Article

Mobile fitness application quality analysis: KANO model satisfaction or dissatisfaction

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Abstract: The mobile health market is expected to continue to grow that will make it harder for mobile application developer to compete. One of the most popular types of mobile health application is health and fitness applications. This application aims to modify user behavior; therefore, it requires user to use the system continuously in relatively longer period of time to effectively change user behavior. Thus, user satisfaction is essential and must be maintained to reach this goal. This study aims to define the mobile health application qualities that would influence user satisfaction level. Developer can priorities the most influential qualities when building their application. Quality dimensions would be explored by literature review and Google Play Store review and categorised using DeLone McLean IS Success Model. We identified 12 quality dimension that will furthered analysed using Kano Model. The data collecting was conducted with online form with 12 pairs of Kano two-dimensional questionnaires ($n = 115$). The results show that the important qualities of mobile health application are Privacy, Availability, Reliability, Ease of Use, Accuracy and Responsiveness, lack of these qualities would cause dissatisfaction from user. The developer might also consider to improve user interface and usefulness of the application to increase user satisfaction even though these qualities would not cause much of dissatisfaction

Keywords: application quality; mobile health; health and fitness; satisfaction; dissatisfaction; KANO model

1. Introduction

The growth of mobile health applications is undoubtedly increasing. The mobile health market is expected to continue to grow in the coming years and is predicted to exceed 300 billion U.S. dollars by 2025 (Statista, 2022). It will trigger strict competition between application developers since user can select from many similar applications. User can also easily move to other applications just by downloading other application on their mobile phone.

Mobile health applications are now also used with purposed to modify user behavior. Health and fitness application is one of the applications that is used to track and change user health related behavior. Thus, this application require user to use the application in relatively longer period of time to effectively measure and confirm any positive change on behalf of user health related habit and behavior.

However, one of the challenges in mobile health application utilization is low rate of user engagement (Edney et al., 2017; Lim et al., 2020; Pyky et al., 2017). This is found in some experiment on mobile health utilization experiment that are meant to modify user behavior. This would become a crucial issue since the continuous

utilization of the application is important to support individual behavior modification. Based on Expectation Confirmatory Theory (ECT), satisfaction and confirmation of expectations play a crucial role in determining users' intentions to continue using the technology (Bhattacherjee, 2001). This theory has been used heavily as the foundation of continuance intention of use in various range of information system application such as mobile banking (Nguyen and Dao, 2024), social media (Khan and Saleh, 2023), social shopping (Yu et al., 2024), mobile health (Nie et al., 2023). The correlation between user satisfaction and user continuance intention to use has been well-established (Yu et al., 2024). User satisfaction refers to the degree to which users of a product, service, or system perceive it to meet their needs and expectations (Bhattacherjee, 2001). However, ECT primarily focuses on how user satisfaction plays a role in influencing users' intentions to continue using a technology, while the technical quality aspects of the system are not fully addressed within this model.

Other popular theory on technology adoption is the DeLone and McLean IS Success Model (DeLone and McLean, 2003). D&M Model considers factors such as system quality, information quality, and service quality to influence user satisfaction (DeLone and McLean, 2003). Aside of D&M model, there is also SERVQUAL Model by Parasuraman et al. in 1985 (Huang et al., 2015) that defined five service quality dimension such as reliability, assurance, tangibles, empathy, responsiveness (Huang et al., 2015).

There are previous studies that has been conducted to analyses user continuance of use the mHealth service (Alzahrani et al., 2022; Kim et al., 2019). On their study (Alzahrani et al., 2022) defined eight quality dimensions that would influence user continuance of use namely reliability, tangibility, availability, efficiency, content quality, responsiveness, assurance, hedonic benefits. Other study by Kim et al. (2019) evaluate the quality dimension such as content quality, engagement, privacy, reliability, usability, influence continuance intention to use or satisfaction. Both of the study found that reliability and content quality would impact user satisfaction. Other study has been conducted to analyses the critical success factor of mobile health implementation using DeLone Mclean model (Handayani et al., 2018), it aimed to define the quality for mobile health without assessing using satisfaction level.

In this study, we would like dissect more on degree of satisfaction level of each quality dimension. User satisfaction would lie on some spectrum range as a degree (Herzberg, 2017). That means that user could feel satisfy, dissatisfy or neutral about some products/service. According to Herzberg's Two-Factor Theory, originally studied for job satisfaction, certain factors (e.g., recognition) contribute to job satisfaction when present but may not necessarily cause dissatisfaction when absent. Conversely, other factors (e.g., salary) may lead to dissatisfaction when absent but do not necessarily result in satisfaction when present (Herzberg, 2017). On the context of mHealth application quality dimension, it's noted that when hedonic benefits are present, user satisfaction tends to rise (Alzahrani et al., 2022). However, there remains a gap in research regarding whether the absence of hedonic benefits results in dissatisfaction or merely neutral feeling. Since mHealth is used to provide healthcare services, such as monitoring medical conditions or disease management, the absence of hedonic benefits such as pleasure or entertainment may not necessarily result in dissatisfaction.

Based on the gap the previous researches, this study aims to identify the quality dimension of mHealth and analyses their influence on user satisfaction and dissatisfaction level. The identification of application quality will be conducted systematically using the Delone-McLean framework, as the three qualities (service quality, system quality, information quality) can serve as the primary overarching categories. The analysis of quality dimensions and their impact on user satisfaction and dissatisfaction will be conducted using the Kano Model. This model allows for the categorization of quality dimension into different groups based on their effect on customer satisfaction.

