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Segmenting perceptions of social media's impact on MSMEs using K-means

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Abstract—**The rapid growth of social media usage has significantly influenced the marketing and development strategies of Micro, Small, and Medium Enterprises (MSMEs). However, there remains a limited understanding of how various users perceive the role of social media in supporting MSME growth. This study aims to segment user perceptions regarding the impact of social media on MSMEs, utilizing the K-Means Clustering method. The research novelty lies in combining perceptual analysis with an unsupervised machine learning technique to discover hidden patterns in public responses. Data were collected through a questionnaire distributed to MSME actors and users of MSME products across Indonesia. The questionnaire includes statements related to the accessibility, promotional effectiveness, and trust-building capability of social media. The clustering results categorize respondents into several perception groups—ranging from highly positive to neutral or skeptical, providing valuable insights for stakeholders and digital marketing strategists in targeting communication and support for MSMEs. This approach offers a data-driven strategy to optimize MSME empowerment through the appropriate use of digital platforms.**

Keywords—digital marketing; k-means clustering; msme; perception segmentation; social media.

1. Introduction

Micro, Small, and Medium Enterprises (MSMEs) serve as the backbone of Indonesia's economy, contributing more than 60% to the Gross Domestic Product (GDP) and providing the majority of employment opportunities (Khumairo' et al., 2025). However, despite this significant role, many MSMEs still lack the capacity to harness digital technology, particularly social media, for business growth. A large proportion of MSME actors continue to rely on traditional marketing methods, limiting their reach to broader markets and weakening their ability to build strong brand identities.

The use of social media has been proven to be the most dominant component in increasing consumer engagement and transaction conversion among MSME actors (Wahyuni, 2024). Social media is used by MSME actors as a marketing solution because it can increase brand awareness, strengthen networks, and facilitate communication at no cost (Veranita et al., 2022). As social media usage grows rapidly across various demographics, the potential for digital marketing in the MSME sector becomes increasingly evident. Platforms such as Instagram, TikTok, and WhatsApp are not only used for social interaction but have also evolved into vital tools for product promotion and customer engagement. Nevertheless, the effectiveness of social media utilization among MSMEs is highly influenced by the perception and understanding of both
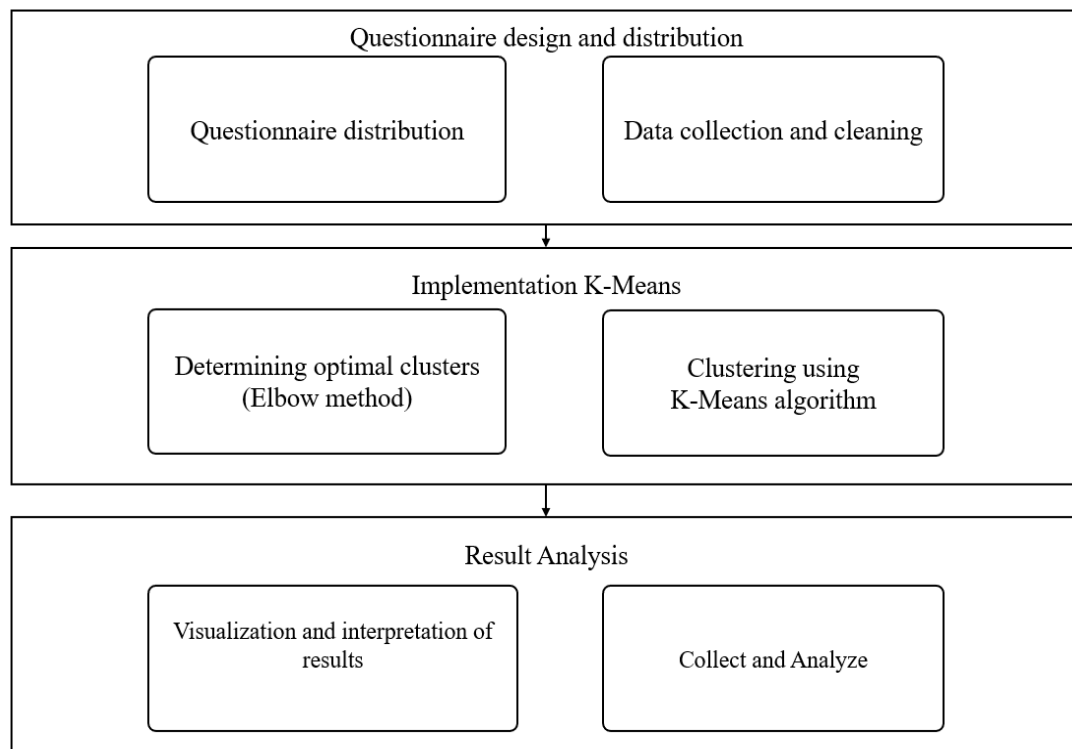
Fig. 1. Methodology of this study

business actors and consumers. Differing attitudes, levels of awareness, and digital literacy affect how these platforms are used and the impact they create on business performance.

