Analysis of the Effect of Dynamic Pricing Based on Intelligent Transportation Systems on User Preferences for Online Transportation Modes

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Abstract – *The development of digital technology in the transportation sector has led to the emergence of online transportation services with the application of dynamic pricing based on Intelligent Transportation Systems (ITS). This study aims to analyze the influence of perceptions toward dynamic pricing and ITS on users' preferences in choosing online transportation modes. The method used is quantitative descriptive, with a questionnaire distributed to 81 PKTJ Tegal students as the sample, selected through purposive sampling technique. Data were analyzed using descriptive statistics via SPSS to identify trends in respondents' perceptions and preferences. Results indicate that perceptions of ITS have a high average score (4.04), followed by preferences for using online transportation modes (3.97), and perceptions of dynamic pricing (3.62). These findings indicate that fares are fluctuating, and users' trust in the efficiency and fairness of the ITS system remains high for online transportation services. This study contributes to providing an empirical overview of the importance of ITS in improving service quality and user preferences, as well as offering recommendations for the broader development of ITS-based transportation systems, particularly in developing cities like Tegal.*

Keywords *— User Preference; Intelligent Transportation Systems; Dynamic Pricing; Online Transportation*

1. INTRODUCTION

The term transportation is derived from Latin; ‘trans’ means across, while ‘portare’ means to carry or transport [1]. Transportation is a fundamental element that supports national life and strengthens unity. Transportation development is the foundation for other sectors in realizing equitable national development across regions. As a fundamental component, transportation supports various aspects of human life, including education and economic growth. There is also a lifestyle aspect that is heavily influenced by trends and popularity, for example in big cities, which also plays a role in shaping people's purchasing patterns when choosing transportation [2]. Its strategic function in the distribution of commodities, service provision, and the movement of human resources (HR) positions transportation as the main driver of economic activity throughout the country [3]. Transportation development continues to evolve over time. In the past, people could only use bicycles, rickshaws, or even motorcycles as means of transportation [1]. The rapid development of transportation is largely due to the growing population in cities [4].

We can see that transportation has undergone significant changes, one of which has occurred in public transportation. We know that in addition to private transportation, public transportation can also help move people and goods [1]. Rapid technological developments have changed people's lifestyles, including how they communicate and access information [5].

The impact of technology on this lifestyle has certainly led to an increase in human needs. Therefore, transportation has also been updated and utilizes technology as a means of supporting people's lifestyles [6].

Technology is constantly bringing about change. Transportation systems are designed to provide convenience for people amid busy lifestyles. The rapid development of transportation systems in Indonesia has driven progress

in the transportation sector, one example being the emergence of online transportation. This service is an innovation in public transportation that integrates digital technology into the booking and payment process. The existence of online transportation not only changes users' mobility preferences but also disrupts transportation demand patterns. This phenomenon triggers a shift in consumer preferences between online transportation modes, private vehicles, and public transportation, ultimately influencing variations and priorities in the transportation market structure [7].

However, on the other hand, in order for a product or service to be known to online transportation customers, promotions are carried out. This is an effort to showcase the uniqueness of the product and persuade customers to buy [7]. In addition to promotions, price reviews are also increasingly important, because every price set by the company will result in different levels of customer demand for a product. Price is the monetary value set for a good or service as compensation for the utility or benefits provided by that product [8].

The city of Tegal is one of the regions in Central Java Province with a population density of 142,105 in 2020 and an area of 39.68 km² (jatengprov.go.id). In Tegal City itself, there are three online transportation operators, namely Grab, Gojek, and Maxim. The availability of online transportation has made it easier for people to do things, such as reaching their destinations faster and at lower costs, leading residents of Tegal City to prefer using online transportation services. Regarding service quality, the author found that users of online transportation services currently still have some criticisms about performance in the field. These include communication issues between consumers and drivers, as well as unsatisfactory service provided to consumers. From the above explanation, it is evident that the determination of satisfaction with online transportation plays a very important role for consumers. Therefore, it is necessary to conduct research related to the above with the title: Analysis of the Influence of Dynamic Pricing Based on Smart Transportation Systems on User Preferences for Online Transportation Modes. This research introduces novelty in the context of the influence of perceptions toward dynamic pricing and smart transportation systems on the loyalty of online transportation users in Tegal City, a topic that has not been extensively explored in previous Indonesian literature.

