Routledge
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Total Quality Management & Business Excellence

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/ctqm20

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To cite this article: Elizabeth Oppong , Robert Ebo Hinson , Ogechi Adeola , Omotayo Muritala & John Paul Kosiba (2021) The effect of mobile health service quality on user satisfaction and continual usage, Total Quality Management & Business Excellence, 32:1-2, 177-198, DOI: 10.1080/14783363.2018.1541734

To link to this article: https://doi.org/10.1080/14783363.2018.1541734

Total Quality Management, 2021
Vol. 32, No. 2, 177–198, https://doi.org/10.1080/14783363.2018.1541734

The effect of mobile health service quality on user satisfaction and continual usage

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This paper assesses the level of mobile health service quality and its effect on user satisfaction and continual usage among selected maternal healthcare users in rural Ghana. A purposive sampling method is deployed to select 305 respondents. Structural equation modelling technique is used to analyse an mHealth service quality model. Among the three dimensions of mHealth service quality, only interaction quality is significant on user satisfaction while all the three mHealth service quality dimensions were found to have a positive impact on continual usage. A positive effect of satisfaction on continual usage exists and perceived monetary cost moderates the effect. The study suggests that service providers should empower their personnel through the provision of periodic training on good customer relations. This paper contributes to the understanding of service quality issues in mHealth services for maternal healthcare delivery with insights for other sectors.

Keywords: Ghana; mHealth; service quality; user satisfaction; continual usage; monetary cost

Introduction

The mobile phone is one of the technologies that has spread fast around the globe (Boateng, Hinson, Galadima, & Olumide, 2014). In 2015, there were over seven billion mobile cellular phone subscribers worldwide (International Telecommunication Union (ITU), 2015). The introduction of low-cost mobile phones from China and pre-paid tariffs from telecommunications networks have contributed immensely to the spread of mobile technology especially in developing economies (Tobbin, 2012). Ghana, a West African country with a population of more than 27 million (World Bank, 2016), is estimated to have over 35 million mobile voice subscriptions (National Communications Authority (NCA), 2016).

Developments in mobile technology services have attracted the interest of donor agencies, programme implementers and health institutions as they seek to establish and deliver mobile health services to consumers (Lewis, Synowiec, Lagomarsino, & Schweitzer, 2012). Mobile health, popularly referred to as mHealth technology can broadly be defined as 'the use of portable devices capable of creating, storing, retrieving, and transmitting data in real time between end users for the purpose of improving patient safety and quality of care' (Akter & Ray, 2010a, p. 75).

Healthcare institutions, especially in developing economies are continually plagued with increased public healthcare challenges such as HIV/AIDS, cholera, malnutrition, malaria and disease outbreaks; coupled with high maternal mortality rates, shortages of

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trained healthcare personnel in rural communities and uneasy access to quality healthcare facilities. (Sanner, Roland, & Braa, 2012; Lewis et al., 2012). Global report on inequalities in rural health protection compiled by the International Labour Organisation (ILO) (2015) indicates that 56% of people living in rural areas across the globe are denied critical healthcare access as compared with those in the urban areas, especially in developing countries. Mobile health has been a tool in closing the gap in access to healthcare. There are over 600 mHealth projects in developing countries (Dahdah, Du- Loû, & Méadel, 2015). Deng, Moa, and Liu (2014) outlines four types, namely, (i) mHealth service for healthcare research, where data is collected with a portable wireless device; (ii) mHealth for healthcare professionals, where mHealth is used for medical education and medical records keeping; (iii) mHealth for patient appointment, reminders and treatment and finally, (iv) mHealth for the general population to promote health behaviour change and emergency care. This study focuses on the aspect of mHealth for a patient appointment and preventive maternal healthcare using reminders.

One of the major organisational challenges in most healthcare institutions is the provision of quality service to an increasing number of people at a minimal cost. Drawing on the above-mentioned organisational challenge, it might be useful to ascertain whether users are satisfied with the quality of mHealth services they receive, and what factors account for their satisfaction and continued usage of mHealth services? The increased use of mobile phones to access healthcare service by both health professionals and consumers has raised the need for more attention to be focused on mHealth service quality issues. In August, the National Institute of Health (NIH), USA, in collaboration with University of California, Los Angeles, conducted a training programme for world leaders in mobile technology and behavioural science and urged current researchers to include mobile health (mHealth) application products in their research to strengthen and support on-going quality health campaigns globally (NIH, 2015).

Provision of quality healthcare in Ghana is a priority in the national health agenda (Atinga, Abekah-Nkrumah, & Domfeh, 2011). This study seeks to assess the level of mHealth service quality and its effect on user satisfaction and continual usage among rural communities in Ghana. The specific objectives are first, to examine the effect of mHealth service quality dimensions on user satisfaction among rural communities in Ghana; second, to examine the effect of mHealth service quality dimensions on continual usage among rural communities in Ghana and finally to examine the effect of monetary cost on the relationship between user satisfaction and continual usage of mHealth service. Findings from this study would enable health regulatory bodies, healthcare institutions, mobile technology developers, mobile network providers and donor agencies to have appreciable knowledge of the motivational factors that promote the adoption and sustainability of mobile health by rural communities in developing countries.

This paper is set out as follows: the first part focuses on the introductory aspects of the study, and the second part reviews extant literature on mHealth service quality. In the third section, the paper presents the conceptual framework and hypotheses that form the basis of the study. The fourth section dwells on the research methods, while the fifth section presents the data analysis and findings. In the sixth section, the conclusion and recommendations are provided.