Originally, The Kano Model is a theory of product development to helps businesses prioritize features during product development based on their impact on customer satisfaction (Kano et al., 1984). Kano model has been used to evaluate the impact of gamification element and feature on user satisfaction in mobile health and fitness application (Yin et al., 2022). This methodology also been when design home health management app for elderly people, Kano model is used to prioritize the features that will be implemented in the app (Zhou et al., 2024). Other studies used Kano model to evaluate quality principles of health apps in orthopedics field (Malinka et al., 2022).

This study will implement Kano Model on assessing qualities of mobile health application based on user perception by firstly categorizing mobile health app quality based on previous study and users' application reviews. The result of the study is supposed to use as guiding information for mobile health application developers on prioritizing the quality of their mobile health app and to describe user perception on mobile health app quality and how it impacted their satisfactions. The rest of the paper is organized as follows: theoretical backgrounds, methodology, result and analysis, discussion, and conclusion.

2. Theoretical background

2.1. Mobile health and fitness application

Mobile Health defined as the use of mobile communication technology that function for health (Handayani et al., 2018). Mobile health service aims to continuously supporting health monitoring, feedback to support individual behavior modification via personal mobile communication devices (Kim et al., 2019). Mobile health application has been growth this past decade and expected to grow to 300 billion U.S dollars market by 2025 (Statista, 2022). This application is categorized by health & fitness and medical by Google PlayStore (2022). Health and Fitness apps are designed to promote physical activity and encourage users into building training habits (Statista, 2022). This application should concern on user engagement to fulfill its purpose in modify user behavior. Thus, user satisfaction on this application is crucial to be maintained.

2.2. Application quality dimension

Previous studies have been conducted to define some mobile application quality dimensions (**Table 1**). A study by Handayani et al. (2018) define some critical success

factor in developing mobile health application in Indonesia. The quality dimension mentioned in this study are adopted from DeLone McLean IS Success Factor model such as system quality, information quality, service quality and an additional of organizational dimension. Other study by Alzahrani et al. (2022) analyzed Reliability, Tangibility, Availability, Efficiency, Content Quality, Responsiveness, Assurance, Economic Benefit as the factors for user continuance intention to use by using Dematel Model. Other studies usually analyze quality dimensions using SEM model to evaluate their impact toward user satisfaction, intention to use, continuance intention, etc. A study has analyzed the factor of continuance of use and satisfaction is the study by Kim et al. (2019). This study investigates the impact of content quality, engagement, privacy, reliability, and usability.

Table 1. Previous studies on health application quality dimension.

Papers	Quality Dimension	Results
(Kim et al., 2019)	Content Quality, Engagement, Privacy, Reliability, Usability	Content Quality, Engagement, Reliability → Satisfaction, Engagement → Continuance Intention
(Alzahrani et al., 2022)	Reliability, Tangibility, Availability, Efficiency, Content Quality, Responsiveness, Assurance, Hedonic Benefit	Assurance, hedonic benefit, efficiency, reliability, content quality influence continuance intention
(Keikhosrokiania et al., 2018)	System Quality, Information Quality, Service Quality	System Quality, Information Quality, Service Quality influence use of application but not satisfaction
(Handayani et al., 2018)	System Quality, Information Quality, Service Quality	Has not been proven empirically to influence satisfaction
(Charlie and Cilliers, 2024)	Information Quality (Reliability, Accuracy, Relevance), System Quality (Usability, Data Protection, Navigation), Service Quality (Responsiveness, Accuracy, Clarity)	Has not been proven empirically to influence satisfaction

Other than previous studies, we also see in the most common theory used for defining service quality which is SERVQUAL Model. This model was developed as the instrument to catch user expectation by Parasuraman et al. in 1985 (Huang et al., 2015). The construct in this model are reliability, assurance, tangibles, empathy, and responsiveness. Since there are so many qualities dimension mentioned in previous studies, we would conduct user reviews analyzed to confirm the relevancy of these qualities by real users reviews on their experience on application. Some of the qualities dimension that will be analyzed in this study after conducting literature review and user review analysis are:

a) Reliability is the ability to perform the promised service dependably and accurately (Alzahrani et al., 2022; Kim et al., 2019). The system will run smoothly without technical error or bug (Keikhosrokiania et al., 2018).

b) Availability: refers to the availability of system functionalities at anytime and anywhere (Alzahrani et al., 2022).

c) Privacy: the ability to guarantee system resources is not used or modified, interrupted, or disturbed by unauthorized persons (Handayani et al., 2018).

d) Empathy: The individualized attention the firm provides to its consumers (Huang et al., 2015).

e) Responsiveness: refers to the promptness of mobile health application to respond to users' expectations (Kim et al., 2019; Keikhosrokiania et al., 2018).

f) Usefulness: the application can be used to fulfil user need to complete task, reach goal (Handayani et al., 2018) and making decision (Jen and Chao, 2008).

g) Accuracy: Accuracy as a significant dimension of information quality in which the accuracy, completeness, and conformity of information is an important factor in the health field (Handayani et al., 2018). Accuracy is defined as the degree of correctness measurement done by the application (Keikhosrokiania et al., 2018).

h) Ease of Use: The existing user interface makes it easy for users (Handayani et al., 2018).

i) User Interface: the appealing, comprehensible, and logical design of the user interface (Birkmeyer et al., 2021).

j) Integration: additional qualities in this study that refers to the ability of the system to connect with other device or application.

k) Economic Benefit: additional qualities in this study that refers to the financial reward that user get as the result of using the application.

l) Completeness of Functionality: additional qualities in this study that refers to the user perception of the wholeness functionality in the system.

