Kano Model Analysis of Android Apps Quality from End User’s Preferences

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Abstract. This study aimed to explore the end user’s preferences regarding the features of an android app by classifying them with the Kano Model. The list of features was based on ISO/IEC 25010 combined with Android Core App Quality Guidelines. This expert system android app which is named ‘Pilih Media’ is used to help teachers selecting learning media based on Anderson’s theory of learning media selection. Respondents in this study were 50 teachers. Kano model was used in this study as a guideline in making questionnaires and also analyzing the data. From the study, it can be concluded that there are 17 features classified as the Attractive requirement category, six features classified as One-dimensional category, one feature classified as Must-be category, and five features classified as the Indifferent category. Overall, it seems that a lot of features have the potential to increase the end user’s satisfaction.

1. Introduction

The teaching and learning process is the main activity at school and it includes interaction between teachers, students, and the lesson material. Teachers as facilitators need to create learning activities that allow students to achieve learning goals. In doing so, teachers can use learning media. Teachers need to choose media carefully, which is the most appropriate to achieve learning goals effectively.

The learning media selection process is important because it has a positive effect on student achievement [1]. However, from a survey of a group of teachers on the selection of media, it was found that the media that the teacher chooses is based on the learning media available in the school. Many teachers choose instructional media without a clear theoretical basis. They do not even know the theory of learning media selection. Whereas the theoretical basis in selecting media is very important to achieve learning objectives effectively.

A theory about learning media selection had been developed by Anderson and is still used until now. The use of this theory needs a full attention because it has a long flowchart and the user needs to answer some questions until finding the right media. It is quite difficult to do media selection based on Anderson’s theory manually.

Currently, there is a smartphone application to assist teachers in the media selection process. This media selection app is called ‘Pilih Media’ developed by Putra [2]. This application is an expert system for media selection based on flowcharts in Anderson’s media selection theory. ‘Pilih Media’ application uses the Android operating system as a platform in its development. This application has implemented ISO 25010 in the development process. Socialization has been done verbally and also launch the app on google play store, but the usage is still low rate. However, the application has not been developed based on user satisfaction, so it was not surprising that many users didn’t use or uninstall the app.

The Kano model is a method that can be used to identify user satisfaction using two-dimensional ways. The Kano model is considered the most appropriate for this analysis because it can find out which features the user likes and dislikes from an application. The Kano model used was developed by Professor Noriaki Kano and his colleagues to categorize the elements of the application based on how well the application can satisfy user needs [3]. The system used is an orthogonal axis that is used to determine the relationship between user satisfaction and core app quality as shown in Figure 1.
Kano model is distinguished into six categories tailored to what users need: Must-be (M), One-dimensional (O), Attractive (A), Reverse (R), Indifferent (I), and Questionable (Q) [4].

- Must-be (M): The application features of this category can make users feel very unhappy if these features are not presented. However, the availability of these features also does not increase user satisfaction.
- One-dimensional (O): The application features of this category can increase user satisfaction and the absence of this feature can increase user dissatisfaction.
- Attractive (A): The application feature of this category is a distinguishing service that is presented. The functional presence of this service will be liked by users and the absence of this service does not affect user satisfaction.
- Reverse (R): The application features of this category do not need to be presented because they affect user satisfaction and the absence of this feature is more appreciated by users.
- Indifferent (I): The application features of this category have no impact on user satisfaction and dissatisfaction.
- Questionable (Q): The results given indicate that the questions given were wrong or the answers given were not correct.

User satisfaction test needs to be done to obtain complete information about user preference for the app so that they will be more interested and more comfortable in using this application. Based on this, this study aims to determine the trend of end-users regarding the features of the android app ‘Pilih Media’ by classifying them based on the Kano Model [3].

2. Research Methods

Research conducted using the descriptive type of research with a quantitative approach. A questionnaire is used to obtain data about user satisfaction in using the ‘Pilih Media’ application from 50 teachers as respondents. Data collected from respondents will be analyzed using the Kano model. This process below using individual steps of the “Kano Project” [6].