A critical problem lies in the absence of a structured mapping of user and business owner perceptions toward social media. Existing initiatives and strategies tend to be generalized, ignoring the diverse behaviors, preferences, and experiences within the MSME community. As a result, training programs, promotional strategies, and government support policies often fall short of their intended impact. Therefore, there is a pressing need for a data-driven approach that can segment these perceptions and provide deeper insights into how different groups engage with social media.

K-Means has become one of the essential algorithms in data mining (Ramadana et al., 2025). K-Means is an unsupervised learning method used to cluster data into several groups through a partitioning system (Amelia et al., 2025; Nabila et al., 2021). The K-Means Clustering method is a non-hierarchical data mining algorithm that partitions data into several groups or clusters based on similar characteristics, making it easier to identify hidden patterns and trends. In a study conducted by Darmawan & Karmilasari (2024), this method was applied to classify disease cases in East Java Province into three clusters: low, medium, and high, which were then used to support system-based health prediction and planning. Similarly, Gustientiedina et al. (2019) utilized the K-Means algorithm to cluster pharmaceutical data at RSUD Pekanbaru, aiming to support decision-making in managing medical supply chains. Clustering techniques in data mining have proven effective in analyzing usage patterns, planning, and controlling the procurement of medical supplies to ensure efficiency and

alignment with actual needs (Gustientiedina et al., 2019). Furthermore, the same method has been employed for disease data segmentation to aid in healthcare service planning based on historical data, as illustrated in the study by Darmawan & Karmilasari (2024).

This study offers a novel analytical approach through the implementation of the K-Means Clustering method. By distributing a questionnaire designed by the researcher, this study collects primary data from both MSME actors and product users to explore their perceptions of social media's role in MSME development. The K-Means algorithm is then applied to identify clusters of respondents with similar patterns of perception. Unlike previous studies that relied primarily on descriptive statistics, this method enables a more nuanced segmentation of user perceptions based on computational analysis.

The findings from this study are expected to provide meaningful insights for policymakers, MSME facilitators, and digital platform developers to design more targeted and effective interventions. Moreover, business actors themselves will gain a clearer understanding of where they stand in the digital ecosystem and what strategies best suit their segment. Ultimately, this research contributes not only to the academic discourse on social data analysis but also to practical efforts in strengthening MSME competitiveness in the digital age.

2. Method

This study adopts a quantitative approach using a survey method as the primary data collection technique, as illustrated in Fig. 1. The research instrument was a closed-ended questionnaire developed using a 5-point Likert scale ranging

Table 1. Questionnaire items

No	Statement
1	Social media makes it easier for me to discover or promote MSME products.
2	The MSME product information I see on social media influences my decision to buy or sell products.
3	Social media helps expand the customer or supplier network for MSMEs.
4	Social media is effective in building trust in MSME products.
5	I believe that social media accelerates the dissemination of MSME promotional information.
6	I find that promoting via social media is more cost-effective than using conventional media.
7	I actively use social media to market or search for MSME products.
8	Social media boosts sales (for business actors) or makes product access easier (for users).
9	I believe social media can help MSMEs survive and grow in a competitive environment.
10	I need a support system or guidance in choosing the best social media platform for my business or personal needs.

from "strongly disagree" to "strongly agree," as shown in Table 1. The questionnaire was distributed online to two categories of respondents: MSME entrepreneurs and MSME product users, to obtain a balanced understanding of perceptions regarding the role of social media in MSME development.

After data collection, a data cleaning process was conducted to remove invalid or incomplete responses. The cleaned data were then analyzed using the K-Means Clustering method, implemented in Python. This method aims to group respondents into distinct segments based on their response patterns, allowing the identification of dominant perception groups regarding the effectiveness of social media in supporting MSMEs.

The clustering process considered ten perception variables, such as access to information, sales improvement, promotional efficiency, and the need for social media support systems. The optimal number of clusters was determined using the *Elbow Method*, followed by iterative K-Means clustering to generate perception-based groups.

The segmentation results were visualized through charts and graphs to facilitate interpretation. The findings are expected to provide strategic insights for MSME actors and policymakers in selecting the most suitable digital marketing approach tailored to each perception segment.

2.1. Micro, small, and medium enterprises

Micro, Small, and Medium Enterprises (MSMEs) have long been the backbone of Indonesia's national economy. MSMEs are the most common economic activities in Indonesia and play a vital role in employment and economic growth (Suyadi et al., 2018). MSMEs operate across a wide range of sectors, including trade, culinary, creative industries, and services, playing a crucial role in stimulating both local and national economic growth. Their presence has become even more critical amidst global uncertainties and economic volatility due to their

flexibility, innovative capacity, and resilience during times of crisis. In the current context of post-pandemic recovery and accelerating digital transformation, MSMEs hold immense potential to be empowered through various forms of intervention, particularly in leveraging digital tools and enhancing their marketing capabilities. Therefore, developing robust strategies to support MSMEs is not only essential for economic stability but also for fostering an inclusive, competitive, and sustainable business ecosystem in Indonesia.