So many studies have been conducted to evaluate the qualities dimension and their impacts on user adoption, continue of use, and satisfaction, however the investigation of the quality priorities on user satisfaction level is still difficult to find.

2.3. Kano model

Kano Model was developed by Noriaki Kano in 1984 (Yao et al., 2018). This model was design in the context of quality management. In this model, there five dimension of quality that categorized by its impact on user satisfaction or dissatisfaction (see **Figure 1**).

Figure 1. Kano model.

a) One-dimensional quality (O): In this dimension user will be satisfied if the quality element is sufficient and will be dissatisfied if insufficient. That can be said the quality element is linear with customer satisfaction level.

b) Attractive quality (A): In this dimension, user satisfaction will be increase greatly if the quality element is sufficient and it does not cause dissatisfaction if the element is lacking. The application will be still acceptable to user.

c) Must-be quality (M): In this dimension, sufficient element of quality will not affect customer satisfaction. User regard this quality for granted. When the application lack of this quality, it will lead to customer dissatisfaction.

d) Indifferent quality (I): In this dimension, the quality element whether sufficient or not, does not affect customer satisfaction level. This means that the quality element is irrelevant to customer satisfaction.

e) Reverse quality (R): In this dimension, user satisfaction will decrease if this quality is sufficient and in contrary, user dissatisfaction will be increase when the quality is insufficient. This dimension is the reverse of one-dimensional quality.

3. Methodology

3.1. Research flowchart

The research flowchart is shown in **Figure 2**. The first step is conducting a literature review to examine previous studies that have defined the quality dimension of mobile health applications. Literature review is used as the guiding step on defining the variables as quality dimension. As mentioned in **Table 1**, the quality dimensions varied; however, the D&M model of service quality, system quality and information quality could be used as the main category to further categorize the more detailed and specific quality dimensions. To identify the quality of the application more concretely, we conducted an analysis of user reviews of mobile health apps.
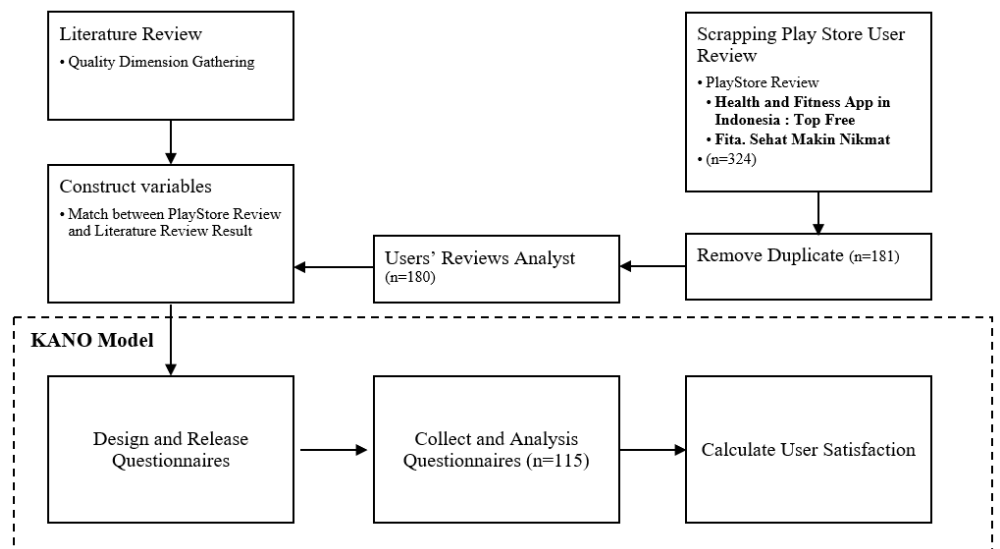

Figure 2. Research flowchart.

We scrapped all the reviews form an application called Fita, which develop by largest telecommunication company in Indonesia. This application was selected since it was the top three free application under category of health and fitness. Another two application was not designed to modify user behaviour and only used to track health information. The number of original reviews was 324. Subsequently, we eliminated

duplicates, resulting in a total of 181 reviews. One of the reviews was irrelevant resulting only 180 reviews that will be further analysed. User reviews will be analyzed based on their content and categorized into each quality dimension accordingly. After the identification of the application qualities, we begin to conduct Kano Model methodology by designing and releasing the questionnaires.

3.2. Questionnaire design and data collecting

The questionnaires were design using Kano two-dimensional questionnaires with 5-Likert Scale. The survey has two parts. The first part contains respondent demographic questions such as gender, age, the mobile health application used, familiarity of the application and the duration of application usage. The second part is the Kano two-dimensional questionnaires (offering and lacking). Twelve pair of two-dimensional questionnaires were constructed for each quality dimension that has been identified from previous step. Before user answer the questionnaires, we provided guidance and example on how to answer the questions since there are tendency for user to answer the question automatically as opposite to its paired question. For example, the questions used for reliability are:

(1) "When the mobile health application can be used smoothly without errors (bugs), you feel ..." (offering).
(2) "When the mobile health application has errors (bugs), you feel ..." (lacking).