Literature review

The use of mobile phones in healthcare delivery is more recent (Dahdah et al., 2015; Meigounpoory, Sajadi, & Danehzan, 2014). Research on mHealth services is still in its infancy

stage and not up to date (Akter, D'Ambra, & Ray, 2013b). The areas of interest in mHealth services that are frequently researched include: self-care management support (Bonoto et al., 2017; Holmen et al., 2014); disease prevention (Park, Beatty, Stafford, & Whooley, 2016; Free et al., 2013); medication adherence (Shellmer, Dew, Mazariegos, & DeVito Dabbs, 2016; Ovbiagele et al., 2015); sexual and reproductive health (Nchise, Boateng, Shu, & Mbarika, 2012); privacy and security (Bhuyan et al., 2017; Martínez-Pérez, De La Torre-Díez, & López-Coronado, 2015); mental health (Proudfoot, 2013; Harrison et al., 2011); maternal care (Dahdah et al., 2015; Tamrat & Kachnowski, 2012); as well as obesity and eating disorders (Fairburn & Rothwell, 2015; Gerber, Stolley, Thompson, Sharp, & Fitzgibbon, 2009). These studies attest to the fact that the use of mHealth service by customers could help reduce or eliminate preventable diseases. Hence, the need for more attention to be focused on the quality of mHealth services in order to encourage continual usage.

Studies by Akter, D'Ambra, Ray, and Hani (2013a) and Meigounpoory et al. (2014) have raised concerns about service quality issues in mobile healthcare delivery and the need for a valid instrument to be used to determine factors that enhance service quality in mHealth. Akter et al. (2013b) developed the mHealth service quality model to predict user satisfaction and continual usage. Three key dimensions of mHealth service quality were identified. These are system quality (users' perceptions regarding the technical level of communication), interaction quality (communication between service provider and consumer) and information quality (benefits of information services). However, the model analysed service quality dimensions in aggregated form. Closing the gap, the current study disaggregates quality of service sub-dimensions and examines their effects on satisfaction and continual usage using data from rural communities in Ghana.

Findings from the study of Nchise et al. (2012) indicate that the cost incentive play a major and influential role in consumers' access to health information through the use of mobile phones. However, studies on mHealth services in relation to monetary cost predominantly focus more on infrastructure, human resource, information technology development, sustainability of mHealth intervention projects and healthcare delivery cost (Schweitzer & Synowiec, 2012). There is a paucity of research on consumer's monetary costs and its implication on satisfaction and continual usage of mHealth services. The monetary cost has been found to have an influence on consumer satisfaction (Zhou, 2011; Boadi, Boateng, Hinson, & Opoku, 2007) and continual usage (Shin, Lee, Sin, & Lee, 2010). The monetary cost was not considered by Akter et al. (2013b), and this further weakens the evidence provided by their study. The current study deploys a model that incorporates situational constructs of perceived monetary cost and evaluates its moderating role on the effect of mHealth quality of service on satisfaction and continuous usage.

Conceptualisation of mhealth service quality

Some researchers have argued strongly that there is need for a clear distinction to be made between mHealth service quality and other existing healthcare service quality frameworks due to the unique characteristics of mHealth such as virtual consultation, ubiquity, accessibility, personalised nature, immediacy, interactivity and mobility (Motamarri, Akter, Ray, & Tseng, 2014; Akter et al., 2013a, 2013b). Lu et al. (2009) and Huang et al. (2015) have also called for a clear distinction to be made between service quality attributes of virtual products and physical products. Early publications on service quality of mHealth did not use any valid scale to directly measure key mHealth service quality attributes identified (Akter et al. 2013b).

Past studies have argued that context-specific measurement of service quality is more suitable than the generic scale (Dagger et al., 2007; Fassnacht & Kooese, 2006). An instrument to measure and predict mHealth service quality specifically for developing economy was recently developed by Akter et al. (2013b) using generic theories in marketing, information systems and health management as a guiding model. The model also assesses how service quality can influence user satisfaction and continuance. The focus of this study is in that direction and hence builds strongly on Akter et al. (2013b)'s model. Several authors have cited and acknowledged Akter et al. (2013b)'s mHealth service quality model (Ha et al., 2015; Meigounpoory et al., 2014; Hossain & Quaddus, 2015; Su et al., 2016). The three key mHealth service quality dimensions identified were system quality, interaction quality and information quality and these are discussed in turn:

System Quality: System quality measures technical success and can be defined as 'users' perceptions regarding the technical level of communication (Delone & McLean, 2003). Chatterjee et al. (2009) argue that the data processing capability of a system, in terms of the ability of a system to integrate data from different places, can effectively influence high use and increase satisfaction among users. Akter et al. (2013b) categorised three key elements that can have a positive impact on system quality. These are system reliability (the ability to perform the promised service dependably and accurately), privacy (the degree to which the customer believes the system is safe and can be trusted) and system efficiency (the degree to which a system is simple to use, properly structured and able to meet the various needs of the user). A system is said to be of quality when it is useful, available, reliable, adaptable and gives a timely response (Delone & McLean, 2003).

Interaction Quality: Interaction is communication that occurs between the service provider and consumer. Human to human interaction is a key tool that influences customer satisfaction and adoption of a technology-facilitated service (Chowdhury et al., 2014). Wu et al. (2015) and Hinson et al. (2011) hold that a frontline personnel level of interpersonal competence has a strong positive impact on service quality. Akter et al. (2013b) also identified three key elements that define interaction quality and these include cooperation (the willingness of the service provider to deliver and provide prompt service to users), confidence (the degree to which a system is considered safe to use) and care (customised attention from service providers to consumers). Brady & Cronin (2001) also identified the attitude, behaviour and expertise of service provider personnel as some of the interaction quality attributes that influence consumer perceptions of service quality.

