

Analysis of User Requirements for a Middle School LMS Using the Fuzzy Kano Method

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ABSTRACT

Advances in information technology in the field of education have driven the use of Learning Management Systems (LMS) as a digital learning medium at the junior high school level. However, the development of an effective LMS must be based on an analysis of user needs so that the features developed align with the expectations of students and teachers. This study aims to analyze the user needs of the SMP LMS application using the Fuzzy Kano method to identify feature categories and priorities based on user satisfaction and dissatisfaction levels. The research method employed is a quantitative approach involving the distribution of a Fuzzy Kano questionnaire to junior high school student respondents. The data obtained was then normalized and analyzed using the Fuzzy Kano method to classify features into Must Be, One-Dimensional, and Attractive quality attributes. Subsequently, calculations for Customer Satisfaction (CS), Customer Dissatisfaction (DS), and Range Score were performed to determine feature development priorities. The results of the study indicate that basic features such as login, access to materials, and assignment submission fall into the Must Be category. The feature with the highest priority in the One-Dimensional category is fast and stable system performance, with a range score of 1.37. In the Attractive category, the gamification feature has the highest range score of 0.80, which is capable of enhancing students' learning motivation.

Keywords : LMS, Fuzzy Kano, User Satisfaction, Requirements Analysis, Junior High School

INTRODUCTION

Advances in information technology have driven the use of Learning Management Systems (LMS) as the primary medium for digital learning in junior high schools (SMP). LMS enables teachers and students to engage in structured learning through the distribution of materials, assignment collection, assessment, and online communication online (Al-Fraihat et al., 2020). Mobile learning via LMS provides users with the convenience of accessing learning materials anytime and anywhere. However, in its implementation at the junior high school level, various obstacles are still encountered, such as features that do not align with student needs, limited interaction, and low user satisfaction with the system used (Berger et al., 2021). Several studies indicate that e-learning system failures are often caused by a lack of in-depth user needs analysis prior to system development (Ellis, 2021). Therefore, it is crucial to identify user needs so that LMS system development can provide an optimal learning experience.

The Kano model is a method used to classify user needs based on their impact on user satisfaction (Haryati et al., 2024). However, the classical Kano model has limitations because it is crisp, making it less capable of capturing the uncertainty of user perceptions (Kano, 2021). To address these weaknesses, the Fuzzy Kano method was developed by combining the Kano model with fuzzy logic, thereby enabling more accurate analysis (Lee et al., 2022). Previous studies have shown that the Fuzzy Kano method is effective in determining feature development priorities for e-learning systems and LMSs (Matzler & Hinterhuber, 2021) (Marthiani, 2024). However, research specifically examining the needs of LMS users at the junior high school level in Indonesia remains limited. Therefore, this study was conducted to analyze the needs of junior high school LMS application users using the Fuzzy Kano method.

LITERATURE REVIEW

A Learning Management System (LMS) is a digital platform used to manage the learning process, including the delivery of course materials, learning assessments, and communication between teachers and students (Nugroho et al., 2023). An LMS provides flexibility in the learning process and enables more systematic management of learning. The success of an LMS implementation is heavily influenced by user satisfaction with the system. User satisfaction can be influenced by various factors such as ease of use, the availability of relevant features, and stable system performance (Putri et al., 2023).

The Kano model is used to identify the relationship between product attributes and user satisfaction levels. This model categorizes service attributes into several categories: Must Be, One-Dimensional, Attractive, Indifferent, Reverse, and Questionable (Rahman et al., 2022). These categories assist system developers in determining feature development priorities. To improve the accuracy of the analysis, the Kano model can be combined with fuzzy logic to produce the Fuzzy Kano method. This method is capable of addressing uncertainty in respondent evaluations and producing a more realistic classification of user needs (Suryani et al., 2022).

Previous research indicates that the Fuzzy Kano method is effective for analyzing the requirements of information systems and e-learning. This method assists system developers in identifying the features that have the greatest impact on user satisfaction (Wahyudi, 2021).

