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User Satisfaction Classification of Tiktok Shop Skincare Products Using C4.5 and Random Forest for Recommendation Strategy

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ABSTRACT

Background: TikTok Shop has become an important social commerce channel for skincare purchases, but recommendation relevance depends on service satisfaction and halal certification awareness in Indonesia's Muslim consumer market.
Method: This quantitative study analyzed questionnaire data from 150 TikTok Shop skincare users using 14 satisfaction items and three halal-related items covering certification awareness, the importance of halal status, and whether purchased products were halal-certified. C4.5 and Random Forest were evaluated using stratified 10-fold cross-validation, and halal awareness was tested as a moderating feature in the satisfaction-classification model.
Results: Product delivery produced the highest C4.5 information gain (0.4551), followed by application usability and product quality. C4.5 achieved 85.33% accuracy, outperforming Random Forest, which achieved 83.33%. When halal-awareness variables were included, classification accuracy increased to 88.00% for C4.5 and 86.00% for Random Forest, indicating that halal considerations improved satisfaction segmentation.
Conclusion: C4.5 offers an interpretable and competitive model for identifying satisfied and unsatisfied skincare consumers. The findings imply that TikTok Shop skincare recommendations should combine service-quality indicators with verified halal-certification signals to improve relevance for Muslim consumers.

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INTRODUCTION

The development of social commerce has changed how consumers search for product information, compare alternatives, and make online purchases. TikTok Shop is a prominent example of a platform that integrates short-video content, live streaming, seller interaction, and transaction features within a single digital ecosystem. In this context, purchasing decisions are influenced not only by price and product quality but also by seller trust, application experience, delivery quality, and the relevance of product recommendations (Putri et al., 2023).

Skincare is a distinct product category because user choices are strongly shaped by personal needs, skin type, perceived safety, user reviews, and product-use experience. Recent research on TikTok live commerce indicates that customer satisfaction plays an important role in encouraging repurchase intention for local skincare products (Fajriah & Sarma, 2025). Therefore, measuring user satisfaction and identifying dominant factors that shape satisfaction are important for supporting product recommendation strategies.

For Indonesian Muslim consumers, skincare evaluation also involves halal certification status, awareness of official halal labels, and confidence that cosmetic ingredients and production processes comply with Sharia principles. Halal awareness has been shown to influence consumer evaluation of products, while Islamic branding literature emphasizes that halal cues operate as both religious assurance and market trust signals (Ambali & Bakar, 2014; Wilson & Liu, 2011). Therefore, skincare recommendation models that ignore halal status risk overlooking a fundamental behavioral dimension in Indonesia's social commerce market.

Customer satisfaction can be understood as the result of comparing expectations with the actual performance of a product or service. In digital services, dimensions such as reliability, responsiveness, and fulfillment determine user experience (Parasuraman et al., 1988; Kotler & Keller, 2016). On TikTok Shop, these dimensions can be translated into product quality, price, seller response, application usability, and product delivery. If one of these aspects does not meet user expectations, user perception of product recommendations may also decline.

Data mining provides a systematic approach for discovering patterns from questionnaire data and user behavior. Classification is a relevant technique for building models that group data into specific classes (Han et al., 2012). The C4.5 algorithm is widely used because it produces decision trees and if-then rules that are easy to interpret (Quinlan, 1993). However, to strengthen experimental validity, C4.5 needs to be compared with another algorithm. Random Forest is used as a comparison model because it has ensemble characteristics based on decision trees, allowing this study to evaluate whether the use of multiple decision trees can provide better classification performance than a single-tree model such as C4.5 (Breiman, 2001).

Previous research on TikTok Shop using C4.5 has focused on general customer satisfaction classification (Farhana et al., 2022). Other research has developed skincare product recommendations using content-based filtering, but it did not directly link recommendation strategy with user satisfaction levels (Azizah & Rozi, 2024). This study addresses that gap by integrating questionnaire instrument validation, user satisfaction classification, comparison between C4.5 and Random Forest, and formulation of skincare product recommendation strategies based on classification results.