Information Quality: Information quality can be defined as the degree to which a service is helpful in completing a particular task (Motamarri et al., 2014). The content of information should be personalised, complete, relevant, easy to understand, and secured (DeLone & McLean, 2003). Information quality can be classified as a utilitarian benefit or hedonic benefit (Akter et al., 2013b; Fassnacht & Koese, 2006). A utilitarian benefit is 'the degree to which the mHealth information serves its actual purpose', and a hedonic benefit is 'the degree to which an mHealth information service arouses positive feelings' (Akter et al., 2013b, p. 185). Chae et al. (2001) identified four key elements in information quality, namely, connection quality (access to stable mobile service with less interruption of connection), content quality (value and usefulness of information provided), interaction quality (which is the service provider's easy and efficient way of interacting with consumers) and contextual quality (that is the timeliness with which customers can have unrestricted access to information irrespective of time and location).

User satisfaction

Maintaining and providing customer satisfaction is one of the major challenges faced by many service industries (Parasuraman, Zeithaml, & Berry, 1988). Satisfaction is a person's 'feeling of pleasure or disappointment resulting from comparing a product's perceived performance or outcome in relation to his or her expectations' (Kotler & Keller, 2012, p. 10). Mahmood, Burn, Gemoets, and Jacquez (2000) suggest that convenience, user background and an organisation's attitude and support constitute three elements that enhance user satisfaction in information technology service. However, Boadi et al. (2007) also hold that customer satisfaction with mobile technology services could be enhanced when service providers give three key elements (abbreviated, the '3C's' – convenience, cost and communication) considerable attention. Narteh (2015) and Makarem, Mudambi, and Podoshen (2009) argue that service convenience is one of the key elements that have a strong impact on customer satisfaction in technology-enabled services. Zhou (2011) asserts that users expect to receive quality services at low cost and hence their satisfaction level would be greatly influenced by the monetary cost of usage.

Conceptual framework and hypotheses

Drawing on the literature reviewed, the conceptual framework for this study centres on the impact of mHealth service quality on user satisfaction and continual usage as well as the effect of monetary cost on user satisfaction and continuance. The three key dimensions in mHealth service quality: system quality, interaction quality and information quality, have a great impact on user satisfaction leading to continual usage of mHealth services (Akter et al., 2013b). The monetary cost of acquisition and usage of mobile services are non-negligible and have an influence on user satisfaction and desire to continue to use the service (Zhou, 2011; Boadi et al., 2007). Figure 1 displays the conceptual framework.

The relationship between service quality and user satisfaction

Three issues that typically characterise the relationship between service quality and satisfaction are, 'satisfaction is an antecedent of service quality, service quality is a predictor of satisfaction, and service quality and satisfaction are interchangeable' (Kassim & Abdullah, 2008, p. 4). Early scholarly writing on service management holds an argument that 'customer

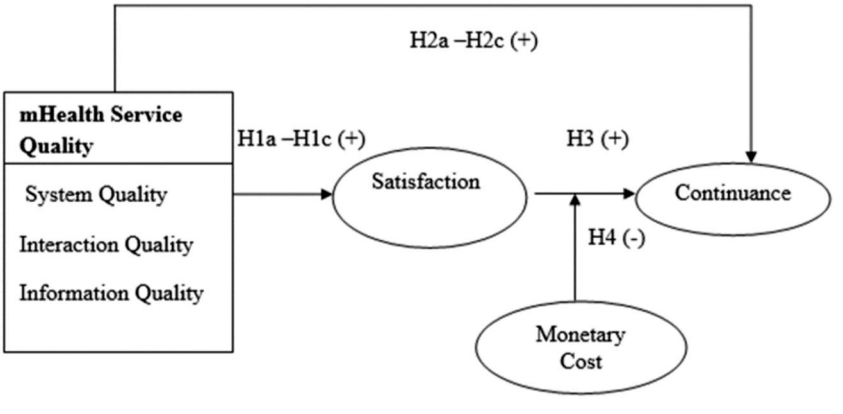

Figure 1. The Conceptual Framework. Source: Adopted from (Akter et al., 2013b; Boadi et al., 2007; Wu & Wang, 2005).

satisfaction depends on the customer's perception of the value received in a transaction, where value is the same as perceived service quality' (Hallowell, 1996, p. 2). In the healthcare sector, service quality and patient satisfaction continue to remain a critical issue for health service providers (Atinga et al., 2011). A study by Atinga et al. (2011) found that communication and the patient–provider relationship are key indicators of health service quality leading to patient satisfaction. Studies by Dagger, Sweeney, and Johnson (2007) confirm that overall health service quality has a significant positive impact on health service satisfaction and behavioural intentions. However, Caruana, Money, and Berthon (2000) posit that although consumers might perceive a service firm to produce quality service, it does not necessarily mean that consumers would be satisfied with the service.

Service quality is hierarchical and multidimensional (Brady & Cronin, 2001). Each dimension plays a different role towards enhancing service quality and customer satisfaction. A system is said to be of quality when it is useful, available, reliable, adaptable and gives a timely response (Delone & McLean, 2003). System reliability is perceived to have a strong influence on usage and user satisfaction of an information system (Nelson, Todd, & Wixom, 2005). Studies by Lu, Zhang, and Wang (2009) identified interaction attributes such as attitude, expertise and problem solving to have a strong influence on service quality of mobile service. Wang and Liao (2008) also posit that quality information leads to user satisfaction in an electronic service. Hence, this study holds the view that each of the three dimensions of mHealth service quality has a major role to play to enhance users' satisfaction. The study, therefore, posits that:

H1a: System quality has a positive effect on user satisfaction of mHealth services.
H1b: Interaction quality has a positive effect on user satisfaction of mHealth services.
H1c: Information quality has a positive effect on user satisfaction of mHealth services

Continual usage of mobile technology services

Providers of services stand the chance of failing and not making a profit unless consumers continue to use their services (Bhattacherjee, 2001a). Continual usage, also called post-adoption, is the behavioural pattern reflecting the continued use of products or services (Zhou, 2011). Boakye (2015), in the context of mobile data service continuance, noted service quality, mobility and customer experience as key determinants. Findings from Bhattacherjee's (2001b) study on the antecedents of electronic commerce service continuance indicated that satisfaction was the strongest predictor of continuance intention. In building on the works of Bhattacherjee (2001b), Akter, Ray, and D'Ambra (2012) suggested that service quality and trust result in positive behavioural intentions and hence play a pivotal role in promoting the continuance of mHealth services. This study, therefore, posits that:

H2a: System quality has a positive effect on continual usage of mHealth services.
H2b: Interaction quality has a positive effect on continual usage of mHealth services.
H2c: Information quality has a positive effect on continual usage of mHealth services.
H3: User satisfaction has a positive effect on continual usage of mHealth services.

