a second-order factor in predicting user satisfaction as compared to first-order six sub-dimensional models does. The data were collected from total of 534 users of mobile banking apps in India through structured questionnaire. The questionnaire contained questions on system quality dimensions and satisfaction. The paper discusses implications for academicians in terms of measurement of system quality, and for practitioners in terms of understanding aspects of system performance from the user's point of view.

Keywords: system quality; user satisfaction; multidimensional scale; mobile banking apps; confirmatory factor analysis; India.

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1 Introduction

Technology has been increasingly playing an important role in banking sector since last couple of decades. And banks are continuously trying to explore best possible uses of technology to provide better services to their customers and increase their convenience and their efficiency. Mobile phones are one of the most commonly used technologies that have become an integral part of every individual's life. Mobile phones help to penetrate banking services to different level of customers with ease and in a cost and time efficient way. To offer their core services in more convenience way, most of the banks have developed their applications (known as apps) which once installed, can be useful to access banking services 24 × 7 from anywhere. According to the annual report of Reserve Bank of India for the year 2017 and 2018, there is a sharp growth in the volume and value of mobile banking transactions in India. According to RBI report, the value of mobile banking transactions has increased by 13% whereas the volume of mobile banking transactions has recorded a significant increase of 92% and reached to the level of 1,871 million transactions by the end of March 2018. These figures suggest that mobile banking is penetrating in India in manifolds.

In this context, it is necessary to understand users' acceptance of mobile banking apps and to identify the quality factors that affect their satisfaction with mobile banking apps. Adoption of mobile apps for banking is affected by system-specific as well as personal factors. DeLone and McLean (1992) model of IS success is one of the widely adopted model to study performance of IS in variety of context and system quality is considered as one of fundamental factors affecting the success of the IS. In IS literature, system quality has been defined as user's perception towards system's overall performance in terms of ease of use, convenience of access, reliability flexibility, etc. System quality significantly affects user's satisfaction and future usage intentions towards the IS. However, the multidimensional nature of system quality has not been explored much in

IS literature. Most of the studies based on DeLone and McLean (1992) model of IS success have measured system quality as one-dimensional construct except Stockdale and Borovicka (2006), Iivari (2005) and Li (2014). Among them, only Li (2014) has adopted system quality scale in context of mobile banking apps. This paper adopts the system quality scale from Li (2014) and tries to validate the system quality scale in mobile banking apps context in India. For this purpose, the data from users of mobile banking apps of major Indian banks has been collected. Sub-dimensions of system quality were identified by performing exploratory factor analysis on the data collected from initial sample and this factor structure is further confirmed using confirmatory factor analysis on the data from second sample of users. The paper also examines system quality as second-order construct and its nomological validity by examining the structural model linking system quality with user satisfaction. The second-order factor system quality-satisfaction model is compared with first-order factor-satisfaction model. Findings of the study will be useful to academicians and practitioners in studying performance characteristics of apps. It will help banks and the apps developers in better understanding major areas of concern from user's point of view.

The following section discusses concept of system quality and its dimensionality as reported by various studies in IS domain. In the following section, the design adopted for the study is explained along with data collection and sample profile. Results of the exploratory factor analysis are presented next. Then after, reliability and validity of the scale is established based on the results of CFA. And analysis of structural model is discussed. Lastly, the implications and limitations of the study are discussed.

2 Literature review

2.1 System quality

DeLone and McLean (2003) model has been widely studied as a model of IS success. And system quality is one of the important constructs of IS success model. System quality captures the desirable characteristics of an IS. DeLone and McLean (2003) noted that system quality reflects the desired technical characteristics of information systems and defined it in terms of usability, availability, reliability, adaptability and response time. The system quality of mobile banking can be regarded as the degree to which a system assists an individual in performing his or her portfolio of tasks. Poor system quality can frustrate the users' experience as it increases their difficulty of using m-banking and cannot lead to users' satisfaction over m-banking services (Carlos and Oliveira, 2017). Kumar and Shenbagaraman (2017) concluded that quality of system has impact on adoption of mobile banking.