In addition, the originality of this study lies in the combination of variables related to perceptions of dynamic pricing and ITS, which were examined quantitatively in the context of a developing city, namely Tegal. Most previous studies have only highlighted the satisfaction or efficiency of online transportation in general, without combining aspects of dynamic pricing based on intelligent systems. The descriptive approach using SPSS statistical analysis also adds value in objectively measuring perceptions and preferences.

2. RESEARCH METHOD

This study uses a quantitative descriptive approach. Quantitative descriptive research is research that aims to describe something that is being studied based on facts by drawing conclusions from observed phenomena using numerical statistics [9]. The results presented from this method are numerical descriptions that have been processed using the SPSS application as a way for researchers to obtain more accurate and precise results.

The main method of data collection in this study was through the distribution of questionnaires to respondents who were selected based on specific criteria. The criteria for selecting respondents were third-year students from the Applied Science Program in RSTJ and TRO at PKTJ Tegal, totaling 142 students. The questionnaire was designed to obtain information relevant to the research focus, ensuring that the data collected accurately reflects respondents' perceptions and preferences regarding the variables under study. The questionnaire used was a closed-ended questionnaire using a Likert scale (1=Strongly Disagree to 5=Strongly Agree). A closed-ended questionnaire is a questionnaire consisting of a number of questions with predefined answer options, while the Likert scale is a research scale used to measure attitudes and opinions based on levels of agreement [10].

After the data was collected, the next stage was data processing and analysis using SPSS software. The analysis performed was descriptive testing, which aimed to obtain a general overview of the data obtained, such as average values, frequencies, and percentages. The sampling technique used in this study is purposive sampling, which is a technique of selecting respondents deliberately based on certain considerations, so that the data collected is truly in line with the research objectives and can provide more in-depth and relevant results. Before distributing the questionnaire, the Slovin formula was calculated to determine the number of respondents that must be obtained to study the research object of 142 students.

The Slovin formula is used to determine the minimum sample size from a specific population so that the research results can accurately represent the population with a certain margin of error. The selection of a margin of error of 10% in this study was based on considerations of time efficiency, resources, and the exploratory-descriptive nature of the research. A 10% margin of error is commonly used in small to medium-scale studies aimed at obtaining a general overview or initial trends of the phenomenon being studied, rather than for broad generalization of the population. The following is the calculation of the Slovin formula using a 10% margin of error (e=0.1):

$$n = \frac{N}{1+ Ne^2} = \frac{142}{1+142(0,1)^2} = \frac{142}{1+1,42} = \frac{142}{2,42} = 59$$

Explanation:
n = number of samples
N = population size (142 students)
e = margin of error (error rate)

The questions contained in the questionnaire consist of three research points, each with several research criteria. The questions are as follows:

a. Perceptions of Dynamic Pricing
- I understand that online transportation fares can change depending on the time and demand.
- I feel that online transportation fares often change suddenly.
- I feel that fare increases during peak hours (dynamic pricing) are reasonable.
- I feel uncomfortable with the uncertainty of prices for online transportation services.
- I have canceled an order because the fare was too expensive due to dynamic pricing.

b. Perceptions of Intelligent Transportation Systems (ITS)
- I understand that online transportation fares are determined by algorithms or smart technology.
- I believe that the system used by online transportation applications is fair in determining fares.
- I feel that smart technology can help improve the efficiency of online transportation services.
- I feel that application providers are sufficiently transparent in explaining how fares are determined.
- In my opinion, the use of smart technology in transportation provides real benefits for users..

c. Preferences in Using Online Transportation Modes
- I still choose to use online transportation even though the rates are high.
- I compare rates from several apps before deciding to order a service.
- I prefer other modes of transportation (public transportation, buses, motorcycle taxis) if online rates are expensive.
- Rates are my main factor in choosing an online transportation service.
- I will continue to use my favorite app even if the rates are more expensive than other apps.