Respondents would answer with Likert scale ranging from 1 to 5 (very dissatisfied to very satisfied). The questionnaires then disseminate online using Google Form. The population of the study are health & fitness applications users. The respondents must have used health & fitness application before. The sample size of Kano model is not defined strictly. The number of samples required varied across previous studies, ranging from 12 (Suh et al., 2019) to 1109 (Seo and Um, 2019). We also came across a study with a sample size ranging in the hundreds, specifically documented as 110 respondents (Yin, et al., 2022). We use purposive sampling in data collecting, because approach allows researchers to selectively choose participants deemed most suitable or most relevant to fulfill their research objectives (Creswell, 2014).

3.3. Data analysis

The data would be analysed using quality classification in **Table 2** based on each quality dimension definition (A: Attractive Quality, O: One-dimensional quality, M: Must-be quality, I: Indifferent Quality, R: Reverse Quality). There are some cells that contains of two dimensions (A/O and I/M). This means that the data will be count as half for each dimension.

In **Table 2**, we could see when a respondent gives a 5 (very satisfied) for an offering quality dimension and gives a 4 or 3 (satisfied or neutral) for a lacking quality dimension, it means that the particular respondent would not mind the quality dimension is lacking however, he/she would be very satisfied if the quality dimension is fulfilled. This case falls on A (attractive quality) category.

Table 2. Quality classification based on Kano questionnaires.

Scale		Lacking				
		5	4	3	2	1
Offering	5	-	A	A	A/O	O
	4	R	-	I	I/M	M
	3	R	I	I	I	M
	2	R	R	I	-	M
	1	R	R	R	R	-

In another scenario, if a respondent rates a quality dimension as a 5 (very satisfied) when it is present and a 1 (very dissatisfied) when it's lacking, it suggests a linear relationship between that particular quality dimension and respondent satisfaction (one-dimensional quality).

However, if a respondent rates a 4 or lower when the quality dimension is offered and a 1 when it's lacking, it indicates that the quality dimension is a must-be quality. In other words, its absence would lead to user dissatisfaction. However, offering this quality dimension does not guarantee satisfaction.

When respondent does not very satisfied (5) nor very dissatisfied (1) when a particular quality dimension is offered or lacked, this quality dimension is fall on indifferent category. This does not really significant to influence user satisfaction and dissatisfaction.

After categorizing all user responses into the Kano dimensions for the 12 quality dimensions of the application, the next step is to aggregate and calculate the percentage of the total responses for each dimension. This involves collecting data from each Kano dimension, including the number of responses falling into each category and calculating the percentage of the total responses for each category.

4. Result and analysis

4.1. PlayStore review analysis

After the literature review to identify some mobile health application quality dimension, we conduct analysis on mobile health application review on PlayStore. The analysis aims to confirm and construct the qualities dimension that will be analyzed further using Kano Model. The application that was selected to be review was Fita, a mobile health application developed by one of the biggest telecommunication companies in Indonesia. This application was chosen since it was the top three free application in the PlayStore at the time. The other two are since the application was for monitoring period (only for women) and blood pressure. These two applications are not designed to modify user behavior, also since Fita is develop in Indonesia, it was easier to find the review of Indonesian. This application is used to record food and beverage intake, physical activities, walking activities, water intake, and body weight records. In this application, users can monitor consumed calories and calories successfully burned. To motivate users in achieving their targets, the application also utilizes points. The more activities users perform and targets they achieve, the higher points they earn. The implementation of points as a gamification feature aims to

maintain user engagement. The user interfaces of the application are shown in **Figure 3**. All reviews of this application were scrapped using Phyton and resulting of 324 descriptive reviews. The other reviews only include ratings without any accompanying comments. After duplicate removal 180 data was analysed and categorized. The result of this analysis is shown in **Figure 4**.
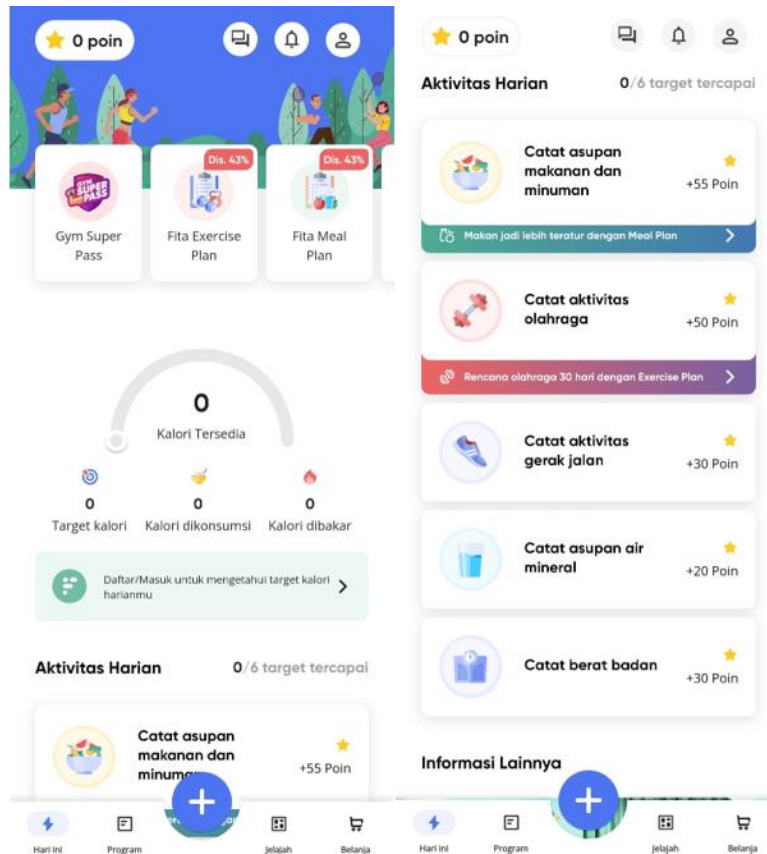