However, studies have considered different sub-dimensions of system quality in different contexts. For example, Ivari (2005) measured system quality with six sub-dimensions as flexibility, integration, response time, recoverability, convenience, and language in their study focusing on Information system used at one of the municipal organisations in Finland. Stockdale and Borovicka (2006) identified accessible, usability, functionality, responsiveness, reliability, flexibility, security, and communication as dimensions of system quality of websites. Table 1 demonstrates dimensions of system quality included in major studies in different IS context. As can be seen in Table 1, ease of use and reliability are most commonly used dimensions to measure system quality.

Apart from this, other dimensions like flexibility (Chong et al., 2010; Lin, 2008), accessibility (Stockdale and Borovicka, 2006; Chong et al., 2010), and integration (Iivari, 2005) have also been considered in system quality measurement depending upon the system context. These studies have explored system quality in variety of system context like accounting system, e-learning system, hospital information system, e-commerce, corporate IS, etc. Most of these studies have measured system quality as one-dimensional construct with four to six statements covering few aspects of the system like ease of use, functionality and usefulness (Seddon and Kiew, 1994; Yakubu and Dasuki, 2018; Ojo, 2017; Wang, 2008; Lee and Lee, 2012; Chen et al., 2015; Montesdioca and Maçada, 2015; Baabdullah et al., 2019; Sharma and Sharma, 2019; Kurt, 2019). And very few studies have measured system quality as multidimensional construct having sub-dimensions (Stockdale and Borovicka, 2006; Iivari, 2005; Li, 2014). Thus, there is a need to explore and validate the multidimensional nature of system quality. Wang (2008) also noted that future research is required to establish a valid and reliable multidimensional measure of the system quality construct. There are few studies which adopt system quality and other constructs from DeLone and McLean (2003) model in mobile banking context (Carlos and Oliveira, 2017; Li, 2014; Budiwati and Kurniasih, 2014). These studies measured system quality as a one-dimensional construct for mobile banking, except Li (2014) which developed multidimensional scale for system quality consisting of sub-dimensions as reliability, ease of use, response time, security, functionality and security. The current study adopts the multidimensional measure of system quality from Li (2014) and validates the scale in mobile banking apps context in India. The study also assesses the multidimensional nature of system quality by comparing second-order system quality-satisfaction model with a rival model (i.e., first-order factors-satisfaction model).

Table 1 Dimensions of system quality

Dimension	*Source*
Reliability	DeLone and McLean (2003), Chong et al. (2010), Lin (2008), Stockdale and Borovicka (2006), Rivard et al. (1997), Li (2014), Montesdioca and Maçada (2015), Wei et al. (2017), Yakubu and Dasuki (2018)
Responsiveness/response time	DeLone and McLean (2003), Lin (2008), Lee and Lee (2012), Li (2014), Montesdioca and Maçada (2015), Wei et al. (2017), Kurt (2019)
Functionality	DeLone and McLean (2003), Au et al. (2008), Lee and Lee (2012), Li (2014), Chen et al. (2015), Montesdioca and Maçada (2015), Ojo (2017), Carlos and Oliveira (2017), Wei et al. (2017), Yakubu and Dasuki (2018)
Security	DeLone and McLean (2003), Stockdale and Borovicka (2006), Budiwati and Kurniasih (2014), Li (2014), Baabdullah et al. (2019)
Ease of navigation/user interface	Chong et al. (2010), Carlos and Oliveira (2017), Li (2014), Kurt (2019), Baabdullah et al. (2019), Sharma and Sharma (2019)
Ease of use	DeLone and McLean (2003), Seddon and Kiew (1994), Chong et al. (2010), Wang (2008), Lee and Lee (2012), Li (2014), Ojo (2017), Carlos and Oliveira (2017), Wei et al. (2017), Yakubu and Dasuki (2018), Sharma and Sharma (2019)

2.2 Dimensions of system quality

2.2.1 Reliability

Reliability has been included as a system quality dimension by many of the studies in this domain. DeLone and McLean (2003) also suggested that reliability is a sub-dimension of system quality. In mobile banking apps context, reliability is concerned with app performing the task without crashing/failing and completing transactions smoothly.