3. RESULTS AND DISCUSSION

After collecting data using questionnaires, we obtained the results of the identities of respondents who had filled out the questionnaires that had been distributed. In the respondent identity section of the questionnaire, we included several elements of respondent identity. These elements consist of the respondent's gender, field of study, frequency of online transportation use per week, and the most frequently used online transportation service. From these elements, the respondents were summarized into a pie chart as explained figure 1.

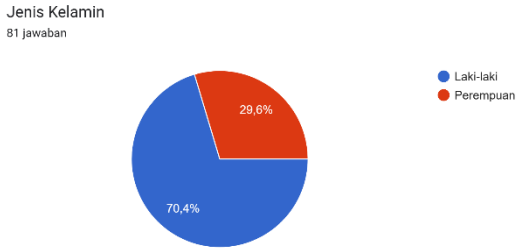

Figure 1. Elemen identitas responden

In terms of respondent identity, 70.4% of respondents were male, while 29.6% were female. It can therefore be concluded that the majority of respondents were male, with a percentage of 70.4%.

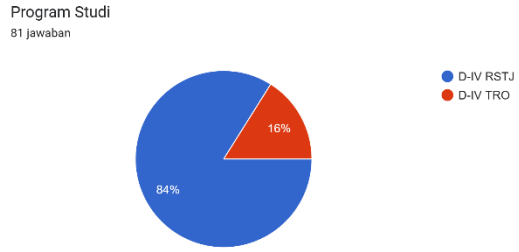

Figure 2. Responding to program elements

Since we only collected data on applied undergraduate programs at the Road Transportation Safety Polytechnic, we obtained two programs to choose from. Figure 2, In terms of program identity, the D-IV RSTJ program accounted for 84% of the total results. In conclusion, the D-IV RSTJ program had the most respondents in terms of program identity.

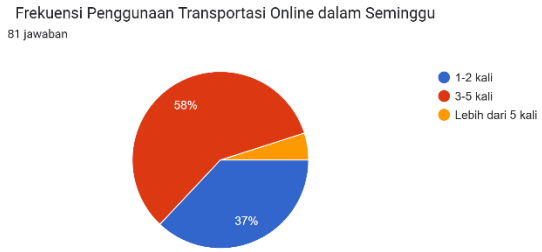

Figure 3. Frequency Element Data

Figure 3, The data on the frequency of online transportation use per week, as reported by respondents, showed that 58% of respondents used online transportation 3-5 times per week. For a frequency of 1-2 times per week, the result was 37%. For a frequency of more than 5 times per week, the result was 5%. Therefore, it can be concluded that a frequency of 3-5 times per week is the most common frequency among respondents for using online transportation services, accounting for 58% of the total

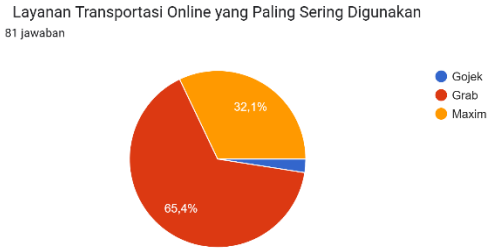

Figure 4. Transportation Services

In the last element of the respondent's identity section figure 4, the most frequently used online transportation service is Grab. The types of online transportation used as a comparison between one online transportation service and another are Gojek, Grab, and Maxim. From these types of vehicles, Grab can be obtained as the most frequently used online transportation with a questionnaire result of 65.4%.