Monetary cost, satisfaction and continuance

The tendency for users to discontinue usage, complain and pass negative comments on mobile services is high, especially when monetary cost of usage is high (Zhou, 2011). Monetary cost is 'any transactions either direct or indirect with a monetary value implemented via a wireless telecommunication network' (Wu & Wang, 2005, p. 2). Kim, Chan, and

Gupta (2007) found monetary cost such as user perceived fee to be a major hindrance to mobile service adoption. Similarly, Zhou (2011) and Boadi et al. (2007) reveal that the satisfaction level and the desire to continue to use or adopt a service by consumers would be greatly influenced by the monetary costs involved.

The monetary cost of mobile service in most developing economies involves equipment cost (price of mobile phone and cost of maintenance), access (initial monetary cost of locating or subscribing to the service), and transaction costs (cost incurred each time services are used) (Boadi et al., 2007; Wu & Wang, 2005). Users must be in a good financial position to access and continually use the mobile service (Wu & Wang, 2005; Zhou, Lu, & Wang, 2010). However, Deng, Lu, Wei, and Zhang (2010) hold the view that when a consumer finds true value for money in accessing services, they would be generally satisfied and continue to use the service.

Most mHealth services in developing countries are sponsored pilot projects (Dahdah et al., 2015) that are delivered to users in rural communities at no fee at the initial stages. Users might pay for mHealth services after the pilot stage. However, to have access to mHealth services and enjoy the full benefit of the service even at the pilot stage, users must own a mobile phone and be able to replace worn-out batteries and chargers, subscribe to a particular network and frequently upload top up credits in order to maintain a mobile phone contact line. In Ghana, a slightly used simple mobile phone costs GHS 50 and above, whereas a simple brand new phone is sold from GHS 150 and above. Starter pack of various networks SIM is GHS 5 including the registration fee charged unofficially by phone card vendors; a mobile phone charger sells from GHS 15 and above, and mobile phone replacement battery is from GHS 15 and above. Charging of mobile phones at designated mobile phone charger shops for people with no access to electricity costs around GHS 1 daily; and then finally, users must make provision for extra money to buy rechargeable cards ranging from GHS 1 and above to upload onto the network periodically in order to keep the phone lines from being disconnected by network providers. This puts the monetary cost of mobile phone at a minimum of GHS 87 in Ghana.

In this study, response to perceived monetary cost constructs is captured. Taking into consideration the high cost of mobile phone relative to the average monthly income of the lower class, the possibility of perceived monetary cost not having any influence on user's satisfaction and desire to continue to use mHealth service is unlikely. This study, therefore, posits that:

> H_4: The higher the perceived monetary cost, the lower the effect on satisfaction and continual usage of mHealth services.

Methodology

The study was conducted as follows: the population for the study was sampled; questionnaires were designed and administered to solicit for respondents' perception of mHealth service quality, user satisfaction, perceived monetary cost and continual usage; data was collected and analysed using Statistical Package for Social Science (SPSS) software version 22 and the SEM with AMOS version.

Sampling method

A cross-sectional survey was employed, and a non-probability purposive sampling technique was used to select cases with requisite knowledge on specific activity in order to have appropriate answers (Saunders, Lewis, & Thornhill, 2009) from women in six rural communities in the Central Region of Ghana who have used mHealth service for maternal

healthcare. This mHealth application enabled pregnant women to receive SMS or voice messages in local languages through their mobile phones. The mHealth services delivered were health messages on diet, pregnancy-related issues, breastfeeding, caring for new-born, customer service centre that handled customers inquires, phone call appointment, reminders and alerts.

Development of questionnaire

The first part of the questionnaire focused on demographic characteristics of respondents. The second section comprised thirty (30) measurable items which concentrated on mHealth service quality attributes namely, system quality, information quality and interaction quality (Parasuraman, Zeithaml, & Malhotra, 2005, 1988; Akter et al., 2013b). The third phase contained four (4) measurable items which focused on overall mHealth service user satisfaction adopted from Akter et al. (2013b) and Bhattacherjee (2001a). The fourth section also contained four (4) items that dwelt on monetary cost attributes such as equipment cost, access cost, transaction cost and user willingness to pay for the service (Wu & Wang, 2005; Chae et al., 2001; Boadi et al., 2007). The fifth section entailed three (3) items and focused on the continual usage of mHealth service (Bhattacherjee, 2001a; Akter et al., 2013b).

Responses to questions on mHealth service quality, monetary cost and continual usage were measured on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). A five-point Likert scale adopted from Vagias (2006) was used to measure user satisfaction. It ranged from 1 (not at all satisfied) to 5 (extremely satisfied).

Administration of questionnaire

The questionnaire was pre-tested on ten respondents who were users of mHealth service for maternal healthcare. An amendment to the questionnaire was done prior to the main data collection. With the help of two research assistants, the questionnaire was administered to 350 respondents and out of which 305 were valid after the screening process, therefore, yielding a response rate of 87%. The screening process checked uncompleted forms, double ticking of responses and lack of consistency that rendered 45 instruments invalid. The administration of the questionnaire lasted over a period of two weeks.