METHODS

This study employs a quantitative approach using the Fuzzy Kano analysis method to identify user needs regarding features in a junior high school LMS application. Research data were collected through interviews, observations, literature reviews, and the distribution of questionnaires to students as LMS users. The study population consisted of 135 students who use the LMS at a junior high school.

The sample size was determined using the Slovin formula, resulting in 100 respondents as the research sample.

The research instrument consists of a questionnaire designed based on the Kano model, comprising two types of questions: functional and dysfunctional. Each question offers five response options: like, expect, neutral, tolerate, and dislike.

The data obtained was then analyzed using the Fuzzy Kano method through several stages,

namely data normalization, fuzzy matrix formation, Kano category classification, and the calculation of Customer Satisfaction (CS) and Customer Dissatisfaction (DS). These values were subsequently used to calculate the range score, which serves to determine the priority of feature development.

RESULTS AND DISCUSSION

Data Collection

Data collection was conducted through literature review, observation, interviews, and the distribution of questionnaires to junior high school students as active users of the LMS application. The literature review was conducted to strengthen the theoretical foundation regarding Learning Management Systems (LMS), User Interface (UI), User Experience (UX), and the Fuzzy Kano method. The literature used was selected because it was relevant to the topic under discussion and the research methodology employed. Next, the requirements for the LMS management system were identified using triangulation, which involved combining the results of interviews with students and teachers, direct observations of LMS usage at the school, and a review of the literature from previous studies. All identified requirements were consolidated into a single list of attributes. If there were duplicate attributes, only one was retained to avoid redundancy.

This list of requirements was then grouped according to the learning processes within the LMS, such as accessing materials, submitting assignments, classroom communication, and learning evaluation. The final result was a list of LMS feature attributes used as a tool in the research.

A questionnaire was then developed based on the Fuzzy Kano method, consisting of two sections of questions, namely:

1. Functional questions (what if the feature is available).
2. Dysfunctional questions (what if the feature is not available).

Each question had five response options: like, expect, neutral, tolerate, and dislike.

Before the questionnaire was distributed via Google Forms, a readability test was conducted to ensure that every statement was easily understood by the junior high school student respondents.

The population in this study consisted of 135 students using the LMS at one junior high school. The sample size was determined using the Slovin formula with a margin of error (e) of 10%, resulting in 100 respondents as the study sample.

$$n = \frac{N}{1 + Ne^2}$$

Explanation:

n = sample size N = population size

e = error margin

Next, the questionnaire results are categorized into 5 response types based on the Fuzzy Kano method, namely:

S = Like

SS = Should be N = Neutral

T = Tolerable TS = Dislike

This subsection presents an example of data processing for one LMS attribute, namely “Task and Deadline Notifications.” The sample consisted of 100 junior high school students who use the LMS. The questionnaire data before normalization for functional and dysfunctional responses is presented in Table 3.1:

Functional Responses

Table 1. Functional Responses

Answer Options	Frequency
Like (L)	40
Hope (SS)	30
Neutral (N)	15
Tolerance (T)	10
Dislike (TS)	5

Dysfunctional Response

Table 2. Dysfunctional Response

Answer Options	Frequency
Like (L)	5
Expect (SS)	10
Neutral (N)	20
Tolerance (T)	30
Dislike (TS)	35

The normalization process is performed by calculating the proportion of each option relative to the total number of responses, resulting in values expressed as decimal fractions. These values are then arranged in a fuzzy matrix and multiplied using the matrix multiplication formula. The multiplication of the functional and dysfunctional matrices produces a 5×5 matrix. The results of this matrix are used to classify each feature based on the Kano categories, namely:

M (Must be)

O (One-Dimensional) A (Attractive) I (Indifferent) R (Reverse)

Q (Questionable)