2.2.2 Response time

The time taken in loading the content, in login and logout and in processing of transactions also affects user's perception of system quality in case of websites as well as mobile apps. Studies in IS domain have considered response time as an important factor for system quality (Lin, 2008; Lee and Lee, 2012; Kurt, 2019).

2.2.3 Security

As internet banking and mobile banking is performed over internet as a channel, users are concerned about security of their information as well as financial security. Users' security concerns may be the major obstacles in adoption of mobile banking apps and users who perceive a banking app to be insecure will be less satisfied and may stop interacting with the banking app. Hidayanto et al. (2015) in their study in e-payment context found that security has significant influence on the adoption of e-payment to consumers. Budiwati and Kurniasih (2014) included security as a system quality factor in their study applying DeLone and McLean (1992) information success model in mobile banking context. Other studies in IS domain have also identified security as sub-dimension of system quality (Stockdale and Borovicka, 2006; Li, 2014; Baabdullah et al., 2019).

2.2.4 Functionality

Functionality refers to the range of banking functions that are available on mobile banking apps. Functionality is suggested as a system quality dimension by DeLone and McLean (2003) in their model. And other studies adopting this model in different IS context have also emphasised functionality of the system as an important criterion to gauge overall system quality of the system (Au et al., 2008; Lee and Lee, 2012; Li, 2014; Chen et al., 2015; Montesdioca and Maçada, 2015; Carlos and Oliveira, 2017; Yakubu and Dasuki, 2018). Availability of most/all banking functions in the banking app is likely result into improved user perception and satisfaction.

2.2.5 Ease of use

Ease of use is the most widely used measure of system quality in the IS success literature. Ease of use is suggested as crucial characteristics of IS in their model by DeLone and McLean (2003). And studies focusing on variety of IS settings have incorporated ease of use as a system quality dimension (Seddon and Kiew, 1994; Chong et al., 2010; Wang, 2008; Sharma and Sharma, 2019) and in mobile banking context also, ease of use has been included while measuring system quality perception (Chung and Kwon, 2009; Budiwati and Kurniasih, 2014; Li, 2014).

2.2.6 User interface

A well designed and structured app lets user access the menus and functions effectively. Ease of navigation, visually appealing aesthetics and layout of the app also affects user perception of the system quality in mobile banking context. Carlos and Oliveira (2017) suggested that by designing structured and easy to navigate mobile banking apps and better user interface, system quality perception can be improved. The dimension of user interface covers these aspects of a banking app. Studies in IS success domain have considered ease of navigation as a dimension of system quality rather than user interface (Chong et al., 2010; Carlos and Oliveira, 2017; Baabdullah et al., 2019; Sharma and Sharma, 2019; Kurt, 2019). And Li (2014) incorporated user interface for measuring system quality in mobile banking context.

3 Research design

The paper aims to validate the system quality scale in mobile banking apps context. For this purpose, the paper adopts scale of dimensions of system quality from the existing literature and explores the underlying dimensional structure by performing exploratory factor analysis and validates the multidimensional structure of system quality using confirmatory factor analysis. Reliability and validity of the system quality scale were examined based on the result of CFA. To test the nomological validity of the scale, the system quality scale was linked with user satisfaction using structural modelling equation, as user satisfaction has been found to be affected by system quality in previous studies (DeLone and McLean, 2003; Iivari, 2005).

3.1 Data collection

The data were collected using structured questionnaire consisting of questions for measuring customer perception towards system quality and satisfaction. In the first phase, the data for exploratory factor analysis was collected from 170 users of mobile banking applications of different Indian banks, out of which 150 questionnaires were found valid for analysis. In the second phase, to confirm the factor structure identified through EFA, the data were collected from a second sample of 400 respondents, out of which 384 questionnaires were found usable. The questionnaires were administered personally as well as electronically and the responses were coded and analysed using SPSS software. The demographic profile of total 534 respondents is presented in Table 2.