Data analysis and result

Demographic profile of respondents

The highest percentage of women who used mHealth services were between the ages of 15 and 24 years, constituting 38.40%. All respondents had some form of basic education. Junior High School (JHS) leavers formed the majority with 55%. The majority of respondents were self-employed, engaged in peasant farming (40.30%) and micro-trading activities (34.80%). There were a few housewives (8.9%) and health workers (6%). The rest were into other entrepreneurial activities such as hairdressing, dressmaking and food selling. Close to half (45.20%) assessed mHealth service weekly with only 4.9% using the service occasionally.

Up to 11.5% of the respondents earned less than GHS 50 a month and close to half (44.90%) earned between GHS 50 and 199, followed by those earning between GHS 200 and 499 (34.1%). Those earning above GHS 500 were the smallest group forming 9.50%. This finding implies that most (56.5%) of the respondents (earning GHS 0 –

GHS 199) are not likely to find it easy to acquire a mobile phone at the on-going minimum cost of GHS 87. It is therefore not a surprise that over half of the respondents (59%) used mobile phones belonging to relatives and friends to access mHealth services, the rest used their personal phones (41%). A summary of the demographic profile is shown in Table 1.

Confirmatory factor analysis

All the measurement scales were extracted directly from other researchers as indicated in appendix B and hence, a confirmatory factor analysis (CFA) was done to test the construct reliability and validity of the study. The validity and reliability of the measures enabled the effective assessment of the psychometric properties of the scaled measures (Fornell & Larcker, 1981). Six variables (SQC1, SQC2, USAT3, USAT4, MC2 and MC4) were dropped during the CFA because their loadings were less than the threshold value of 0.50. The t-value of the individual indicators is within the acceptable range of 1.915 to 36.293 (Anderson & Gerbing, 1988).

The model fit indices in the measurement model exhibited good fit on all the eleven constructs ($\chi^2 = 1695.015$, df = 715, GFI = .897, CFI = .916, RMSEA = .067, PCLOSE = .056). These indices meet the acceptable criteria for the overall model fit of the sample group as recommended by Kline (2005). Table 2 displays the summary of the measurement model result.

CFA of second–order variables

The mHealth service quality dimensions, namely, system quality, interaction quality and information quality were made up of eight first-order constructs. System quality was further computed from variables making up reliability, efficiency and privacy. Interaction quality was obtained from cooperation, confidence and care. Information quality was

Table 1. Demographic characteristics of respondents.

Items	Categories	Statistics	Items	Categories	Statistics
Age		**%**	**Occupation**		**%**
	15–24	38.4		Traders	34.8
	25–29	36.1		Housewives	8.9
	30–34	15.4		Health Workers	2
	35–39	7.5		Farmers	40.3
	40 >	2.6		Hairdresser	6.6
	Total	100		Others	7.5
Education				Total	100
	Primary	17.7	**Frequency of Usage**		
	JHS	55.1		Daily	31.8
	SHS	21.3		Weekly	45.2
	Vocational	5.9		Monthly	18
	Total	100		Occasionally	4.9
Average Monthly Income				Total	100
	< than GH 50	11.5	**Phone Ownership Status**		
	GH 50-199	44.9		Personal	41
	GH 200-499	34.1		Shared	59
	GH 500 >	9.5		Total	100
	Total	100			

Source: Field data, 2016.

Table 2. The measurement model result.

Constructs	Items	Loading	t-Value
Reliability	SQR1	0.523	7.947
	SQR2	0.759	10.832
	SQR3	0.718	10.624
	SQR4	0.679	Fixed
Efficiency	SQE1	0.688	8.136
	SQE2	0.594	7.423
	SQE3	0.588	10.691
	SQE4	0.547	Fixed
Privacy	SQP1	0.947	31.353
	SQP2	0.99	36.293
	SQP3	0.917	Fixed
Cooperation	SQC1	0.324	5.338
	SQC2	0.273	4.626
	SQC3	0.834	14.565
	SQC4	0.819	Fixed
Confidence	SQCO1	0.569	9.975
	SQCO2	0.825	15.655
	SQCO3	0.924	17.073
	SQCO4	0.772	Fixed
Care	SQCA1	0.745	12.024
	SQCA2	0.963	13.387
	SQCA3	0.733	15.586
	SQCA4	0.67	Fixed
Utilitarian	SQI1	0.807	12.095
	SQI2	0.965	13.723
	SQI3	0.962	13.705
	SQI4	0.622	Fixed
Hedonic	SQH1	0.627	Fixed
	SQH2	0.837	9.366
	SQH3	0.606	8.338
User satisfaction	USAT1	0.552	Fixed
	USAT2	0.865	8.402
	USAT3	0.479	6.564
	USAT4	0.122	1.915
Monetary cost	MC1	0.639	Fixed
	MC2	0.489	7.303
	MC3	0.680	9.299
	MC4	0.484	7.075
Continual Usage	CU1	0.6	Fixed
	CU2	0.706	7.854
	CU3	0.669	7.746

$\chi^2 = 1695.015$, df = 715, GFI = .897, CFI = .916, RMSEA = .067, PCLOSE = .056.

also composed of utilitarian and hedonic factors. All variable indicators had significant standardised loadings of $p \leq .001$ with t-values of the individual indicators ranging from 6.533 to 8.912. The composite construct reliability of each construct ranged from 0.711 (information quality) to 0.830 (user satisfaction), which falls within the required criteria (Hair, Black, Babin, Anderson, & Tatham, 2006). The AVE scores of the constructs ranged from 0.501 (information quality) to 0.714 (user satisfaction), which indicates adequate convergent validity (Fornell & Larcker, 1981). The model fit indices in the measurement model exhibited a good fit on the data (Chi-square = 240.600, df = 115, GFI = .931, CFI = .963, RMSEA = .052, PCLOSE = 0.201). Table 3 summarises the CFA results.

Table 3. CFA results of second –order variables.

