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Kano Based Investigation on Preference of Young People in Selecting Campus Buses' Additional Features

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Abstract

In order to optimize the public transportation system within a campus and reduce the use of private motor vehicles, buses on a campus in Lampung, Indonesia, need to improve their services by adding attractive features, especially for students. However, the addition of these features needs to be tailored to student preferences to be effective in meeting their needs as bus passengers. This study employs the Kano method to investigate students' tendencies towards eight features to be added to campus buses. From the survey and interview process conducted, it was found that only two features were considered attractive by participants, while the rest were categorized as indifferent. Ranking these features into a priority list will aid in the bus service improvement process by identifying which features are most important to add and which ones are unnecessary.

Keywords: Kano Method, Youngsters' Preferences, Bus Design, Sustainable Transportation, Campus Transportation

Introduction

The presence of an appropriate public transportation system on a campus is one of the crucial factors in realizing a sustainable campus [1]. This is because the campus is a bustling place to visit due to the high level of activities within it. And certainly, every activity will result in emissions that, whether consciously or not, will have a negative impact on the surrounding environment [2]. Especially on campuses that are quite large, requiring vehicles for mobility within the campus. If a decent public transportation system is not available, then most campus residents will opt to use private vehicles [3, 4]. And if these private vehicles are motorized, it will inevitably cause significant pollution and consume a large amount of fuel.

This situation is represented by Universitas Lampung, a campus in the Lampung province of Indonesia, where there are many motorized vehicles coming in and out of the campus area every day. In fact, Lampung University already has a public transportation system in the form of campus buses, with a total of 12 units available, but most campus residents still prefer to use private vehicles such as motorcycles and cars. However, Universitas Lampung also aspires to create a more environmentally friendly campus, which is why it is necessary to design a better public transportation system for the future. One way to achieve this is by providing more attractive campus buses for staff and students, making campus buses the preferred choice for campus residents to move around within the campus.

Most residents on the Universitas Lampung campus are young students, most of whom use motorcycles, while others rely on public transportation or cars. Many of these students reside near the campus area but still use motorcycles for mobility within the campus. One factor influencing this situation is the unappealing nature of campus buses to students, necessitating design changes for improvement efforts. Design alterations can involve a complete overhaul, but this would undoubtedly incur significant costs. Alternatively, changes could entail adding additional features to the buses to make them more appealing to students. However, any additional features must be carefully studied to ensure they are truly targeted. This study aims to understand students' preferences for additional features on campus buses, with the goal of making campus buses more attractive as a transportation option within the campus. To achieve this, the Kano method is selected as the research method because it can identify which design features are genuinely desired by prospective consumers to be added to the product.

Materials and Methods

his study employs three research stages, namely the identification stage of additional bus features to be considered in the design of future buses, followed by the consumer needs analysis stage using the Kano method, and finally, the determination of which features will be utilized for the next design phase. The identification of additional features is conducted by the research team through discussions with a group of experienced student teams who have expertise in product design, using KJ method [5]. From these discussions, a list of bus features will be generated for analysis using the Kano method [6]. Indeed, the Kano method is typically used in conjunction with Quality Function Deployment (QFD); however, Kano can also be employed as a standalone method to assist designers in creating products that better meet the expectations of potential consumers [7].

Subsequently, the Kano method is utilized to analyse which features are truly necessary to be incorporated into the bus design. The technique employed involves distributing questionnaires to a number of participants from the targeted consumer segment (Table 1). In real purchasing situations, customers often struggle to precisely articulate their desired product attributes. Typically, only superficial aspects are revealed through a basic questionnaire, failing to capture the true needs of the customer. Therefore, systematic assistance is vital to accurately discern the relevant customer requirements. The Kano method emerges as a solution capable of identifying the fundamental customer needs. Kano introduced the concept of attractive quality, presenting a two-dimensional model of quality attributes grounded in theoretical principles. Additionally, a practical methodology was outlined to apply this theory effectively. The theory of attractive quality posits five dimensions of perceived quality: Attractive, one-dimensional, must-be, indifferent, and reverse quality [8]. However, subsequent research has introduced another dimension called 'questionable,' signifying misunderstandings, errors, or misjudgements (Table 2).

Table 1: Kano Questionnaire

Kano Questions	Options for Participants
Functional questions (ex. If the bus has ‘stop button’, how do you feel?)	a. I like it that way b. It must be that way c. I am neutral d. I can live with it that way e. I dislike it that way
Disfunctional questions (ex. If the bus does not have ‘stop button’, how do you feel?)	a. I like it that way b. It must be that way c. I am neutral d. I can live with it that way e. I dislike it that way

Table 2: Kano Evaluation Table

Customer Requirements		Disfunctional Questions				
		Like	Must be	Neutral	Live with	Dislike
Functional Questions	Like	Q	A	A	A	O
	Must be	R	I	I	I	M
	Neutral	R	I	I	I	M
	Live with	R	I	I	I	M
	Dislike	R	R	R	R	Q

The abbreviations utilized in the evaluation table are as follows: A for Attractive, O for One-Dimensional, M for Must-Be, I for Indifferent, R for Reverse, and Q for Questionable.