Table 2 Sample profile (n = 534)

Variables		*Frequency*	*Percent*
Gender	Male	346	64.8
	Female	188	35.2
Age	18 to 30 years	202	37.8
	30 years to 45 years	230	43.1
	45 years to 60 years	102	19.1

Table 2 Sample profile (n = 534) (continued)

Variables		*Frequency*	*Percent*
Education	Senior secondary	7	1.3
	Higher secondary	32	6.0
	Graduation	262	49.1
	Postgraduation	202	37.8
	Doctorate	31	5.8
Banking app used	State Bank of India	113	21.2
	Bank of Baroda	85	15.9
	HDFC Bank	89	16.7
	ICICI Bank	77	14.4
	Axis Bank	69	12.9
	CITI bank	9	1.7
	Kotak Mahindra Bank	28	5.2
	Union Bank	9	1.7
	Others	55	10.3
Frequency of usage	Less than once a week	147	27.5
	About once each week	146	27.3
	Several times each week	143	26.8
	About once each day	75	14.0
	Several times a day	23	4.3
	Total	*534*	*100.0*

4 Exploratory factor analysis

To examine whether the system quality scale is multidimensional or not and to explore the underlying dimensions of system quality, instrument containing total 26 variables were adopted from the literature. The responses were measured on a five point Likert scale from strongly agree to strongly disagree. Initial sample of 150 respondents was considered for collecting data for EFA, thus maintain the ratio of 1:5 of number variables to respondents as suggested by Hair et al. (2006). The responses were coded and analysed using SPSS. Exploratory factor analysis was performed using varimax rotation method. Bartlett test of sphericity and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was used to check whether the data is suitable for factor analysis or not. The results of the Bartlett test of sphericity (χ^2 = 2,588.30 with df = 300, p < 0.0001) suggested that the correlation matrix was not an identity matrix. The KMO value of the data at an overall level of 0.844 is considered excellent (Hair et al., 2006). At individual level also, the MSA value for each variable was > .5, indicating that the variables can be considered for factor analysis. EFA resulted into final factor structure consisting of six factors with total 25 variables after removal of one item due to low communality value ("My mobile banking app adjusts well to the screen size of my manufacturer device"). The resulting factor structure along with factor loadings is presented in Table 3. The six factors

namely, reliability, use interface, security, response time, ease of use, and functionality combinedly explained 72.87% of the total variance.

Table 3 Exploratory factor analysis

Factor	*Loadings*
Reliability	
This app does not crash.	.850
The app does not log me out in the middle of transactions.	.835
Pages on the app do not freeze.	.816
The app does not give me blank screens.	.792
The app always lets me log in.	.769
User interface	
The interface of this app looks good.	.805
The layout of this app is appealing.	.764
The menu of this app is well designed.	.760
The information on this app is attractively displayed.	.681
The app provides straightforward navigation to the functions I want to use.	.644
Security	
There is little risk involved in using this app.	.828
The app is secure.	.814
I am confident about the security of banking via this app.	.771
If I lost my manufacturer device, I would not be concerned that someone could access my account via this app.	.703
Response time	
Logging out of the app is fast.	.801
Logging into the app is fast.	.787
The app quickly loads all content	.772
The app processes my transactions quickly	.682
Ease of use	
It is easy to use the app to accomplish my banking tasks.	.835
Using the app is simple.	.751
Interaction with the app does not require a lot of mental effort.	.630
The app is easy to use.	.619
Functionality	
The app provides all the online banking functions that I want	.769
The app provides a wide range of online banking functions.	.763
Most online banking functions are included in the app.	.685

Notes: Extraction method: principal component analysis. Rotation method: varimax with Kaiser normalisation. n = 150.