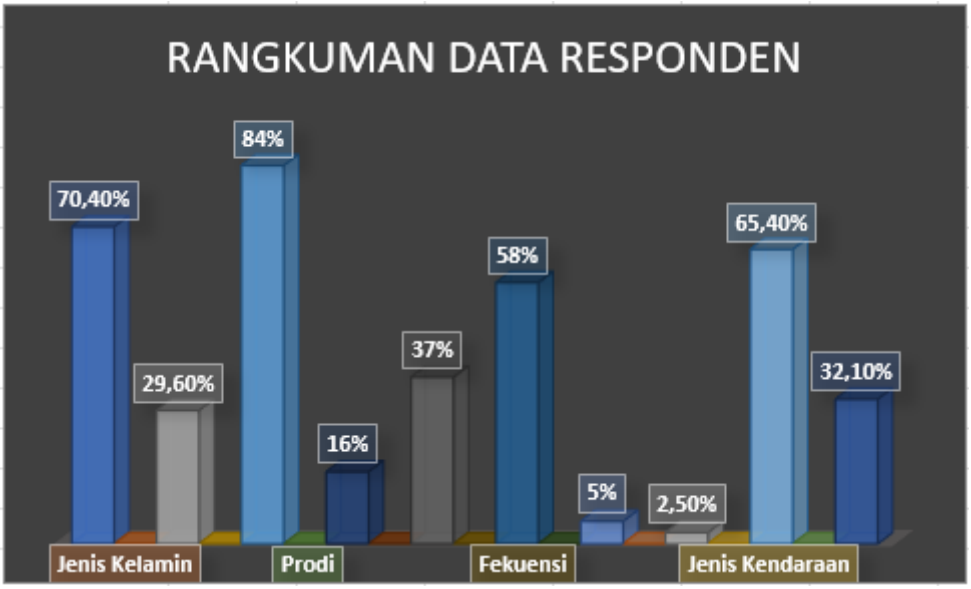

Figure 5. Summary of Respondent Data

The figure 6 summarizes the respondent identity data obtained from the questionnaire results. The data shows in detail the percentage of each element obtained from the questionnaire responses. Therefore, the bar graph is used to facilitate the reading of the questionnaire results.

After analyzing the respondents' identities, the next step is to discuss the results that have been processed using the SPSS application. The discussion of the research results and tests obtained is presented in the form of theoretical descriptions, both qualitatively and quantitatively. The results of the experiment should be displayed in the form of graphs or tables. For graphs, you can follow the format for diagrams and images..

Based on the results of data processing using the SPSS application, the following results were obtained with data processing in accordance with the results table 1.

Table 1. Data Processing Results Using SPSS Application

	N	Minimum	Maximum	Mean	Std. Deviation
Perceptions of Dynamic Pricing	81	11	25	18.09	3.447
Perceptions of Intelligent Transportation Systems (ITS)	81	15	25	20.21	2.528
Preferences for Using Online Transportation Modes	81	13	25	19.85	2.816
Valid N (listwise)	81				

Table 1 shows the results of descriptive statistical data processing using SPSS software. This table presents the minimum, maximum, mean (average), and standard deviation values of the three main variables in this study, namely perceptions of dynamic pricing, perceptions of intelligent transportation systems (ITS), and preferences for using online transportation modes. All data were obtained from 81 respondents, and the results show that the highest mean value was found in the variable of perception of ITS with a mean of 20.21, while the lowest value was found in the perception of dynamic pricing with a mean of 18.09.

The table also shows data variation through standard deviation values, which describe how much the data deviates from the mean. The variable of perception of dynamic tariffs has the highest standard deviation of 3.447, indicating a greater level of variation in responses compared to other variables. Meanwhile, the variable of perception toward ITS has the lowest standard deviation of 2.528, indicating that respondents' answers tend to be more consistent. This finding is important in the discussion as it provides an overall picture of how respondents evaluate the three variables that are the focus of the study, as well as indicating the potential influence of each variable on preferences for using online transportation modes.