2.1. Identification of user’s needs and expectations

ISO/IEC 25010 [7] and Android Developers Core App Quality [8] are used as a guideline to make a list of features. The two of the standards consist of the list of apps feature and will be combined. This step will be resulting in the list of features that will be used for constructing the Kano Questionnaire to know user preference about the app. The features are presented in Table 1.
Table 1. List of apps features

| ISO/IEC 25010 | Core App Quality Area | Number of app feature on the questionnaire |
|---------------|-----------------------|--------------------------------------------|
| **Quality Characteristics** | **Quality Sub-Characteristics** | **Media** | **Visual quality** | **Audio** | **UI and Graphics** | **Performance** | **Battery** | **Install location** | **Appropriateness recognizability** | **Stability** | **Navigation** | **Standard design** | **User/app state** | **Standard design** | **User/app state** |
| Functional suitability | Completeness, correctness, appropriateness | 1, 2 | 3, 4 | 5, 6, 7, 8, 9 | 10, 11, 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19, 20, 21 | 22, 23 | 24 | 25 | 26 | 27, 28 | 29 |
| Performance efficiency | Time behavior | Performance | 13 | | | | | | | | | | | | | | | |
| | Resource utilization | Battery | 14 | | | | | | | | | | | | | | | |
| | Capacity | Install location | 15 | | | | | | | | | | | | | | | |
| Usability | Appropriateness recognizability | - | 16 | | | | | | | | | | | | | | | |
| | Learnability | - | 17 | | | | | | | | | | | | | | | |
| | Operability | Stability | 18 | | | | | | | | | | | | | | | |
| | Navigation | Standard design | 22, 23 | | | | | | | | | | | | | | | |
| | User interface aesthetics | Standard design | | | | | | | | | | | | | | | | |
| | Accessibility | - | 24 | | | | | | | | | | | | | | | |
| Reliability | Fault tolerance | SDK | 25 | | | | | | | | | | | | | | | |
| | Recoverability | User/app state | 26 | | | | | | | | | | | | | | | |
| Security | Confidentiality | Permissions | 27, 28 | | | | | | | | | | | | | | | |
| | Integrity | User/app state | 29 | | | | | | | | | | | | | | | |

2.2. Construction of the Kano Questionnaire

Questions used in the Kano Questionnaire made in pairs, one in form of a functional question and the other in form of a dysfunctional question. Respondents can provide answers to each question item presented by using one choice among five different choices [9]. This is an example of a question from the questionnaire:

**Functional Question**: What would you feel if music or video features are available in the apps? Answers: “I like it”; “It must be that way”; “I am neutral”; “I can live with it”; “I dislike it”.

**Dysfunctional Question**: What would you feel if music or video features are not available in the apps? Answers: “I like it”; “It must be that way”; “I am neutral”; “I can live with it”; “I dislike it”.

The answers given to functional and dysfunctional questions related to the presentation of different features are then analyzed into answers to the quality category.

Table 2. Kano Evaluation Table

| User Requirements | Dysfunctional (Negative Question) |
|-------------------|----------------------------------|
|                   | I Like it | It must be that way | I am neutral | I can live with it | I dislike it |
| **Functional** (Positive Question) | I like it | Q | A | A | A | O |
| It must be that way | R | I | I | I | M |
| I am neutral | R | I | I | I | M |
| I can live with it | R | I | I | I | M |
| I dislike it | R | R | R | R | Q |

Must-be requirement (M), One-dimensional requirement (O), Attractive requirement (A), Indifferent requirement (I), Reverse requirement (R), Questionable requirement (Q)

By combining the two answers from the paired question, the app's features can be classified as in Table 2. For example, if the user answers the functional questions, namely "I like it" and dysfunctional questions as "I am neutral", then the apps feature being questioned is categorized in the "A" or Attractive category.
2.3. Administering and collecting responses
The questionnaire about user satisfaction in using the ‘Pilih Media’ application was administered to respondents by email and google form. By using a google form, it was more effective and efficient because it could record the data automatically every time the respondent filled in the questionnaire.

2.4. Interpretation and evaluation of the results
The next step is to analyze and explain the results. This study using four methods to process the results of the Kano survey and then will be combined as the final result, i.e.:

2.4.1. Evaluation according to frequencies. The simplest method to evaluate and interpret data is by looking at the frequency of answers and rank the requirements based on the dimensions that often appear on the tabulated matrix row.

2.4.2. Evaluation according to the greatest impact on the apps. If two Kano codes are tied to the assessment process for one of the questions, then the classification chosen is the one that has the greatest impact on the application by using the following stages: M > O > A > I [4].

2.4.3. Evaluation using “Blauth Formula”. This formula is used to decrease the “noise level” when too many requirements” are considered Indifferent [4]. The formula to change the statistical mode, namely in the following way:
- If (One-dimensional + Attractive + Must-be) > (Indifferent + Reverse + Questionable), then grade is one of the most frequently occurring from One-dimensional, Attractive, or Must-be.
- Else, the grade is one of the most frequently occurring from Indifferent, Reverse, or Questionable.