Table 4 Confirmatory factor analysis

Factor	*Loadings*	*AVE*	*CR*
Reliability			
The app does not crash.	0.757	0.607	0.885
The app does not log me out in the middle of transactions.	0.720		
Pages on the app do not freeze.	0.833		
The app does not give me blank screens.	0.818		
The app always lets me log in.	0.761		
User interface			
The interface of the app looks good.	0.844	0.665	0.908
The layout of the app is appealing.	0.839		
The menu of the app is well designed.	0.875		
The information on the app is attractively displayed.	0.804		
The app provides straightforward navigation to the functions I want to use.	0.705		
Security			
There is little risk involved in using the app.	0.511	0.554	0.825
The app is secure.	0.867		
I am confident about the security of banking via the app.	0.898		
If I lost my manufacturer device, I would not be concerned that someone could access my account via the app.	0.629		
Response time			
Logging out of the app is fast.	0.842	0.697	0.902
Logging into the app is fast.	0.827		
The app quickly loads all content	0.852		
The app processes my transactions quickly	0.817		
Ease of use			
It is easy to use the app to accomplish my banking tasks.	0.855	0.716	0.910
Using the app is simple.	0.861		
Interaction with the app does not require a lot of mental effort.	0.827		
The app is easy to use.	0.842		
Functionality			
The app provides all the online banking functions that I want.	0.764	0.695	0.872
The app provides a wide range of online banking functions.	0.910		
Most online banking functions are included in the app.	0.821		

Note: $\chi^2(257) = 572.03$, $\chi^2 / df = 2.226$, AGFI = .869, CFI = 0.945, SRMR = 0.042, RMSEA = 0.057, CR – component reliability, AVE = average variance extracted and n = 384.

5 Confirmatory factor analysis

To confirm the factor structured identified from EFA, confirmatory factor analysis was run using AMOS Software. For this purpose, data was collected from second sample of

384 respondents using mobile banking app different Indian banks. The first-order CFA model exhibited a good model fit ($\chi^2(257) = 572.03$, χ^2 / *df* = 2.226, AGFI = .869, CFI = 0.945, SRMR = 0.042 and RMSEA = 0.057) as per Hu and Bentler (1999). As shown in Table 4, all of the 25 items loaded on their designated factors significantly. A subsequent CFA of the second-order factor model of system quality was performed which also produced provided acceptable model fit ($\chi^2(266) = 690.243$, χ^2 / *df* = 2.595, AGFI = .842, CFI = 0.938, SRMR = 0.070 and RMSEA = 0.065).

5.1 Common method bias

To ensure that the dataset is free from common method bias, the 25 scale items for six factors were examined using Harman's (1976) single-factor method (Podsakoff et al., 2003). The statistical results in this respect indicated that no single factor was able to emerge as well as the first factor accounted for 35.91% of variance which is less than the cut-off value of 50% as suggested by Podsakoff et al. (2003). Thus, the data on system quality does not have any concerns regarding the common method bias.

5.2 Reliability and validity

Reliabilities are assessed using composite reliabilities (CRs) values. As shown in Table 4, the CRs of all the factors are > 0.7, demonstrating adequate reliabilities for the all sub-dimensions (Fornell and Larcker, 1981). Further, convergent, discriminant, and nomological validity of the scale is assessed using the results of CFA. Convergent validity is an indication of the extent to which assessment measures correlate with other measures that it should be related to. Convergent validity can be examined by calculating the average variance extracted (AVE). Here, AVE for each factor is > .5, indicating acceptable convergent validity of the scale. Discriminant validity can be ensured if a measure does not correlate very highly with other measures from which it is supposed to differ. Discriminant validity of the measures was assessed in two ways. First, all the cross-construct correlation coefficients were significantly ($p < 0.001$) less than 1.0. Second, square root of AVE values was compared with construct correlations. As shown in Table 5, all the square root of AVE values (diagonal values) are greater than the construct correlation values (Fornell and Larcker, 1981). This confirms discriminant validity for the constructs.