The objectives of this study are: (1) to test the validity and reliability of the TikTok Shop user satisfaction instrument; (2) to classify user satisfaction toward skincare products using C4.5 and Random Forest; (3) to identify dominant service attributes based on information gain and feature importance; (4) to examine halal certification awareness as a moderating dimension in satisfaction classification; and (5) to formulate skincare product recommendation strategies based on user satisfaction patterns and halal-relevant consumer needs.

METHOD

Dataset and Instrument

This study used a quantitative approach based on primary data. Data were obtained through an online questionnaire distributed to 150 TikTok Shop users who had purchased skincare products. Purposive sampling was applied with the following criteria: active TikTok users, users who had purchased skincare products through TikTok Shop, and users aged at least 18 years.

The instrument consisted of respondent characteristics, 14 Likert-scale items measuring service attributes and satisfaction level, and three items measuring recommendation tendencies. The Likert scale ranged from 1 to 4, namely Unsatisfied, Less Satisfied, Satisfied, and Very Satisfied. Items Q1-Q3 measured product quality, Q4-Q5 measured price, Q6-Q7 measured seller response, Q8-Q9 measured application usability, Q10-Q11 measured product delivery, and Q12-Q14 measured user satisfaction.

To address the Sharia economics relevance of skincare consumption, the revised instrument also included three halal-related items: H1 measured user awareness of halal certification labels on TikTok Shop skincare products; H2 measured the importance of halal status in purchase decisions; and H3 identified whether the purchased skincare product was halal-certified or displayed a valid halal label. These items were treated as consumer-trust indicators because halal status can function as a religious assurance cue in digital skincare transactions.

Preprocessing and Label Formation

The raw data were examined to ensure that Q1 to Q14 contained no missing values. Each construct score was calculated using the average of its constituent items. The class label was formed from the average of Q12, Q13, and Q14. Respondents with an average satisfaction score of at least 2.50 were categorized as Satisfied, while respondents with a score below 2.50 were categorized as Unsatisfied. This threshold produced a balanced class distribution, consisting of 75 Satisfied and 75 Unsatisfied respondents.

Halal awareness was operationalized through a Halal Awareness Index calculated from H1 and H2. Respondents with an average halal-awareness score of at least 2.50 were categorized as High Halal Awareness, while those below 2.50 were categorized as Low Halal Awareness. The H3 item was retained as a halal-certification purchase-status variable to distinguish respondents who reported purchasing halal-certified skincare products from those who purchased non-certified products or were unsure of certification status.

For decision tree modeling, each construct score was converted into ordinal categories: 1.00-1.75 = Unsatisfied, 1.76-2.50 = Less Satisfied, 2.51-3.25 = Satisfied, and 3.26-4.00 = Very Satisfied. This conversion maintained rule interpretability and made it easier to translate classification results into recommendation strategies.

Validity and Reliability Testing

Item validity was examined using corrected item-total correlation, which measures the correlation between each item score and the total instrument score after excluding that item from the total. An item was considered valid when the r-count value exceeded the r-table value. With 150 respondents and a 5% significance level, the r-table value was 0.160.

Reliability testing was conducted using Cronbach Alpha. An instrument was considered reliable when the alpha value was at least 0.70. Reliability was assessed for each construct and for all Q1-Q14 items.

C4.5 and Random Forest Algorithms

C4.5 constructs a decision tree by selecting the best attribute based on the reduction of class uncertainty. Entropy measures the uncertainty of the dataset, while information gain measures an attribute's ability to separate classes (Quinlan, 1993; Kusrini & Luthfi, 2009). The attribute with the highest gain is selected as the root node.

Random Forest builds multiple decision trees using bootstrap sampling and random feature selection, then determines the final output using majority voting (Breiman, 2001). With its ensemble characteristics, Random Forest was used as a comparison model to evaluate whether the use of multiple decision trees could provide better classification performance than a single-tree model such as C4.5.

Model Evaluation

Model evaluation was performed using stratified 10-fold cross-validation so that the proportions of Satisfied and Unsatisfied classes remained balanced in each fold. The evaluation metrics included accuracy, precision, recall, F1-score, and confusion matrix. C4.5 was evaluated as an interpretable model, while Random Forest was evaluated as a performance comparison model.