Constructs and alphas	Items	Loading	*t*-Value	AVE	Composite reliability
System quality ($\alpha = 0.726$)	RELI	.660	8.170	.511	.727
	EFF	.781	8.411		
	PRIV	.612	Fixed		
Interaction quality ($\alpha = 0.713$)	COOP	.765	7.169	.506	.720
	CONF	.587	6.533		
	CARE	.681	Fixed		
Information quality ($\alpha = 0.698$)	UTIL	.539	6.820	.501	.711
	HEDO	.651	Fixed		
User satisfaction ($\alpha = 0.896$)	USAT1	.693	7.293	.714	.830
	USAT2	.974	Fixed		
Monetary cost ($\alpha = 0.710$)	MC1	.647	8.912	.502	.718
	MC3	.580	Fixed		
Continual usage ($\alpha = 0.741$)	CU1	.615	7.738	.516	.746
	CU2	.683	8.034		
	CU3	.681	Fixed		

$\chi^2 = 240.600$, df = 115, GFI = .931, CFI = .963, RMSEA = .052, PCLOSE = 0.201.

Structural analysis and testing of hypotheses

The Structural Equation Modelling (SEM) enables the control of the measurement of error, tests multiple relationships and also provides information on the degree of fit of the tested model (Byrne, 2013). The structural paths were estimated to test the hypotheses of the constructs. The results reveal that the model appears to have established an acceptable fit and thus, accomplished a satisfactory level of nomological validity. The chi-square was 39.533, df = 17, $p < .01$; the root-mean-square-error of approximation (RMSEA) value, 0.070; goodness-of-fit index (GFI), 0.94; and the comparative fit index (CFI) value, 0.95 (Bagozzi & Yi, 1988; Hu & Bentler, 1999).

Table 4 displays the standardised parameter estimates and significance levels for each path. The significance cut-off level for most social science studies is an alpha level of 0.05 (Zar, 1984; 2013). An alpha level of 0.05 signifies a statistical indication of a possible 95% confidence interval (Payton, Greenstone, & Schenker, 2003). This means that a hypothesis can be accepted when the significance level is below the cut-off probability value (*p*-value set at .05) and rejected when it is above.

Hypothesis *H1a* (system quality has a positive effect on user satisfaction of mHealth services) is not supported because the parameter estimates of system quality are not

Table 4. Structural model assessment result.

Ho	Effects	β Estimate	*t*- Value	*P*-value	Remarks
H1a	System quality ——> satisfaction	–0.043	–0.796	.426	Rejected
H1b	Interaction quality —> satisfaction	0.519	10.318	0	Supported
H1c	Information quality—> satisfaction	0.041	0.755	.45	Rejected
H2a	System quality———> continual usage	0.116	2.011	.044	Supported
H2b	Interaction quality –> continual usage	0.168	2.659	.008	Supported
H2c	Information quality—> continual usage	0.227	3.913	0	Supported
H3	Satisfaction –> continual usage	0.366	13.065	0	Supported

Source: Field data, 2016
Note: multi-group invariance effect of monetary cost.

significant for satisfaction (β= –0.04; p >.05). In support of *H1b* that interaction quality has a positive effect on user satisfaction of mHealth services, the results reveal that interaction quality significantly affects satisfaction (β = 0.52; p <.05). The study did not find support for *H1c* that information quality has a positive effect on user satisfaction of mHealth services because the parameter estimates of information quality is not significant for satisfaction (β = 0.04; p >.05). The results support the argument for *H2a*, *H2b*, *H2c* and *H3* that system quality (β = 0.12; p <.05), interaction quality (β = 0.17; p <.05), information quality (β = 0.23; p <.05) and satisfaction (β = 0.37; p <.05) are significant for continual usage of mHealth. Table 4 presents an overview of the results.

Moderating effect of monetary cost

Cluster analysis

K-means is an analytical tool designed to assign cases to a fixed number of groups (clusters) with typically known characteristics but could be determined from a set of variables specified by the researcher (Assaker & Hallak, 2013; Odoom, 2016). One main advantage of K-means cluster is that it is insensitive to outliers in the data since grouping is based on multiple iterations (Odoom, 2016). Consequently, K-means cluster analysis was used in categorising respondents into high (expensive) and low (affordable) level groups based on their responses to the two items of monetary cost (Assaker & Hallak, 2013). Out of 305 respondents, 132 respondents perceived mHealth monetary cost of the service as high representing 43%, while 173 perceived monetary cost of the mHealth service as low representing 57% of the total respondents. For the two sets of homogenous groups (high and low), the convergence of centre .000 was achieved on the third iteration.

Overall, the results of the K-means procedure indicated that the two cluster solution is valid and statistically significant (p <.001) in contributing to the clustering process (Table 5). The F-statistics reveal significant variations among the monetary cost measures: (MC1), I think mHealth service equipment cost was not expensive (F = 65.614, p < .001); and (MC3), I think service access cost was not expensive (F = 2559.838, p <.001).

Multigroup invariance analysis results

The study utilises a multi-group invariance analysis to examine how the two groups of monetary cost vary across satisfaction and continual usage. In examining multi-group, the invariance of the regression weight between the two groups was the focus of the test for moderation. The path between satisfaction and continual usage was constrained to be equal across groups (Peyrot, 1996). According to Nguyen-Rodriguez, Chou, Unger, and Spruijt-Metz (2008), if the model fit remained, it means there was no moderating effect.

Table 5. *K*-means cluster results on monetary cost.