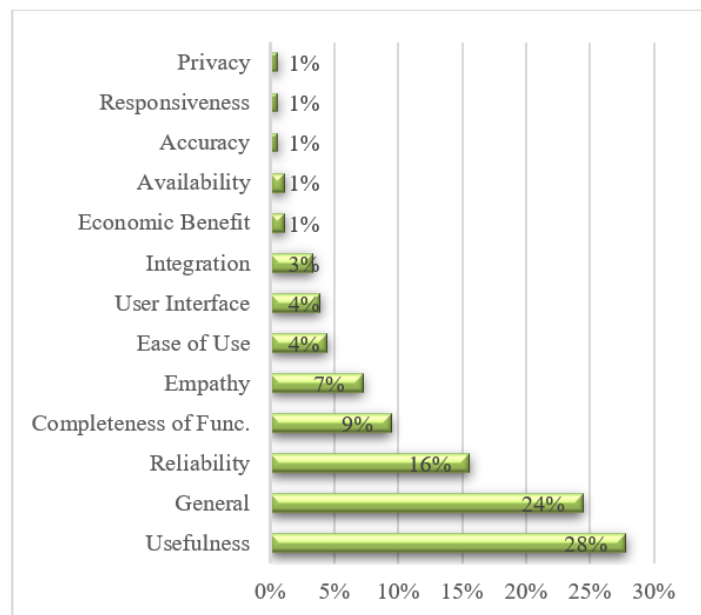**Figure 3.** Fita app user interface.

Figure 4. PlayStore reviews.

The most frequent category that was appeared in the reviews are usefulness. People mention that the application was useful and helpful for them. Then some other review is categorized as general since the review is not specific and only mention that the application is good or bad, or user just simply like or did not like the application. Then reliability of the application was also mentioned a lot. These reviews pertain to errors or bugs within the system that are causing trouble for some users. The next most common reviews focus on the completeness of functionality, the motivation users feel when using the application, its ease of use, and its good user interface. Some users also express their desire for the application to be integrated with other apps or devices to avoid having to input health information twice. The other reviews mention the economic benefit of the app, availability, accuracy, responsiveness, and privacy. Thus, these twelve qualities dimension will be further analysed using Kano Model.

Based on DeLone McLean IS Success model these qualities can be categories as follows:

A) System Qualities: Reliability, Availability, User Interface, Integration, Ease of Use, Responsiveness, Privacy.

B) Service Qualities: Usefulness, Economic Benefit, Completeness of Functionality, Empathy.

C) Information Qualities: Accuracy.

Based on SERVQUAL Model, there are two qualities that are not mention and relevant on this study, which are tangibles and assurance.

4.2. Respondent demography

For Kano Model analysis, the questionnaires were disseminated online, and we successfully collect 115 respondents. The respondent's demography shows in **Table 3**. Most of the respondents are very familiar or familiar with their application. Most

Table 3. Respondent demography.

Gender			Mobile health application used		
Female	64	56%	Samsung health	44	38%
Male	51	44%	Apple-Health	33	29%
Age			Six pack in 30 days	8	7%
<20 years	4	4%	FitCoach	6	5%
20–25 years	42	38%	Others	24	21%
25–30 years	33	30%	**Duration of use**		
30–35 years	28	25%	<1 month	11	10%
35–40 years	5	5%	1–3 month	26	23%
>40 years	0	0	3–6 month	18	16%
Familiarity of the app			6–9 month	2	2%
Very familiar	29	25%	9–12 month	1	1%
Familiar	55	47.8%	>1 year	57	50%
Neutral	28	24.3%			
Not familiar	1	9%			
Very not familiar	2	1.7%			

of them also has been using the application more than one year and using Samsung Health or Apple Health. Other applications that also used other than mentioned in **Table 3** are Google Fit, Zepp, Fitness First, Home Workouts, Huawei Health, Lose Belly in 30 Days, Lose Weight for Men, Mi Fit, My Fitness Pal, Nike Runner, Plank Workout, Primaku, Pulse, Virgin Plus. There are three age categories as the main respondents of this study which are 20–25 age group, 25–30 age group and 30–35 age group.