Afterwards, the participants are briefly interviewed by the survey team to understand the reasons behind the choices made in the questionnaire. This is necessary to uncover the rationale behind the participants' decisions, enabling a more in-depth analysis. The ultimate goal is to determine the priority order of features to be incorporated into the product design, so that with limited resources, optimal customer satisfaction can be achieved. This research process can be visually represented graphically in Fig 1.

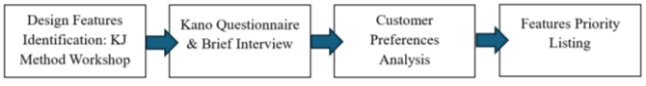

Fig 1: Research Methods

Results and Discussions

The research team conducted a workshop using the KJ method to compile a list of additional features that could be incorporated into the design of campus buses. The first feature identified was a stop button on the bus, as currently, campus buses do not always stop at designated bus stops but also at specific locations upon passenger requests. Communicating these requests verbally to the bus driver sometimes proves ineffective as they may not hear them. The presence of a stop button would enable passengers to easily signal the driver when they want the bus to stop at a specific location. The second feature suggested was an air conditioner, as currently, Universitas Lampung campus buses do not have air conditioning despite the hot temperatures in Lampung province. The third feature to be added is comfortable passenger seats, as some campus buses currently lack seats, requiring passengers to stand, and some existing seats were deemed uncomfortable by workshop participants. The fourth proposed feature is a music player to provide entertainment for passengers during the journey. The fifth suggestion is to add darker window tinting to filter sunlight and keep the bus interior cooler. The sixth is a smartphone battery charging system. The seventh is a Wi-Fi feature on the bus, and the eighth is the addition of television on the bus.

Based on these eight additional features, a brief questionnaire was then created to be distributed to students who use campus buses at Universitas Lampung. The questionnaire was distributed in the form of sheets and manually filled out by the students, with the research team successfully collecting data from 100 participants in October 2023. The questionnaire followed the Kano method as previously explained. According to the Kano model, user requirement surveys are structured to efficiently rank requirements using a two-step process involving positive and reverse questions, along with attribute-based summaries of product features or services. Each question in the survey allows users to rate their satisfaction on a scale of five levels: Very satisfied, expected, neutral, just satisfactory, and dissatisfied.

The outcomes of the survey questionnaire are categorized based on the Kano model matrix, which encompasses must-be needs (M), one-dimensional needs (O), attractive needs (A), indifferent needs (I), reverse needs (R), and questionable results (Q). Among these, one-dimensional needs and attractive needs are pivotal in enhancing user satisfaction, while reverse needs are disregarded as reference data. Questionable results are excluded to maintain the integrity of the analysis and prevent any impact from disorganized data. Below are the results of the survey that has been conducted, where each feature will be categorized by each participant. The number of responses from participants for each category is provided in Table 3.

Table 3: Kano Survey Results

Features	A	M	O	R	Q	I	Total
Stop button	32	1	5	2	1	59	100
Air conditioner	47	10	16	1	0	26	100
Comfort seat	43	7	8	2	0	40	100
Music player	22	8	6	0	0	64	100
Darker window tinting	7	9	4	4	3	73	100
Smartphone charging system	8	6	6	4	0	76	100
Wi-Fi	41	5	6	3	0	45	100
Television	11	8	9	5	0	67	100

From the overall results table, we can observe several trends and draw conclusions regarding the category of each analysed feature. Considering the minimal number of Q responses, we can infer that the survey results are quite valid. None of the M, O, and R categories are dominant across all features, with only A and I categories being predominant. This reinforces the notion that the analysed features are indeed supplementary rather than essential bus features. Consumers may perceive these features as unimportant or, conversely, feel that their presence is a delightful surprise.

One of the simplest methods to determine feature categories is by examining which category receives the highest response from participants. For instance, for the stop button feature, the I category received 59 responses, although the A category followed closely with 32 responses. Thus, we can conclude that the stop button is an indifferent feature, meaning it will not be given much consideration by consumers. Although 32% of participants actually find the stop button attractive, one person considers it a must-be, and five people regard it as one-dimensional. This approach can be applied to the other seven features to arrive at final conclusions.

However, experts employ different methods to draw conclusions with greater accuracy, typically by considering responses from other categories through a comparative approach. The second approach evolved from the initial one aims to reduce the noise level until all "requirements" are perceived as indifferent. Consequently, it is proposed that if the sum of Attractive, One-Dimensional, and Must-Be requirements (O+A+M) exceeds the sum of Indifferent, Reverse, and Questionable requirements (I+R+Q), the maximum value of (O, A, M) should be embraced. Conversely, if (O+A+M) is less than (I+R+Q), the maximum value of (I, R, Q) should be favoured. Moreover, in cases where two frequency requirements yield identical results, the classification with the most significant impact on the product or service should be selected. The priority order should adhere to Must-Be (M) > One-Dimensional (O) > Attractive (A) > Indifferent (I). With this second method, most features will fall into the same category as in the previous method. The difference occurs with the Wi-Fi feature, where in the first method, Wi-Fi is categorized as indifferent, while in the second method, it falls into the attractive category.