Cluster centres–monetary cost levels					
	Low	High	Total	F	Sig.
Monetary cost measures	(n = 173)	(n = 132)	(n = 305)		
MC1 – I think mHealth service equipment cost was not expensive.	3.35	4.21	3.72	65.614	.000
MC3 – I think service access cost was not expensive	1.77	4.23	3.84	2559.838	.000

Nguyen-Rodriguez et al. (2008) emphasised that, if the model fit was lost with the added constraint, it implies that there was a significant weight status interaction. The significance of the change in model fit was tested using Chi-square difference test

To test for the moderating effect of monetary cost, a base model combining the final models for each of the two groups were tested, yielding $\chi 2 = 1.737$, $p < .00001$, CFI = .901, and RMSEA = 0.049. The regression weight between the two factors was constrained to be equal across groups. The constrained model yielded $\chi 2 = 2.091$, $p < .00001$, CFI = .829, and RMSEA = 0.060. The chi-squares difference test showed that there was a significant difference between the unconstrained model and the fully constrained model ($p = .000$). The formation of the two groups reduced the sample size and therefore had an influence on the model fitness. Larger samples are seen as better fitting (Hair et al., 2006).

The finding supports hypothesis 4 and suggests that respondents who considered the mHealth service costs as low ($\beta = 0.077$, $p < .10$) have a greater tendency to be satisfied and continue the system usage than those who considered it high ($\beta = 0.054$, $p < .10$). The chi-square values ($\chi 2 = 1.737$ and $\chi 2 = 2.09$) shows that there is a significant difference between high and low monetary cost levels ($p < .001$).

Discussion of findings

Among the three dimensions of mHealth service quality, only interaction quality had a positive and significant relationship with user satisfaction. This finding contradicts previous findings by Akter et al. (2013b, 2010b) and Meigounpoory et al. (2014) who found all the three mHealth service quality dimensions to have a positive relationship with satisfaction in contexts that are different from the current study. Although system quality and information quality together have been found in other mHealth studies to enhance service quality leading to user satisfaction, for the current study on maternal healthcare in rural communities in Ghana, interaction quality is the strongest determinant of mHealth service quality and user satisfaction. On the other hand, the three mHealth quality dimensions were positive and significant on continual usage, with information quality being the highest contributor. Findings from this study collaborate previous work by Lee et al. (2009) who also found information quality to be a key determinant of continual usage of mobile technology service. In addition, Kuo (2003) also attested to the fact that service quality has a positive relationship with continual usage of service by consumers.

The findings also showed a statistically significant relationship between user satisfaction and continual usage which is consistent with Bhattacherjee (2001b) on electronic commerce and Zhao et al.'s (2012) on mobile value-added service. People who are more vulnerable to health-related challenges might show much interest in health innovation such as mHealth and might be more willing to continue to use the services than those who are healthy (Cocosila and Archer, 2010).

As against the finding from this study where perceived mHealth service costs have a greater tendency to affect satisfaction and continual usage, Deng et al. (2010) concluded that monetary value might not significantly predict customer satisfaction, especially when the cost of service is low, and it is very affordable for users. Moreover, previous studies by Boadi et al. (2007) and Kim et al. (2007) indicated that the monetary cost involved in mobile technology service had a great influence on user satisfaction and adoption. Even, Caruana et al. (2000) argued that although services rendered by a firm to customers might not be of high quality, an affordable price could have a good influence on a consumer's satisfaction of service.

Implication of findings, conclusions and policy recommendations

Beyond medical gains and benefits of mHealth services, factors that positively influence mHealth service quality, user satisfaction and continual usage need not be ignored or given little attention by policy makers and service providers. This study has shown that Interaction quality is a key indicator of mHealth service quality for maternal healthcare leading to satisfaction and continual usage. This makes the human side of mHealth service very essential. The willingness of health personnel to deliver timely services and provide the right service the first time, the provision of mHealth information services that are safe for maternal healthcare, customised information service that serves its purpose well and giving users individual attention would enhance users' perception of mHealth service quality and user satisfaction.

Attitude and behaviour of both frontline and key health personnel might change customer's perception of mHealth service quality positively or negatively. There is, therefore, a need for service providers to empower their health and Information Technology (IT) personnel through the provision of periodic training on good customer relations. Incorporation of customer relationship management practices in the design and implementation of mHealth services will be essential. Reward and incentive systems encourage service personnel to demonstrate outstanding customer care, attitude to work and improve performance (Güngör, 2011; Falola, Ibidunni, & Olokundun, 2014).

The system quality and information quality have a significant effect on continual usage but not on satisfaction. The mHealth service for maternal healthcare was designed for the deprived people living in rural communities in developing countries. Rural communities in most developing countries, including Ghana, experience and are used to poor network signal, and this could have led to the lack of effect of system quality of mHealth services for maternal healthcare on user's level of satisfaction. Majority of the respondents (59%) were using shared phones from relatives and friends to access the mHealth services, and this has implications on privacy issues, and could as well have led to the non-significant effect of system quality on satisfaction. Parasuraman, Zeithaml, and Berry (1985) and Johnston (1995) identify confidentialities/privacy issues as one of the influencers of service quality.

A larger proportion of the rural women have a low level of Education that plays a key role on quality of service satisfaction (Pitchayadejanant & Nakpathom, 2016) and the importance they attach to mHealth system and information quality issues. Hence, the government concentrating on improving the level of education in rural area, particularly for women, can improve satisfaction obtained from mHealth service. That said, a lack of alternative maternal health care in the study areas may be responsible for continual usage among women even though the level of satisfaction has not been impacted. Kwok, Jusoh, and Khalifah (2016) indicated that gender plays a moderating role in the relationship between service quality and satisfaction and affects the service quality perception (Butler, Oswald, & Tuner, 1996; Mokhlis, 2012).

Providers of mHealth service for maternal healthcare must be aware of the fact that societal needs change over time. Users' desire for quality and preferences in technology services might change as they become more exposed to information technology and other competitors' services. Managers of mHealth service must constantly identify the changing needs of their customers and upgrade or improve their services to meet the changing needs of users. An mHealth service that is helpful in meeting users' maternal healthcare needs, in terms of information provided being complete and easy to understand will encourage users' continuance of mHealth service in the absence of viable alternative care systems. In this

regard, the Ministry of Health and regional public sector health institutions could consider introducing or strengthening their customer service units to provide strategic oversight for the introduction of customer service excellence benchmarks in mHealth and other health interventions programmes.