To test the moderation issue raised by the halal-consumer context, two additional model specifications were compared. The baseline model used the five original satisfaction attributes, whereas the halal-aware model added the Halal Awareness Index, halal-certification purchase status, and interaction features between halal awareness and the dominant satisfaction attributes. Model

improvement was assessed by comparing classification accuracy and macro F1 across the same stratified cross-validation procedure.

RESULTS AND DISCUSSION

Respondent Characteristics

Table 1. Main respondent characteristics

Characteristic	Category	Frequency	Percentage
Gender	Female	120	80.00%
Gender	Male	30	20.00%
Age	18-20 years	34	22.67%
Age	20-25 years	66	44.00%
Age	25-30 years	38	25.33%
Age	>30 years	12	8.00%
Purchase frequency	1-2 times	94	62.67%
Purchase frequency	3-5 times	47	31.33%
Purchase frequency	>5 times	9	6.00%

Table 1 shows that respondents were dominated by female users (80.00%). The largest age group was 20-25 years (44.00%), indicating that the data represent young social commerce users. Most respondents had purchased skincare products one to two times, suggesting that many users were still in the early or intermediate stage of purchasing skincare through TikTok Shop.

Item Validity Results

Table 2. Validity test results for Q1-Q14

Item	r-count	Decision
Q1	0.786	Valid
Q2	0.796	Valid
Q3	0.841	Valid
Q4	0.695	Valid
Q5	0.867	Valid
Q6	0.847	Valid
Q7	0.881	Valid
Q8	0.871	Valid
Q9	0.871	Valid
Q10	0.830	Valid
Q11	0.864	Valid
Q12	0.864	Valid
Q13	0.850	Valid
Q14	0.619	Valid

All items had r-count values greater than the r-table value of 0.160. The lowest r-count was found in Q14 (0.619), while the highest was found in Q7 (0.881). Thus, all items were appropriate for further analysis. These results strengthen the quality of the questionnaire data before classification was performed.

Reliability Results

Table 3. Cronbach Alpha reliability results

Construct	Number of Items	Alpha	Decision
Product Quality	3	0.905	Reliable
Price	2	0.805	Reliable
Seller Response	2	0.929	Reliable
Application Usability	2	0.916	Reliable
Product Delivery	2	0.911	Reliable

User Satisfaction	3	0.875	Reliable
Overall Q1-Q14	14	0.969	Reliable

The Cronbach Alpha values for all constructs were above 0.70. The overall alpha value of 0.969 indicates very high internal consistency. This confirms that the instrument was reliable and suitable for classifying user satisfaction.

Descriptive Analysis

Table 4. Average score of research variables

Variable	Average	Category
Product Quality	2.64	Satisfied
Price	2.75	Satisfied
Seller Response	2.33	Less Satisfied
Application Usability	2.39	Less Satisfied
Product Delivery	2.36	Less Satisfied
User Satisfaction	2.34	Less Satisfied

Price obtained the highest average score (2.75), followed by product quality (2.64). However, seller response, application usability, product delivery, and overall user satisfaction were categorized as Less Satisfied. This pattern indicates that promotional and price aspects were perceived positively, while operational service aspects remained sources of dissatisfaction.

Halal Certification Awareness and Moderation Analysis

The added halal-certification items indicate that halal status is a relevant decision dimension in skincare purchases through TikTok Shop. Most respondents reported high awareness of halal certification and considered halal status important in skincare purchase decisions. However, a notable proportion of respondents were either unsure about certification status or had purchased products without clear halal certification, showing that halal assurance remains unevenly integrated into social commerce recommendations.

Table 5. Halal certification-related respondent responses

Variable	Category	Frequency	Percentage
Halal certification awareness	High	103	68.67%
Halal certification awareness	Low	47	31.33%
Importance of halal status	Important/Very Important	112	74.67%
Importance of halal status	Less Important/Not Important	38	25.33%
Purchased product halal-certified	Yes	96	64.00%
Purchased product halal-certified	No/Not sure	54	36.00%

The moderation test was conducted by adding halal-awareness variables and interaction terms to the satisfaction-classification pipeline. The comparison shows that halal-aware modeling improved both C4.5 and Random Forest performance, indicating that halal awareness conditions how service-quality attributes translate into satisfied and unsatisfied classes.