4.3. Kano model result and analysis

The Kano two-dimensional questionnaires were analyzed using the quality classification presented in **Table 2**. The results of the analyses are illustrated in **Figure 5**. The Kano model is computed by evaluating respondent answers based on the classification table. The total number of respondents answering based on the calculation table is determined, and the percentages are presented in **Table 4** (M, O, A, I, R). The highest percentage among all categories represents the Major Kano Model dimension. However, for some qualities, minor differences in percentages are observed between the Major Kano Model and other dimensions. For instance, in reliability, "O" is identified as the Major Kano Model, yet the difference with the "A" dimension is marginal, with percentages of 39% and 37%, respectively. Hence, we calculate the Secondary Kano Model, as shown in the Secondary Kano Model column.

Table 4. Kano model analysis result.

No	Quality	M	O	A	I	R	Major Kano Model	Extent of Satisfaction (SI)	Extent of Dissatisfaction (DSI)	Secondary Kano Model
1	Reliability	11%	39%	37%	13%	0%	O	0.766	−0.5	OA (37%:39% = 0.95)
2	Ease of use	15%	34%	31%	20%	0%	O	0.646	−0.49	OA (31%:34% = 0.95)
3	Completeness	5%	23%	39%	33%	0%	A	0.619	−0.28	AI (33%: 39% = 0.85)
4	Usefulness	4%	31%	39%	26%	0%	A	0.699	−0.35	AO (31%:39% = 0.77)
5	Accuracy	7%	42%	35%	16%	0%	O	0.763	−0.49	OA (35%:42% = 0.83)
6	Responsiveness	12%	39%	27%	22%	0%	O	0.664	−0.51	OA (27%:39% = 0.68)
7	Economic benefit	3%	9%	37%	51%	0%	I	0.459	−0.12	IA (37%:51% = 0.73)
8	Integration	5%	14%	28%	52%	1%	I	0.422	−0.19	IA (28%:52% = 0.544)
9	Empathy	9%	23%	32%	36%	0%	I	0.55	−0.31	IA (32%:36% = 0.889)
10	User interface	9%	29%	34%	28%	0%	A	0.628	−0.38	AO (29%:34% = 0.844)
11	Privacy	10%	73%	10%	7%	0%	O	0.833	−0.83	-
12	Availability	12%	52%	25%	11%	0%	O	0.763	−0.64	-

Notes: M (Must-Be Quality), O (One-Dimensional Quality), A (Attractive Quality, I (Indifferemt Quality), R (Reverse Quality).
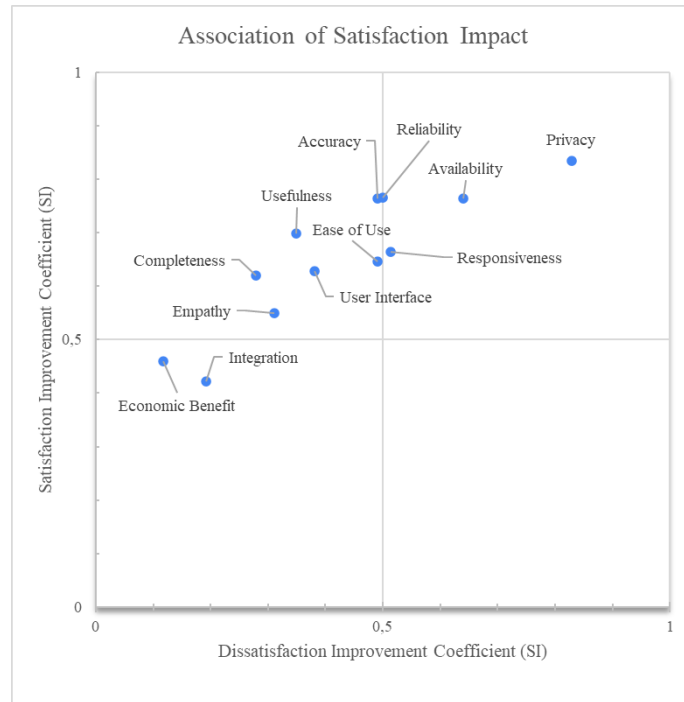
Figure 5. Association of satisfaction impact.

The extent of satisfaction and dissatisfaction is also computed. The extent of satisfaction (Satisfaction Improvement Coefficient/SI) is calculated as $(A + O)/(A + O + M + I)$, and the extent of dissatisfaction (Dissatisfaction Improvement Coefficient/DSI) is calculated as $(M + O)/(A + O + M + I)$ (Yao et al., 2018). When a quality has great value of SI that means that it impacts user satisfaction more that quality with lower value of SI. In contrary when a quality has low value of DSI it would impact dissatisfaction more than the quality with higher value of DSI.

In **Figure 4**, there are two axes, vertical for SI and horizontal for SDI. It shows that privacy is the positioned at the upper level of the Cartesian plane, this reflects the great value of SI. Privacy has great influence for user satisfaction. Privacy also positions at the left of the Cartesian plane that tells it has great impact for user dissatisfaction. In contrary economic benefit and integration lies of the bottom right of the Cartesian plane. These two qualities have less impact for user satisfaction and lesser impact on user dissatisfaction. The association of SI and DSI for each quality can be observed in **Figure 4**. From the results of the Kano Model Analysis, it is found that there are six one-dimensional qualities, three attractive qualities, three indifferent qualities, and no must-be quality.