There was a statistically significant relationship between user satisfaction and continual usage. Health service personnel level of competency and their ability to understand the specific needs of users would enable users to be satisfied and continue the use of the mHealth service. Since there will be new entrants and changes in women maternity cycle, regular updating of customer database would also enable specific health needs to be anticipated in order to deliver customised mHealth services. Migration might necessitate regular updating of the database. Rural-urban migration in Ghana has risen from 32% in 2000 to 51% in 2010, and the population is shifting more to urban localities (Ghana Statistical Service, 2014a) every year. In addition, the central region where the study sample is drawn has not been a popular location for settlers (Ghana Statistical Service, 2014b).

The study shows that rural women who perceived the mHealth service costs (in terms of equipment and service access) as affordable have a greater tendency to be satisfied and continue the system usage, in the absence of alternative cares, than those who considered it expensive. The majority of mHealth users were self-employed, engaged in peasant farming and micro-trading activities which to a greater extent, determines their level of income. About 57% of the rural women earned GHS 0 – GHS 199, and at the minimum cost of GHS 87, acquisition of mobile phone is unlikely for the majority who earned a living from a meagre income. Any additional cost such as an mHealth service fee might not, therefore, encourage more rural women to use mHealth service. Hence, policy makers and service providers might have to look for means to support the mHealth service for maternal healthcare in rural communities, and this can include subsidies. According to Kotler and Keller (2012, p. 10), 'Firms should not only look at how many customers want their product but rather how many customers can afford and are willing to pay'.

Policy makers and service providers must give all the three mHealth service quality dimensions (system quality, information quality and interaction quality) equal attention.

Limitations of the study and future research directions

Despite the significant contributions of this study, some limitations are identified, and these provide indications for future research. First, this study only examines the effect of mobile health service quality on maternal healthcare among women in rural areas; hence, a generalisation of the findings of the study for all mHealth service users might pose a challenge. Future studies should examine the effect of mobile health service quality for both male and female users and extend the investigation beyond maternal healthcare to include other types of healthcare. Second, the study respondents were selected from rural communities in the Central Region of Ghana, this limits the generalisation of the study findings in other settings. In order to add more depth, future studies should consider other cultural contexts. Cross-country analysis may provide robust findings with various useful implications that will be of relevance to countries with similar healthcare characteristics and challenges.

Third, this study examines the user perspective of mobile health service quality, thereby limiting the strength of evidence since the perspective of health workers were not included in the study. To complement user perspective of mHealth service quality and user satisfaction, future studies should consider both the perspective of users and health workers. Further studies on the impact of culture on mHealth user satisfaction can be explored.

Notwithstanding these limitations, this study has been able to make significant contributions to the existing literature on mHealth service quality by the disaggregating quality of service sub-dimensions and investigating their effects on satisfaction and continual usage. Another important contribution of this study is the evaluation of a model that includes situational constructs of perceived monetary cost and moderates its effect on satisfaction and continuous usage.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix

Construct Statement	Source
System quality	Parasuraman et al. (2005, 1988) and Akter et al., (2013b).
Reliability	
SQR1 mHealth platform was always available	
SQR2 I could access system whenever I needed	
SQR3 I could receive service right away.	
SQR4 It doesn't have long waiting time	
Efficiency	
SQE1 This system was simple to use	
SQE2 It was easy to get service from this system.	
SQE3 The system was flexible to meet variety of needs	
SQE4 Information on this platform was well organised	
Privacy	
SQP1 M-health platform protected my personal information	
SQP2 It does not share information with others	
SQP3 It offered me a meaningful guarantee not to share my information	
Information quality	Parasuraman et al. (2005, 1988) and Akter et al., (2013b).
Cooperation	
SQC1 M-health service personnel were always willing to help me.	
SQC2 They showed interest to solve my problems.	
SQC3 They provided service right the first time.	
SQC4 They provided the service by a certain time	
Confidence	
SQCO1 Behaviour of mHealth personnel on platform instilled confidence in me	
SQCO2 I felt safe while consulting them on the platform	
SQCO3 They were competent in providing service on the platform	
SQCO4 They have knowledge to answer my question	
Care	
SQCA1 M-health service personnel understood my specific needs.	
SQCA2 They gave me personal attention	
SQCA3 They had my best interests at heart	
SQCA4 They gave me individual care.	
Interaction quality	Parasuraman et al. (2005, 1988) and Akter et al., (2013b).
Utilitarian	
SQI1 mHealth information services served its purpose very well	
SQI2 Overall, this information service has been useful to me.	
SQI3 Information provided has been worthwhile	
SQI4 I enjoyed using this information service	
Hedonic	
SQH1 I feel hopeful as a result of having information.	
SQH2 I feel encouraged having this information.	
SQH3 Using mHealth technology has increased my chances of improving my health	
User satisfaction	Akter et al. (2013b) and Bhattacherjee (2001a)
USAT1 How satisfied were you with mHealth service quality	
USAT2 How satisfied were you with mHealth service personnel attitude and performance	
USAT3 How satisfied were you with overall mHealth monetary cost	
USAT4 How do you feel about your overall experience of mHealth usage	

Monetary Cost	Wu & Wang (2005), Chae et al. (2001) and Boadi et al. (2007)
MC1 I think mHealth service equipment cost was not expensive.	
MC2 I think service transaction fee was not expensive.	
MC3 I think service access cost was not expensive.	
MC4 I am willing to pay for using mHealth service	
Continual usage	Bhattacherjee (2001a) and Akter et al. (2013b)
CU1 I intended to continue using mHealth service to get medical information services.	
CU2 My intentions were to continue using mHealth service than use any alternative means (such as traditional health systems)	
CU3 I will encourage friends and others to use this service	

Notes: 1 _ strongly disagree, 5 _ strongly agree.