Examples of matrix multiplication in Equation (1) and Equation (2) are shown as follows:
 Normalization is performed using the formula:

$$[S H N T T S]^T \text{ fungsional} * [S H N T T S] \text{ disfungsi} = \begin{bmatrix} Q & A & A & A & O \\ R & I & I & I & M \\ R & I & I & I & M \\ R & I & I & I & M \\ R & R & R & R & Q \end{bmatrix}$$

Normalization = Frequency / Number of Respondents Since there are 100 students, we obtain:

Functional Matrix (F) = [0.40 0.30 0.15 0.10 0.05]

Dysfunctional Matrix (D) = [0.05 0.10 0.20 0.30 0.35]

Fuzzy Matrix Multiplication

0.05 0.10 0.20 0.30 0.35

Table 3. Fuzzy Matrix Multiplication Results

0.40	0.020	0.040	0.080	0.120	0.140
0.30	0.015	0.030	0.060	0.090	0.105
0.15	0.007	0.015	0.030	0.045	0.052
0.10	0.005	0.010	0.020	0.030	0.035
0.05	0.002	0.005	0.010	0.015	0.017

The results of the Kano category mapping are as follows:

Must Be (M) = 0.18

One-Dimensional (O) = 0.42 Attractive (A) = 0.28 Indifferent (I) = 0.08 Reverse +
 Questionable = 0.04

The final step in this analysis is to classify features by summing the category values obtained from the defuzzification process. According to Lee & Huang (2009), the determination of feature categories is based on the largest or highest membership degree value. If there are two categories with the same value, the category priority principle is applied, namely in the order $M > O > A > I$.

The next step is to establish feature priorities. The first step in this process involves identifying user perceptions regarding the specified features, namely perceptions of dissatisfaction (disgust) and satisfaction (delight). These perception values are obtained by summing the scores for each Kano category for each feature. The calculation of the dissatisfaction (disgust) score and the satisfaction (delight) score refers to the method by Berger cited in the literature by Chen, as stated in Equations (3) and (4).

$$\text{Equation (3)} \\ \text{Customer Delight} = \frac{A + O - R}{M + O + A + I + R + Q}$$

$$\text{Customer Disgust} = \frac{A + O}{(M + O + A + I + R + Q) \cdot (-I)} \quad \text{quation (4)}$$

The next step is to determine the range score, which is used as the basis for ranking feature priorities. The larger the range score of a feature's , then the higher the priority level. This range score is calculated using the formula given in Equation (5), where the range score is derived from the difference between the delight score and the disgust score. Once these scores are calculated, the features are ranked from highest to lowest score according to their respective Kano categories.

Defuzzification Process

Defuzzification uses a threshold of 0.4. If the value is ≥ 0.4 , it is assigned a value of 1. If the value is < 0.4 , it is assigned a value of 0.

The defuzzification process is presented in Table 4 :

Table 4. Results of the Defuzzification Process

Category	Value	Result
M	0.18	0
O	0.42	1
A	0.28	0
I	0.08	0

The 'Task and Deadline Notifications' feature falls under the One-Dimensional category.

3.1.5 Calculation of CS and DS $CS = (A + O) / (A + O + M + I)$ $DS = -(M + O) / (A + O + M + I)$

$$CS = 0.73$$

$$DS = -0.62$$

Next, calculate the range score using the equation below:

Equation (5)

$$\text{Range score} = \text{delight score} - \text{disgust score}$$

$$\text{Range Score} = CS - DS$$

$$\text{Range Score} = 0.73 - (-0.62) = 1.35$$

The final stage of this study is to formulate conclusions that include the results of feature grouping and prioritization based on the attribute rankings obtained using the Fuzzy Kano method. These rankings are used to determine the urgency level of improvement recommendations, taking into account user needs and satisfaction levels for each attribute. The higher the ranking of an attribute, the higher its priority in efforts to improve features in the LMS application. Based on the calculation results, this feature falls into the One-Dimensional

category and has a high priority in the development of the junior high school LMS.