4.3.1. One-dimensional quality (**Privacy and availability**)

In this dimension, the quality would result in the same level of satisfaction or dissatisfaction under contrary conditions. The quality dimensions that fall into this category are privacy (O = 73%) and availability (O = 52%). Improved privacy quality would enhance satisfaction, and conversely, diminished privacy quality would decrease satisfaction (SI = 0.83, DSI = −0.83). Similarly, enhanced availability quality would boost satisfaction, while decreased availability quality would lead to dissatisfaction. These mean, based on the survey result the majority of respondents

feel very satisfied if privacy and availability can be provided by the application, but they would feel very dissatisfied if these qualities are not met.

In the application review, only 1% of the reviews mentioned that users wouldn't want to share their private data. However, in the Kano Model analysis, this variable receives the highest dissatisfaction coefficient (DSI = −0.83) if the application fails to mention its commitment to protecting user privacy. Users' concerns for privacy may have increased, especially since there have been several data privacy breaches in recent years. One notable breach in the health industry was the BPJS data leakage in 2021 (Tempo, 2021). With similar cases occurring, many media outlets have covered and highlighted the negative impact of data breaches on society. Therefore, it is crucial to educate users on the importance of securing private data. Application developers must ensure that users receive their commitment to data privacy and inform them how the application will use their data.

Similarly, availability was mentioned in only 1% of the application reviews. However, this quality is extremely important for maintaining user satisfaction. The application must have high availability because when users cannot access it, dissatisfaction can lead to discontinuing its use. With users having more options for health and fitness applications, it is easier for them to switch when an application fails to meet their expectations.

4.3.2. Reliability, ease of use, responsiveness and accuracy (One-dimensional quality with attraction as secondary kano model—OA)

In this dimension, the quality would lead to greater satisfaction than dissatisfaction under contrary conditions. The quality dimensions that fall into this category are reliability (O = 39%, A = 37%), ease of use (O = 34%, A = 31%), responsiveness (O = 39%, A = 27%) and accuracy (O = 42%, A = 35%). Improved reliability would have a greater impact on satisfaction compared to the absence of reliability for dissatisfaction. Similarly, if the application is easier to use, it would have a greater impact on satisfaction than the absence of ease of use, and if it is difficult to use, it would lead to less dissatisfaction than the absence of ease of use. Moreover, better accuracy would impact satisfaction more than the absence of accuracy ("O" dimension), while being least accurate would result in less dissatisfaction than the absence of accuracy. When the application provides prompt responses, it would have a greater impact on satisfaction than the absence of promptness, and when the response is slow, it would lead to less dissatisfaction than the absence of promptness.

Reliability is one of the top three issues mentioned by users in the application reviews. Many complaints are related to technical issues with the application. This quality falls into the "O" category, indicating that lacking reliability will decrease user satisfaction. Therefore, quality assurance and quality control processes are crucial when developing the software. For ease-of-use quality, the Satisfaction Improvement (SI) value is greater than the Dissatisfaction Improvement (DSI) value. The satisfaction of having a user-friendly application outweighs the dissatisfaction of using a non-friendly user interface. However, a study by Kim et al. (2019) found that ease of use did not significantly impact satisfaction. Responsiveness is mentioned in only 1% of reviews, but this quality has a significant influence on user satisfaction levels. Users now have high expectations regarding how quickly their requests are responded

to. Similarly, accuracy is mentioned in only 1% of reviews. Users will be satisfied if their information is presented accurately. Application developers must ensure that the algorithms for data manipulation are correct and up-to-date.

4.3.3. Usefulness, user interface (Attractive quality with one dimensional as secondary kano model—AO)

In this dimension, the quality would significantly increase satisfaction and only cause minimal dissatisfaction under contrary conditions. The quality dimensions that fall into this category are usefulness (A = 39%, O = 31%) and user interface (A = 34%, O = 29%). When the application is useful and beneficial, it greatly impacts satisfaction, while causing only minor dissatisfaction if lacking. Similarly, when the application has an attractive user interface, it significantly impacts satisfaction, with only minor dissatisfaction if lacking.

Usefulness is the most frequently mentioned quality in user reviews. Users feel satisfied when they receive help to complete their tasks using the application. User interface has been declared to have a strong positive significant influence on user satisfaction (Birkmeyer et al., 2021). Nowadays, there are constant improvements in the design of user interfaces, as what users see in the application defines their perception of it.

4.3.4. Completeness (Attractive quality with indifferent as secondary Kano model—AI)

In this dimension, the quality would increase satisfaction more and would not cause dissatisfaction under contrary conditions. The quality dimension that falls in to this category is completeness of functionalities (A = 39%, O = 33%). If the application has complete functionality, it would significantly impact satisfaction more than the absence of functionality, and if the application is not complete, it would not cause dissatisfaction.

Completeness of functionality is mentioned in a few reviews, which is quite common on an application review page. Users typically provide feedback regarding which functionalities should be added to the application. However, this quality has a Satisfaction Improvement (SI = 0.619) value higher than the Dissatisfaction Improvement (DSI = −0.28) value. This indicates that complete functionality would increase user satisfaction, but incomplete functionality would not significantly impact user dissatisfaction. Application developers could implement additional features gradually after conducting more research on which features to prioritize first.