Table 2. Scoring Criteria for Assessment

No	Score	Interpretasi
1	1	Strongly disagree
2	2	Disagree
3	3	Neutral / Undecided
4	4	Agree
5	5	Strongly agree

Table 2 contains the scoring criteria for assessment based on the Likert scale, which is used as the basis for processing questionnaire data by researchers. This table shows the five rating levels given to respondents: score 1 for “Strongly disagree,” score 2 for “Disagree,” score 3 for “Neutral/Undecided,” score 4 for “Agree,” and score 5 for “Strongly agree.” These criteria are important as a reference in the process of assigning values to each respondent's answer before statistical analysis using SPSS software.

In the data processing process, this scale allows researchers to quantify respondeants' perceptions and preferences in a measurable way. By using the Likert scale, researchers can calculate the average value of each question item in the distributed questionnaire, then analyze respondents' attitudes toward the topic being studied. These values are then used in the preparation of frequency distribution tables and in the discussion of results, which are an important part of data analysis in scientific journals.

Table 3. Frequency Distribution of Items for the Variable Perception of Dynamic Tariffs (X1)

Item	Answer Score 1		2		3		4		5		Average value
	F	%	F	%	F	%	F	%	F	%	
X1.1	0	0	4	4.9	12	14.8	41	50.6	24	29.6	4.05
X1.2	1	1.2	7	8.6	25	30.9	32	39.5	16	19.8	3.68
X1.3	1	1.2	7	8.6	22	27.2	33	40.7	18	22.2	3.74
X1.4	3	3.7	16	19.8	31	38.3	22	27.2	9	11.1	3.22
X1.5	1	1.2	21	25.9	24	29.6	15	18.5	20	24.7	3.40
Average Total Score											3.62

Table 3 shows the results of data analysis using SPSS software. This table presents the frequency distribution of the variable of perception of dynamic tariffs based on respondents' responses to five statements (items) assessed using a Likert scale of 1 to 5. The data in the table includes the frequency count (F) and percentage (%) for each response option, as well as the average score for each item. The results indicate that most respondents tend to score in the 4 (agree) category, particularly for item X1.1, which has the highest average score of 4.05. The lowest average score is found in item X1.5, with a value of 3.24.

Overall, the average total score for the five items was 3.62, which is close to a score of 4. This indicates that most users of online transportation services agree or acknowledge that service rates change dynamically. This finding indicates that the dynamic pricing applied by online transportation service providers has been recognized by users, and this perception may influence their preferences when choosing a mode of transportation. Therefore, this result is an important point in the discussion as it demonstrates the influence of perception on dynamic pricing within the context of a smart transportation system.

Table 4 Frequency Distribution of Items Perceived Variables Regarding Intelligent Transportation Systems (X2)

Item	Answer Score										Average
	1		2		3		4		5		value
	F	%	F	%	F	%	F	%	F	%	
X1.1	0	0	6	7.4	21	25.9	37	45.7	17	21	3.80
X1.2	0	0	2	2.5	19	23.5	40	49.4	20	24.7	3.96
X1.3	0	0	1	1.2	9	11.1	45	55.6	26	32.1	4.19
X1.4	0	0	4	4.9	12	14.8	43	53.1	22	27.2	4.02
X1.5	0	0	0	0	10	12.3	42	51.9	29	35.8	4.23
Average Total Score											4.04

Table 4 contains the frequency distribution for the variable of perception of the intelligent transportation system (X2). This table is the result of quantitative data analysis using SPSS and consists of five statement items measured using a 1–5 Likert scale. Each column describes the frequency (F) and percentage (%) of respondents who chose each score. The average value for each item is also displayed on the right side of the table, with the highest value being 4.32 for item X1.5 and the lowest value being 3.80 for item X1.1. Most respondents tended to give scores of 4 and 5, indicating a high level of agreement with the statements provided.