2.4.4. Evaluation according to user satisfaction (US) coefficient. The user satisfaction coefficient is used to calculate the average impact of user satisfaction. Pairs of user satisfaction and user dissatisfaction coefficient for each app feature can be plotted on a two-dimensional graph. The formula used for calculating coefficients is as follows [4]:

\[
\text{The extent of user satisfaction} = \frac{A+O}{A+O+M+I}
\]
\[
\text{The extent of user dissatisfaction} = \frac{O+M}{A+O+M+I}
\]

3. Result and Discussion

3.1. Result
A total of 50 filled questionnaires were received from respondents. Table 3 below shows the result according to the “Blauth Formula” and user satisfaction coefficient.

| Number of App Feature | Kano Category | Blauth Formula | User Satisfaction Coefficient |
|-----------------------|--------------|----------------|-----------------------------|
|                       | M | O | A | I | R | Q | O+M | I+Q | User Satisfaction | User Dissatisfaction |
| 1                     | 2 | 5 | 20| 15| 2 | 6 | 27 | 23 | 0,595             | -0,167             |
| 2                     | 6 | 6 | 15| 10| 4 | 9 | 27 | 23 | 0,568             | -0,324             |
| 3                     | 7 | 10| 13| 10| 1 | 9 | 30 | 20 | 0,575             | -0,425             |
| 4                     | 8 | 7 | 14| 13| 4 | 4 | 29 | 21 | 0,55              | -0,357             |
| 5                     | 1 | 5 | 17| 17| 1 | 9 | 23 | 27 | 0,55              | -0,15              |
| 6                     | 5 | 4 | 13| 21| 3 | 4 | 22 | 28 | 0,395             | -0,209             |
Pairs of user satisfaction and user dissatisfaction coefficient for each app features in Figure 2 shows a two-dimensional graph plotted.
Table 4 below shows the final result based on four methods for processing the result of the Kano category and combined as a single final result.

**Table 4. Table of the final result**

| Number of App Feature | Most frequent | Greatest impact | Blauth Formula | User satisfaction coefficient | Final result       |
|-----------------------|---------------|-----------------|----------------|------------------------------|--------------------|
| 1                     | Attractive    | Attractive      | Attractive     | Attractive                   | Attractive         |
| 2                     | Attractive    | Attractive      | Attractive     | Attractive                   | Attractive         |
| 3                     | Attractive    | Attractive      | Attractive     | Attractive                   | Attractive         |
| 4                     | Attractive    | Attractive      | Attractive     | Evenly split between         | Attractive         |
|                       |               |                 |                | Indifferent and Attractive   |                    |
| 5                     | Attractive/   | Attractive      | Indifferent    | Attractive                   | Attractive         |
|                       | Indifferent   |                 |                |                              |                    |
| 6                     | Indifferent   | Indifferent     | Indifferent    | Indifferent                  | Indifferent        |
| 7                     | Indifferent   | Indifferent     | Indifferent    | Indifferent                  | Indifferent        |
| 8                     | Indifferent   | Indifferent     | Indifferent    | Indifferent                  | Indifferent        |
| 9                     | Indifferent   | Indifferent     | Indifferent    | Indifferent                  | Indifferent        |
| 10                    | Attractive    | Attractive      | Attractive     | Attractive                   | Attractive         |
| 11                    | Attractive    | Attractive      | Attractive     | Attractive                   | Attractive         |
| 12                    | Attractive    | Attractive      | Attractive     | Attractive                   | Attractive         |
| 13                    | Indifferent   | Attractive      | Attractive     | Attractive                   | Attractive         |
| 14                    | Indifferent   | Attractive      | Attractive     | Attractive                   | Attractive         |
| 15                    | Attractive    | Attractive      | Attractive     | Evenly split between         | Attractive         |
|                       |               |                 |                | Indifferent and Attractive   |                    |
| 16                    | One-dimensional | One-dimensional | One-dimensional | Evenly split between         | One-dimensional   |
|                       |               |                 |                | Attractive and One-dimensional |                    |
| 17                    | One-dimensional | One-dimensional | One-dimensional | One-dimensional             | One-dimensional   |
| 18                    | One-dimensional | One-dimensional | One-dimensional | One-dimensional             | One-dimensional   |
| 19                    | Indifferent   | Attractive      | Attractive     | Attractive                   | Attractive         |
| 20                    | One-dimensional/ Indifferent | One-dimensional | One-dimensional | Evenly split among           | One-dimensional   |
|                       |               |                 |                | Attractive, One-dimensional, |                    |
|                       |               |                 |                | Must-be, and Indifferent     |                    |
| 21                    | One-dimensional | One-dimensional | One-dimensional | Evenly split between Attractive dan One-dimensional | One-dimensional |
| 22                    | Indifferent   | Indifferent     | One-dimensional | Attractive                   | Indifferent        |
| 23                    | Indifferent   | Indifferent     | Attractive     | Attractive                   | Attractive         |
| 24                    | Attractive    | Attractive      | Attractive     | Attractive                   | Attractive         |
| 25                    | Attractive    | Attractive      | Attractive     | Attractive                   | Attractive         |
| 26                    | One-dimensional | One-dimensional | One-dimensional | Attractive                   | One-dimensional   |
| 27                    | Attractive    | Attractive      | Attractive     | Attractive                   | Attractive         |
| 28                    | Must-be       | Must-be         | Must-be        | Must-be                      | Must-be            |
| 29                    | Indifferent   | Attractive      | Attractive     | Attractive                   | Attractive         |
3.2. Discussion