4.3.5. Economic benefit, integration, empathy (Indifferent quality with attractive as secondary Kano model—IA)

In this dimension, the quality would increase satisfaction slightly and would not cause dissatisfaction under contrary conditions. The quality dimensions that fall into this category are economic benefit (I = 51%, A = 37%), integration (I = 52%, A = 37%), and empathy (I = 36%, A = 32%). When the application offers financial benefits, it would have a slight impact on satisfaction, but it would not cause dissatisfaction if lacking. Similarly, when the application has integration features with other apps or devices, it would have a slight impact on satisfaction, but it would not cause dissatisfaction if lacking. Lastly, when the application offers motivation for users, it

would have a slight impact on satisfaction, but it would not cause dissatisfaction if lacking.

Economic benefit is not considered an essential quality in mobile health applications. Integration with other applications was mentioned by some users in the review, but this feature was not deemed important enough to significantly influence user satisfaction. Empathy was defined as providing individualized attention to the user. In the review, this variable was mentioned as the application's ability to motivate users to reach their health-related goals.

5. Discussion and implication

5.1. Discussion

Our research provides valuable insights into the quality dimensions of mobile health applications and their impact on user satisfaction and dissatisfaction. Based on the Kano analysis conducted, we found that the quality factor most influencing user satisfaction is privacy, with the highest Satisfaction Improvement (SI) value. Additionally, the Dissatisfaction Improvement (DSI) value for this quality is also at the lowest position. Privacy has been evaluated as the influencing factor for users to use mobile health applications (Yang, et al., 2024). In the context of mobile health applications, concerns about privacy often serve as a barrier for users to adopt and use these apps. Users frequently hesitate to share their personal health information if they're unsure about how their data will be stored and managed securely and privately. Moreover, users' concerns for privacy may have increased, especially since there have been several data privacy breaches in recent years. One notable breach in the health industry was the BPJS data leakage in 2021 (Tempo, 2021). The next quality dimension that has a significant impact on user satisfaction is availability. System availability refers to the degree to which a system or service is operational and accessible to users within a specified period, falling under the category of system quality in the D&M (DeLone and McLean, 2003) model. A mobile health application with high availability enables users to access health information continuously, anytime and anywhere. Research conducted by Keikhosrokiania et al. (2018) has shown that system availability influences the usage of healthcare applications.

Other quality dimension that has great impact on satisfaction is reliability. Reliability is also a component of system quality (Keikhosrokiania et al., 2018), and it has been studied by Alzahrani et al. (2022), showing its impact on mHealth usage. Reliability is closely related to service availability, as a reliable service is always available. Ease of use has also been proven to impact user satisfaction, with the difficulty of using an application potentially causing user dissatisfaction. This finding is consistent with research conducted by Yan et al. (2021). Accuracy is also identified as a significant quality factor to consider. The accuracy of data presented in the system will influence user satisfaction. In the study by Kim et al. (2019), content quality was found to affect user satisfaction, with one aspect being the credibility of information.

The next priority of quality dimension that has less impact on user satisfaction are usefulness and user interface. Usefulness is studied as part of service quality, where services are useful and helpful in monitoring user health and providing decision-making information. This finding aligns with research by Jen and Chao (2008).

Perceived usefulness is a construct often studied and influences satisfaction (Hashemi, et al., 2024; Yan et al., 2021). Also, according to the Expectation Confirmation Theory (ECT), a factor influencing user satisfaction is the perceived usefulness of the system (Bhattacherjee, 2001). An attractive user interface can enhance user satisfaction in using mobile health apps based on the analysis conducted. The design of the interface also influences satisfaction, as found in the study by Birkmeyer et al. (2021). However, in this research, an unattractive interface only causes minimal user dissatisfaction.

From our finding, the completeness of system functions is appreciated by users, but incomplete functionalities do not significantly impact user dissatisfaction. Therefore, system development can launch applications gradually without waiting for all features to be complete. System development with Scrum also aligns with these results, where applications are delivered iteratively by considering user feature priorities. Our findings also show that Economic Benefit, Integration, and Empathy have the lowest impact on user satisfaction levels. While users appreciate economic benefits, integration features, and empathy in mobile health applications, their absence does not significantly impact user dissatisfaction. Application developers should consider these dimensions as additional features to enhance user experience but focus on other critical quality dimensions for higher user satisfaction.

5.2. Implication and limitation

This study successfully confirms that the quality of mobile health applications can impact user satisfaction levels, ultimately influencing user continuance of use. Additionally, this study introduces several qualities not previously mentioned, including completeness of functionality, integration, and economic benefits. However, we found that only completeness of functionality attracts users and boosts their satisfaction, although this quality is not considered a must-have. Further research could confirm this finding through additional qualitative or quantitative methods.

From a practical standpoint, the results of this study provide valuable insights for application developers. Quality is crucial for developers to consider, with certain qualities emerging as primary priorities for thorough development, such as privacy, availability, reliability, ease of use, accuracy, and responsiveness. Moreover, our study indicates that using Scrum methodology as an application development method does not compromise user satisfaction. While comprehensive features contribute to satisfaction, incompleteness does not necessarily lead to user dissatisfaction.

6. Conclusion

This study successfully identified 12 quality dimensions based on reviews from mobile health application users. Subsequently, an analysis was conducted to assess the impact of these qualities on user satisfaction and dissatisfaction using the Kano Model. Based on our findings, the important qualities of mobile health applications are availability, privacy, reliability, ease of use, accuracy, and responsiveness. The absence of these qualities would lead to user dissatisfaction. Developers should also consider improving the user interface and usefulness of the application.

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