Application Attribute Description

Results of processing data using the Fuzzy Kano method on the Merdeka Curriculum- based SMP LMS application. The analysis was conducted to group features into the Must Be, One-Dimensional, and Attractive categories based on satisfaction (delight), dissatisfaction (disgust), and range values.

Features in the Must Be category are quality attributes.

The Must Be category consists of basic features that must be available in the junior high school LMS. If these features are not available, they will cause high levels of dissatisfaction. Presented in Table 5 :

Table 5. Must Be Category Features and Their Satisfaction Analysis

No	Feature	Delight	Disgust	Range
1	Student and Teacher Login	0.35	-0.75	1.10
2	Access to learning materials	0.40	-0.70	1.10
3	Online assignment submission	0.38	-0.72	1.10

The feature with the highest priority in the Must Be category is 'Access to learning materials'. This feature is a primary requirement because the LMS serves as a medium for distributing instructional materials. Without this feature, the digital learning process cannot run effectively. The 'Student and Teacher Login' feature ensures security and personalized access. Meanwhile, 'Online Assignment Collection' supports digital-based assessment in accordance with the implementation of the Merdeka Curriculum.

Features in the One-dimensional quality attribute category.

The One-Dimensional category consists of features where an improvement in quality leads to a linear increase in user satisfaction. These are presented in Table 6 :

Table 6. One-Dimensional Features with Delight, Disgust, and Range Values

No	Feature	Delight	Disgust	Range
1	Task & deadline	0.73	-0.62	1.35
2	Class discussion forum	0.70	-0.60	1.30
3	Grades & immediate feedback	0.75	-0.58	1.33
4	Fast and stable loading	0.72	-0.65	1.37

The 'Fast & Stable Loading' feature received the highest score, indicating that system performance significantly impacts student and teacher satisfaction.

The 'Assignment & Deadline Notifications' feature helps students manage their time.

The 'Instant Grades & Feedback' feature enhances the transparency of learning evaluations.

Features in the Attractive Quality Attribute category.

The Attractive category consists of innovative features that significantly increase satisfaction, but their absence does not cause major dissatisfaction. Presented in Table 7 :

Table 7. Attractive Features with Delight, Disgust, and Range Values

No	Feature	Delight	Disgust	Range
1	Gamification (badges & points)	0.60	-0.20	0.80
2	Custom theme	0.55	-0.15	0.70
3	Class leaderboard	0.58	-0.18	0.76

The 'Gamification (badges & points)' feature ranks highest in the Attractive category.

This feature boosts student motivation through a digital rewards system. Class leaderboards foster a healthy competitive spirit, while custom themes provide a personalized experience for users.

Based on the results of the Fuzzy Kano analysis, features in the Must Be category should be the top priority in the development of the junior high school LMS. Next, the quality of One-Dimensional features should be improved to enhance user satisfaction. Attractive features can be developed as additional innovations. The following graphs are presented in image form for each category