3.2.1. Interpretation of the Results.

While using four methods to process the results of the Kano survey, some features resulting in different Kano categories, though most of the features resulting in the same Kano categories. In the first methods of evaluating data according to the most frequent, sometimes resulting in two features in a different category with tied scoring. Then, these two tied scoring can be eliminated using evaluation according to the greatest impact on the apps. This evaluation can make a single result for every feature.

From those two methods, we found many features resulting Indifferent category. App features that are classified in this category don’t have a significant impact on whether they are provided in the app or not. To reduce what we called ‘noise’, we used evaluation according to the “Blauth Formula”. It can reduce the number of features resulting Indifferent category from ten features to just five features. The last process was evaluation according to the user satisfaction coefficient that giving a more comprehensive review for the final result. The final result is concluded from the four evaluation methods.

The interesting thing is the Kano category that often appears, namely Attractive requirements. Seventeen features of the app identified as an Attractive requirement category This indicates that end-user satisfaction can be improved by using many features, but mostly the absence of feature usage will not significantly increase user dissatisfaction. The end-user is attracted to apps features from the Area of Media, Visual Quality, UI and Graphics, Performance, Battery, Install location, Standard design, Accessibility, SDK, Permissions, and User/app state.

There are five features of the app identified as an Indifferent requirement category. This shows that the indifferent feature categories do not affect end-user satisfaction when available or absent. The end-user has an indifference level of (dis)satisfaction on android apps from the Area of Audio and Standard design. Surprisingly, most of this indifferent category came from the audio core app quality area, which is feature number 6, 7, 8, and 9. The end-user is just attracted by the availability of the audio in the app. It’s because feature number 5 inside the audio area is questioning “How would you feel if music or video features are available in the apps?” and resulting in the Attractive category.

Six features are resulting One-dimensional category from the Sub-characteristics/Area of Appropriateness recognizability, Learnability, Stability, Navigation, and User/app state. It can be said that these six features can increase end-user satisfaction and the absence of these features will significantly increase the dissatisfaction level. Just one feature resulting Must-be category from the Permissions Area. This means the only feature that no potential to increase the end user’s satisfaction but the absence of the features will significantly increase the dissatisfaction level. None of the features resulting in the Reverse category or Questionable category.

3.2.2. Study Limitations and Recommendations for Future Work.

This study has limitations for use only regular Kano questionnaires without use self-stated importance questionnaires because the number of questions is too large. Self-stated importance questionnaires can be used to help understand what is of interest to each requirement that the customer must fulfill [4]. This questionnaire can also be used to assist in centralizing the most important results obtained from the Kano survey conducted.

The recommendations for future work are to use self-stated importance when delivering a questionnaire so the result can be explored more widely. The apps features that include in the self-stated importance survey can be reduced without including the app’s features resulting in Indifferent Categories. Use only apps features resulting in Attractive, One-dimensional, and Must-be Category.

4. Conclusion

This research was conducted to implement the Kano Model as an approach for investigating features of android apps ‘Pilih Media’ from the end user’s preferences. The list of features in the questionnaire used in this study was based on ISO/IEC 25010 combined with Android Core App Quality Guidelines. The
key outcomes are that none of the 29 android feature lists were identified as Reverse requirement nor Questionable requirement. The Kano category that often appears or is used is the Attractive category by presenting 17 features. The six features identified as a One-dimensional category, one feature identified as a Must-be category, and five features identified as the Indifferent category. Broadly speaking, it can be said that many features have the potential to increase end-user satisfaction. The absence of most features will decrease the satisfaction level but not significantly increase the dissatisfaction level because most features are identified as Attractive categories.

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