Table 6. Model performance after adding halal-awareness moderator

Model	Baseline Accuracy	Halal-Aware Accuracy	Change
C4.5	85.33%	88.00%	+2.67 percentage points

Random Forest	83.33%	86.00%	+2.67 percentage points

These results show that halal certification should not be treated merely as an external product label, but as a consumer-trust feature that improves the relevance of skincare satisfaction segmentation. For Muslim consumers with high halal awareness, recommendation logic should prioritize products with verified halal labels, transparent ingredient information, reliable seller claims, and delivery services that preserve product integrity.

Information Gain of C4.5

Table 7. Information gain values of each attribute

Attribute	Information Gain	Rank
Product Delivery	0.4551	1
Application Usability	0.4493	2
Product Quality	0.4314	3
Seller Response	0.3667	4
Price	0.3546	5

Information gain analysis shows that Product Delivery was the most dominant attribute, with a value of 0.4551. This means that Product Delivery had the greatest ability to reduce uncertainty between Satisfied and Unsatisfied classes. In skincare purchases, timely delivery and good product condition are crucial. If products arrive late or damaged, user experience can become negative even when price and promotion are attractive.

Performance Comparison between C4.5 and Random Forest

Table 8. Model performance comparison for the Satisfied class

Model	Accuracy	Precision	Recall	F1-score	Macro F1
C4.5	85.33%	85.33%	85.33%	85.33%	85.33%
Random Forest	83.33%	82.05%	85.33%	83.66%	83.33%

Table 9. Model performance comparison for the Unsatisfied class

Model	Accuracy	Precision	Recall	F1-score
C4.5	85.33%	85.33%	85.33%	85.33%
Random Forest	83.33%	84.72%	81.33%	82.99%

The evaluation results show that C4.5 achieved an accuracy of 85.33%, while Random Forest achieved 83.33%. In this dataset, C4.5 slightly outperformed Random Forest. This may occur because the dataset was relatively small and the satisfaction pattern could be effectively captured by a single decision tree. Random Forest remains useful as a comparison model because it demonstrates that the main model's performance was competitive against an ensemble method.

Table 10. Confusion matrix of C4.5 and Random Forest

Model	Actual Class	Predicted Satisfied	Predicted Unsatisfied
C4.5	Satisfied	64	11
C4.5	Unsatisfied	11	64
Random Forest	Satisfied	64	11
Random Forest	Unsatisfied	14	61

The confusion matrix shows that C4.5 correctly classified 64 Satisfied respondents and 64 Unsatisfied respondents. The misclassification pattern was relatively balanced, with 11 Satisfied respondents predicted as Unsatisfied and 11 Unsatisfied respondents predicted as Satisfied. Random Forest correctly classified 64 Satisfied respondents and 61 Unsatisfied respondents.

Feature Importance of Random Forest

Table 11. Random Forest feature importance

Variable	Importance	Rank
Application Usability	0.3119	1
Product Quality	0.2340	2
Product Delivery	0.1977	3
Seller Response	0.1817	4
Price	0.0747	5

Unlike the C4.5 information gain results, which placed Product Delivery as the main attribute, Random Forest placed Application Usability as the most important variable. This difference occurs because Random Forest calculates attribute contributions across multiple trees, while C4.5 emphasizes the best initial split. Nevertheless, both models indicate that non-price service factors, especially application usability, product quality, delivery, and seller response, are key determinants of user satisfaction.

Implications for Skincare Product Recommendation Strategy

Table 10. User segmentation and recommendation strategy

Segment	Segmentation Basis	Recommendation Strategy
Responsive users	Satisfied and willing to receive recommendations	Recommend basic skincare products such as facial wash, moisturizer, sunscreen, serum, toner, and body care with high user reviews.
Selective users	Satisfied or Unsatisfied but still willing to receive recommendations	Provide recommendations accompanied by product quality evidence, ratings, reviews, delivery estimates, and clear seller information.
Less responsive users	Unsatisfied and not willing to receive recommendations	Prioritize products from stores with good delivery performance, complete descriptions, quality assurance, and responsive service.

Recommendation strategies should not only display popular products. Based on classification results, recommendations need to consider service experience. Satisfied users can receive recommendations for highly rated basic skincare products, while unsatisfied users should be directed to products from stores with better delivery and service performance. Thus, classification results serve as a bridge between satisfaction analysis and more personalized recommendation strategies.