Table 5 Convergent and discriminant validity

Factors		*AVE*	*1*	*2*	*3*	*4*	*5*	*6*
1	Functionality	0.695	*0.834*					
2	Reliability	0.591	0.351	*0.769*				
3	User interface	0.665	0.653	0.474	*0.815*			
4	Response time	0.715	0.558	0.526	0.525	*0.846*		
5	Security	0.554	0.564	0.408	0.531	0.733	*0.744*	
6	Ease of use	0.733	0.756	0.521	0.788	0.543	0.524	*0.856*

Notes: All the cross-construct correlation coefficients were statistically significant ($p < 0.001$). Diagonal values are square root of AVE values.

Table 6 Structural model comparison (system quality as second-order factor v/s. six-factor model)

Structural model comparison (system quality as second-order factor v/s six-factor rival model)					
Second-order factor model			*Six-factor rival model*		
		Standardised coefficient			*Standardised coefficient*
System quality	Satisfaction	0.870*	Reliability	Satisfaction	-0.017
System quality	Reliability	0.544*	User interface	Satisfaction	0.149*
System quality	User interface	0.837*	Response time	Satisfaction	0.071
System quality	Response time	0.654*	Security	Satisfaction	0.187*
System quality	Security	0.664*	Functionality	Satisfaction	0.324*
System quality	Functionality	0.829*	Ease of use	Satisfaction	0.599*
System quality	Ease of use	0.907*			
Explained variance in			*Explained variance in*		
	Satisfaction	75%		Satisfaction	53%
	Reliability	30%			
	User interface	70%			
	Response time	43%			
	Security	44%			
	Functionality	69%			
	Ease of use	82%			
Model fit values			*Model fit values*		
	χ^2 / df	2.302		χ^2 / df	0.822
	CFI	0.945		CFI	0.833
	TLI	0.938		TLI	0.813
	RMSEA	0.058		RMSEA	0.1
	SRMR	0.0672		SRMR	0.339

Note: *Significant at .05 level.

Nomological validity is established when the construct behaves as expected with other constructs to which it is theoretically related. To assess nomological validity of the system quality scale, the relationship of second-order system quality scale with user satisfaction with the mobile banking app is investigated, as user satisfaction has been found to be affected by system quality by existing studies (DeLone and McLean, 2003; Iivari, 2005; Kurt, 2019). User satisfaction was measured using three-item scale in this study. The second-order model linking system quality to user satisfaction was tested via structural equation modelling (SEM). Further, a six-factor model was created as a rival model to test the relationship between the six sub-dimensions of system quality and user satisfaction. This rival model is developed with the assumption that system quality is not a second-order construct and six factors predict user satisfaction better than the overall system quality construct does. The results of the model comparison are presented in Table 6. The second-order system quality → user satisfaction model demonstrated a better model fit (χ^2 / *df* = 2.324, CFI = 0.944, TLI = .937, RMSEA = 0.059 and SRMR = .0658) than the rival model (χ^2 / *df* = 5.093, CFI = 0.827; TLI = 0.806, RMSEA = 0.1 and SRMR = .3385). Also, second-order system quality model performed better in terms of explaining variance in user satisfaction as compared to rival model (75% as compared to 53%, respectively). The test results confirmed that system quality had a significant and positive effect on user satisfaction (β = .870), providing support for the nomological validity of the scale. And the results also confirmed that second-order factor model better fits the data and thus, providing for the validity of the second-order system quality scale.

6 Discussion and implications

Quality of the IS as perceived by its users is of prime importance for acceptance of the IS. Literature in IS domain has considered system quality as a predictor of acceptance and success of the information system. However, multidimensional nature of system quality has not been explored much and most of the studies have measured the construct as one-dimensional construct. As banks have started offering their services through mobile apps and adoption of these apps is of great importance in terms of convenience and efficiency for both banks and customers, user's perception of system quality towards these apps needs to be studied. In this context, this study aims at validating multidimensional scale of system quality of mobile banking apps. The sub-dimensions of system quality are identified from existing literature and the scale was tested for reliability and validity using the data collected from users of mobile banking apps. The findings suggest that system quality is a multidimensional construct consisting of six dimensions namely, reliability, user interface, security, response time, ease of use and functionality. This 25-item scale of system quality was further confirmed by results of CFA. The first-order and second-order model of system quality was found valid and reliability and validity of the scale was examined. The results of CFA supported convergent and discriminant validity of the scale. To establish nomological validity, the structural model linking system quality with user satisfaction was developed and analysed. System quality construct found to have significant positive impact on user satisfaction as expected, thus supporting nomological validity of the scale. It can be concluded that the system quality scale stands validated to a good extent in mobile banking apps context.