The table shows that the average total score for perceptions of intelligent transportation systems is 4.04. This score indicates that respondents generally agree that the implementation of intelligent transportation systems (ITS) has an impact on the efficiency and performance of online transportation modes. This reflects users' awareness of the benefits of technology in modern transportation management, including in terms of speed, accuracy, and service transparency. This finding is significant in the journal discussion as it supports the assumption that the implementation of ITS has a positive impact that is directly felt by users of online transportation.

Table 5 Frequency Distribution of Preference Variable Items in the Use of Online Transportation Modes (Y)

Item	Answer Score										Average
	1		2		3		4		5		value
	F	%	F	%	F	%	F	%	F	%	
X1.1	5	6.2	2	2.5	11	13.6	39	48.1	24	29.6	3.93
X1.2	0	0	1	1.2	12	14.8	39	48.1	29	35.8	4.19
X1.3	3	3.7	10	12.3	21	25.9	28	34.6	19	23.5	3.62
X1.4	0	0	1	1.2	12	14.8	43	53.1	25	30.9	4.14
X1.5	4	4.9	4	4.9	10	12.3	34	42.0	29	35.8	3.99
Average Total Score											3.97

Table 5 contains the frequency distribution of the preference variable in the use of online transportation modes (Y). This table is the result of data processing using SPSS based on respondents' responses to five statements measured using a 1–5 Likert scale. Each row shows the frequency (F) and percentage (%) of respondents who chose each score, as well as the average value for each item. The highest average value is found in item X1.2 at 4.19, while the lowest value is found in item X1.3 at 3.62. Most respondents gave scores in the 4 and 5 categories, indicating a tendency to agree with the statements presented.

The average total score for all items in the online transportation mode preference variable is 3.97. This value is very close to 4, indicating that the majority of respondents tend to agree and continue to choose to use online transportation services. This shows that users consider the effectiveness and efficiency of services to be important, as they provide convenience in daily mobility. This finding is an important indicator in the analysis, as it shows that despite the dynamics of fares and the influence of smart transportation systems, users continue to demonstrate a high preference for online transportation modes.

4. CONCLUSION

Based on the results of the descriptive analysis that has been conducted, it was found that the existence of an Intelligent Transportation System (ITS) has an influence on the efficiency and effectiveness of online transportation mode usage. With an average score of 4.04 on the variable of perception towards ITS, it can be concluded that most online transportation mode users agree that this system contributes to improving transportation efficiency.

In addition, dynamic fare changes in online transportation services are also an important factor influencing user preferences. The average value of 3.62 indicates that users of online transportation modes are aware of dynamic fare changes, and in general they agree that this phenomenon occurs in online transportation services.

User preferences in using online transportation modes have an average rating of 3.97, indicating that most users continue to choose this service due to its convenience, effectiveness, and efficiency. This indicates that even though online transportation fares are dynamic, the existence of ITS is able to improve service efficiency, making it attractive to users.

Overall, it can be concluded that ITS contributes to improving the efficiency of online transportation systems, which in turn influences users' perceptions of dynamic pricing and their preferences in choosing online transportation modes. Although prices can change flexibly, the convenience and efficiency provided by ITS remain the main reasons users maintain their choice of online transportation services.

5. SUGGESTIONS

Further research should expand the respondents beyond students to obtain more representative results. Use inferential statistical analysis to gain a deeper understanding of the relationships between variables. Include other factors such as comfort, safety, and brand image in future research. Conduct a comparative study among online transportation operators such as Grab, Gojek, and Maxim. Further qualitative research is needed to understand users' perceptions of the ITS system. Integrate real-time data from the application and field observations to strengthen the findings. Online transportation providers can utilize the results of this research to develop a more transparent and predictive pricing system based on ITS, thereby enhancing user comfort and loyalty in the long term.

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