In a Sharia economics context, the recommendation strategy should also include a halal-certification filter. Products recommended to halal-aware users should display official halal certification status, clear ingredient information, and seller accountability indicators. This addition strengthens the practical relevance of the model because recommendation accuracy in Indonesia's skincare market is not only determined by delivery, usability, and product quality, but also by whether users perceive the product as religiously permissible and trustworthy.

The main finding of this study is the dominance of Product Delivery in the C4.5 model. This differs from the study by Farhana et al. (2022), which found price as the dominant factor in TikTok Shop customer satisfaction. The difference may be caused by the product focus. In skincare purchases, users do not only evaluate price but also product condition, packaging safety, and delivery timeliness. Damaged, leaking, or late skincare products can reduce user trust in sellers and platforms.

This result also supports the service quality concept. Delivery is closely related to reliability and fulfillment, namely the ability of the platform and seller to fulfill service promises according to user expectations (Parasuraman et al., 1988). In social commerce, promotional content can attract user attention, but final satisfaction is still determined by post-transaction experience. Therefore, an effective product recommendation strategy should include service indicators, not merely product category relevance.

The comparison between C4.5 and Random Forest shows that a more complex model does not always produce better performance on a small and structured dataset. C4.5 performed better in this

study because the data pattern could be explained using simple rules. Random Forest still provided additional insight through feature importance. In larger e-commerce studies, Random Forest may show higher performance than single models (Purwanto et al., 2025). Therefore, model selection must consider dataset size, interpretation needs, and implementation objectives.

The main contribution of this study lies in the integration of three aspects: instrument validation, satisfaction classification, and recommendation strategy. Previous skincare product recommendation studies often focused on product content similarity (Azizah & Rozi, 2024), while this study uses user satisfaction as the basis for recommendation segmentation. This approach can help sellers identify users who need different recommendation treatments based on their service experience.

The inclusion of halal awareness extends the contribution of the study to Sharia economics. The results suggest that user satisfaction in skincare social commerce is shaped by both service-quality performance and religious assurance cues. This finding explains why halal-certified products may require different recommendation treatment from non-certified or unclear-certification products, especially among users who consider halal status important in purchase decisions.

This study has several limitations. The data were obtained from 150 respondents and did not yet include actual TikTok Shop transaction data such as store ratings, real delivery time, click history, or purchase history. In addition, the recommendations produced are still rule-based strategies, not an automated recommender system that calculates product relevance scores. The halal-certification status was also measured through respondent self-report and was not independently verified against an official halal product database; therefore, future studies should validate halal status using platform-level or regulatory certification records. Future studies should combine C4.5 or Random Forest with content-based filtering, collaborative filtering, or association rule mining to produce more personal and measurable product recommendations.

CONCLUSION

This study classified TikTok Shop user satisfaction toward skincare purchases using C4.5 and Random Forest. The results show that product delivery was the most dominant attribute in the C4.5 decision tree, while application usability emerged as the most important variable in the Random Forest feature-importance analysis. C4.5 achieved 85.33% accuracy, outperforming Random Forest at 83.33%, indicating that an interpretable single-tree model can provide competitive performance for a relatively small and structured satisfaction dataset. After adding halal-certification awareness, halal-status importance, and halal-certified purchase status, model performance increased to 88.00% for C4.5 and 86.00% for Random Forest. This confirms that halal awareness strengthens satisfaction classification and is an essential dimension of skincare consumer behavior in Indonesia.

Practically, the classification results can support skincare recommendation strategies by prioritizing delivery reliability, application usability, product quality, seller responsiveness, and user willingness to receive recommendations. For Muslim consumers, recommendation systems should also prioritize verified halal certification, transparent ingredient information, and reliable seller claims as trust signals. The study is limited by its sample size, reliance on self-reported questionnaire data, and absence of transaction-level behavioral records. Future research should use actual TikTok Shop transaction data, add skin-type and skin-problem attributes, verify halal certification through official sources, and integrate satisfaction classification with content-based filtering, collaborative filtering, or association rule mining so that recommendations become more personal, Sharia-relevant, and empirically measurable.

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