One of the major contributions of the study is to assess multidimensionality of system quality construct. Previous studies have reported dissimilar findings on dimensionality of system quality and not operationalised system quality as higher-order construct. This study conceptualised and examined system quality as second-order construct. For this purpose, the model predicting user satisfaction with system quality as second-order factor was compared with a rival model having six-factors as independent variables and user satisfaction as dependent variable. The results of model comparison suggested that system quality as second-order factor predicts user satisfaction better and the model demonstrated better fit than the rival model. This provides strong evidence for multidimensional nature of system quality. As noted in literature review, most of the studies in IS domain have operationalised system quality in terms of one or two aspects (ease of use and user interface) only. This study derives comprehensive set of factors capturing user's perception of what constitutes system quality from existing literature and validates the six-dimensional scale of system quality. The multidimensional scale of system quality may be used by future studies in examining system quality and its impact on important behavioural variables in other IS contexts.

Findings of the study bear several important managerial implications also. The study helps practitioners in understanding system's performance related factors that constitute user perception towards overall system quality. The six factors namely, reliability, user interface, security, response time, ease of use and functionality represent the major areas of concern for users of mobile banking apps. Findings of the study suggest that bank managers and app designers should focus on designing apps which performs consistently and does not crash while operating. Also, the apps should have user friendly and well-designed interface and structure, as this would contribute to enhanced user experience. Further, the mobile banking apps should be designed to keep the time taken in loading the content and completing transactions minimum. As mobile banking apps require users to share data and perform transaction online, security of these apps is of prime importance for users. Another important recommendation is to negate any chance of user's scepticism regarding security of the system for better acceptance of the system. Further, bankers and app designers need to stress on the functionality offered by the apps. Apps offering very limited range of functions to users will be perceived as having poor system quality as the app will not provide a fulfilling experience to the user. User acceptance of the system depends largely on how much easy it is for the user to learn and to use it. As noted in literature review, ease of use has been the most widely used measure of system quality in IS literature. As performing banking transaction through mobile apps might be tricky and complex for many customers, designing the apps, which are easy to use, will be major determinant of their adoption.

Another important finding of the study provides evidence for relationship between system quality and user satisfaction, as observed by many other studies also. The second-order system quality explained 75% variance in user satisfaction. Thus, banks offering their services through apps, need to consider the factors of system quality while designing their apps as they combinedly affect user satisfaction towards their apps. By designing apps which operates reliably, takes lesser time in responding, allows users to perform range of functions, have user friendly interface and menus, have better security control, and which are easier to learn and use, bankers and apps developers can ensure better user satisfaction.

7 Limitations of the study and future research directions

The present study has several limitations. First, the present study is based on cross-sectional data only. By replicating the study and by carrying longitudinal studies, findings of the studies can be further validated. The second limitation of the study is that, the research investigated system quality within the mobile banking apps context, that too within one country only. Further studies may consider replicating this research in other cultures and contexts. The other limitation of the study is that it does not shed any light on importance of sub-dimensions from user's point of view. It is likely that the sub-dimensions of system quality may bear different importance and users with different demographics may weigh certain aspects of system quality more than other. Future studies may try to study which dimensions are more important to customers. Lastly, the study related system quality with user satisfaction for establishing nomological validity of multidimensional measure of system quality. Future studies may consider other consequences of system quality like intention to use, use and perceived value to confirm its nomological validity.

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