The third method involves calculating the index for each feature, which includes the satisfaction index (SI) and dissatisfaction index (DI) [9]. The formulas for calculating these two indices are as follows.

$$SI = \frac{A+O}{A+O+M+I} \quad (1)$$

$$DI = \frac{M+O}{A+O+M+I} \quad (2)$$

The SI and DI values will range between 0 and 1, where higher values indicate higher levels of consumer satisfaction or dissatisfaction with the feature. The determination of feature categories based on the index can be seen in the table... With this method, the analysis is limited to categorizing features as A, O, M, or I (Table 4). However, R and Q categories are not included in the analysis. Nevertheless, based on the results of the first and second methods where there are no R and Q categories, the third method can be used in this case study. Results of SI and DI calculations is presented in Table 5.

Table 4: Index Based Category Reference

Requirement		Features Category
SI	DI	
<0.5	<0.5	I
<0.5	>=0.5	M
>=0,5	>=0.5	O
>=0.5	<0.5	A

Table 5: Index Calculation

Features	SI	DI
Stop button	0.38	0.06
Air conditioner	0.63	0.26
Comfort seat	0.52	0.15
Music player	0.22	0.14
Darker window tinting	0.17	0.13
Smartphone charging system	0.15	0.13
Wi-Fi	0.47	0.11
Television	0.2	0.18

Based on the three determination methods outlined above, we can categorize each feature into A, M, O, R, Q, or I. The comparison of results between the three methods can be seen in Table 6.

Table 6: Features Category Identification Based on the 3 Methods

Features	Frequency based	Comparison based	Index based
Stop button	I	I	I
Air conditioner	A	A	A
Comfort seat	A	A	A
Music player	I	I	I
Darker window tinting	I	I	I
Smartphone charging system	I	I	I
Wi-Fi	I	A	I
Television	I	I	I

It can be observed that for almost all features, the decisions made by the three methods are the same. There is only one feature, Wi-Fi, where the decision made by the comparison method differs from the other two methods. Out of the eight features provided to participants, only two features, the air conditioner and comfort seat features, are considered attractive. Darker window tinting and the smartphone charging system are deemed indifferent features with very low SI and DI values. However, darker window tinting would provide comfort by reducing UV penetration into the bus. The low values could be due to most buses already having window tinting, albeit not very dark, and passengers expecting coolness with the addition of air conditioning units. Meanwhile, the smartphone charging system is not considered important by most participants because the bus travel distance is not too far, with an average travel time of about 10-15 minutes, so there is no need for charging during that time. Additionally, the charging process is considered risky as it may result in passengers leaving their smartphones behind on the bus when they disembark.

As for the music player and television features intended as entertainment aspects on the bus, they are also not considered important by the majority of participants. This is because most students already use their smartphones to access music and videos, aided by earphones. Therefore, they can freely choose their own entertainment, whereas systems installed on the bus tend to follow the driver's choices. On the other hand, the stop button feature is deemed necessary if the bus used is large, as it would be difficult to verbally notify the driver when passengers intend to stop. However, up to now, Universitas Lampung campus still employs small to medium-sized buses due to narrow roads, making it difficult for larger buses to maneuver or turn.

Based on these findings, the eight features can be ranked into a priority list, where the first priority will be given precedence in the design improvement plan, followed by the second priority, and so on. This will assist in situations where the design improvement process needs to be carried out with limited funds, for example, or needs to be implemented gradually over a certain period of time. Features categorized as a will naturally take precedence, then further detailed by examining the SI and DI values. The results of the ranking can be seen in Table 7. Each feature essentially has the potential to enhance the attractiveness of the bus as a transportation choice, but their impact varies. Therefore, if the available budget is substantial, there is no harm in equipping all of these features.

Table 7: Features Priority Ranking

Priority	Features
1	Air conditioner
2	Comfort seat
3	Wi-Fi
4	Stop button
5	Television
6	Music player
7	Darker window tinting
8	Smartphone charging system

Conclusion

This research has involved a series of activities to understand the preferences of young consumers in selecting attractive features for them when using public buses as a means of transportation. The Kano method used has proven effective in determining which features need to be prioritized in the design of public buses in the future, including features such as air conditioning and comfortable seats. Meanwhile, other features previously considered suitable for the needs of today's young people are not deemed important due to various reasons that have been presented. The findings of this research are crucial for bus designers, especially in designing transportation facilities that appeal to young people, encouraging them to choose public transportation over private vehicles.

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