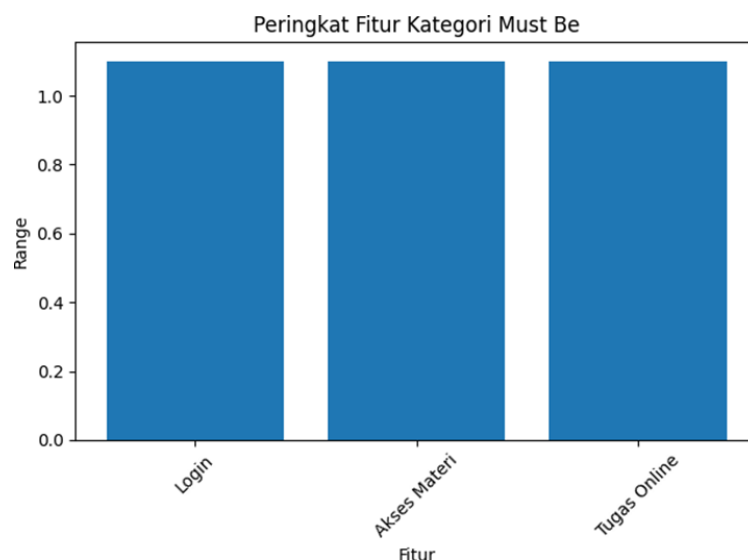


Figure 1. Feature Rankings for the "Must Be" Category

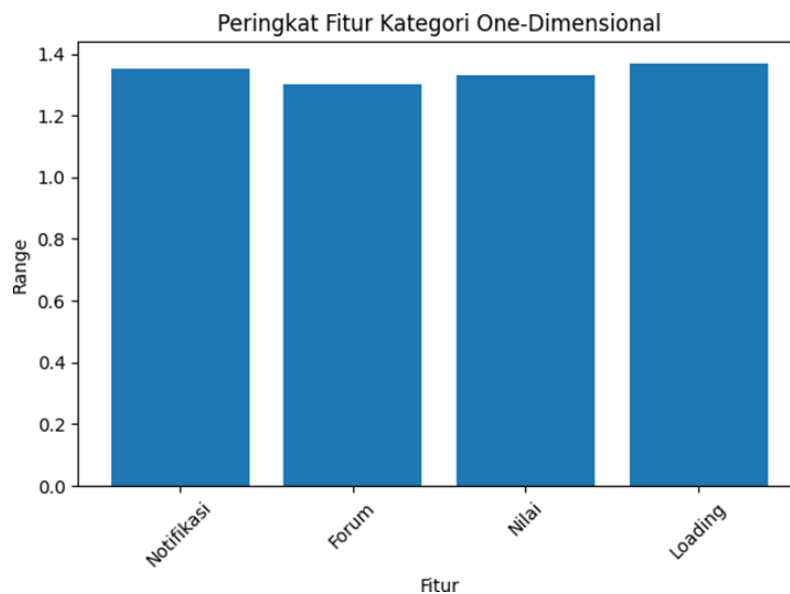


Figure 2. Feature Rankings for the One-Dimensional Category

CONCLUSION

Based on the discussion in the previous chapter, the conclusions drawn from this study are as follows:

1. A number of requirements defined as features in the Merdeka Curriculum-based Junior High School LMS Application are divided into three main categories of the Fuzzy Kano method, namely Must Be, One-Dimensional, and Attractive quality attributes.
2. Features in the "Must Be" quality attribute category include basic features such as student and teacher login, access to learning materials, and online assignment submission. These features are essential requirements that must be available, as their absence can lead to high levels of user dissatisfaction.
3. Features in the "One-Dimensional Quality Attribute" category indicate that the better the quality of the features provided, the higher the level of user satisfaction. The feature with the highest ranking in this category is "Fast and Stable Loading," with a "Delight" score of 0.72 and a "Disgust" score of -0.65, resulting in a range of 1.37. This indicates that system performance is a critical factor influencing student and teacher satisfaction when using the LMS.
4. In the Attractive quality attribute category, the "Gamification (badges and points)" feature ranks highest with a delight score of 0.60 and a disgust score of -0.20, resulting in a range of 0.80. This feature is not mandatory, but its presence significantly enhances student motivation and learning experience.
5. Based on the overall analysis results, LMS development priorities for junior high schools should begin with fulfilling the "Must Be" category features, followed by improving the quality of "One-Dimensional" features, and then developing "Attractive" features as additional innovations.

RECOMMENDATIONS

The following recommendations can be provided for system development and future research:

- 1 Future research is expected to conduct analyses based on respondents' demographic characteristics, such as differences between students and teachers, to identify variations in perceived needs regarding LMS features.
- 2 Future research is advised to increase the number of respondents so that the results of the Fuzzy Kano analysis are more representative and accurate.
- 3 Future research could compare LMS feature requirements across different educational levels, such as elementary, middle, and high school, to generate more specific system development recommendations tailored to user characteristics.
- 4 LMS developers for junior high schools are advised to prioritize improving system performance (speed and stability), as the analysis indicates that these features have the greatest impact on user satisfaction.

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