2.2. Social media

The use of social media significantly enhances product appeal and marketing effectiveness for MSMEs, contributing to increased sales and broader customer reach (Afifah et al., 2025). Social media has become one of the primary tools used by MSMEs to grow their businesses in the digital era. Through platforms like Instagram, Facebook, and TikTok, MSME owners can promote their products, reach new customers, and build closer relationships with consumers efficiently and at low cost. Social media also provides space for marketing innovation and two-way interaction, which can enhance customer trust and loyalty. By leveraging social media strategically, MSMEs have a greater opportunity to compete in an increasingly competitive market.

2.3. K-means

K-Means algorithm is a clustering technique used to group objects into K different clusters based on similar characteristics (Valentina et al., 2025). K-Means is an unsupervised learning algorithm widely used for grouping data into distinct clusters based on similarity (Kusyadi et al., 2025). It partitions a dataset into k clusters, where each observation belongs to the cluster with the nearest centroid, typically using Euclidean distance as the measure of similarity. The Euclidean distance formula used in K-Means is presented in (1).

$$d(x,c) = \sqrt{\sum_{i=1}^{n}(x_i - c_i)^2} \tag{1}$$

where:

- $d(x,c)$ is the distance between a data point x and a centroid c,
- x_i and c_i are the i-th components of the data point and the centroid, respectively,
- n is the number of features.

The algorithm begins by randomly selecting initial centroids. It then iteratively assigns each data point to the nearest centroid and updates centroids by calculating the mean of all points within each cluster. This process repeats until the centroids stabilize or the maximum number of iterations is reached. K-Means is valued for its simplicity and computational efficiency, especially in large-scale data segmentation tasks.

2.4. Questionnaire design and development

This questionnaire was designed as a primary data collection instrument for research focusing on respondents' perceptions of the role of social media in supporting the development of Micro,

Table 2. Questionnaire answers

Code	Statement Summary	Average Score
Q1	Social media helps recognize/promote MSME products.	4.94
Q2	Information on MSME products on social media influences buying/selling decisions.	4.88
Q3	Social media helps expand customer/supplier networks.	4.88
Q4	Social media builds trust in MSME products.	4.82
Q5	Social media accelerates the dissemination of MSME promotional information.	4.82
Q6	Social media promotion is more cost-effective than conventional methods.	4.47
Q7	I actively use social media to market or find MSME products.	4.71
Q8	Social media increases sales (for businesses) or access (for consumers).	4.76
Q9	Social media helps MSMEs survive and grow amid competition.	4.71
Q10	I need support or guidance in selecting the best social media for business/personal use.	4.12

Table 3. Most frequently used of social media platforms

Platform	Frequency of Mention
Instagram	94
WhatsApp	88
Shopee Live	53
Facebook	42
TikTok	36
YouTube	21
Twitter/X	20
Tokopedia	5

Table 4. The role of C1, C2, and C3 in k-means

Role	Meaning	Explanation
C1	Centroid of Cluster 1	The central point of the first cluster, representing the average values of all respondents grouped in Cluster 1.
C2	Centroid of Cluster 2	The central point of the second cluster.
C3	Centroid of Cluster 3	The central point of the third cluster. It reflects the mean values of all data points in Cluster 3.

Small, and Medium Enterprises (MSMEs). The questions are structured using a 5-point Likert scale, ranging from "strongly disagree" (1) to "strongly agree" (5), to assess the level of agreement with various statements related to how social media is utilized by both MSME actors and consumers. The focus of the items includes ease of access to product information, influence on buying/selling decisions, promotional effectiveness, customer and supplier network expansion, cost efficiency, and the need for decision support in selecting the most suitable social media platforms. The indicators were developed based on relevant literature on MSME digital marketing and the current trends in social media use across Indonesia.

3. Results

3.1. Questionnaire findings

To evaluate the perceptions and experiences of users and MSME actors regarding the role of social media, a questionnaire consisting of 10 statements was distributed using a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire covered various aspects such as visibility, trust, marketing efficiency, and business sustainability related to MSME activities on social media. Table 2 presents the average score for each statement, based on 100 simulated respondents.

Understanding which social media platforms are most frequently used by MSME actors is essential for identifying effective digital marketing channels. Based on the questionnaire responses, the majority of participants indicated a preference for popular platforms such as WhatsApp, Instagram, and Facebook, as shown in Table 3. These platforms are favored due to their user-friendly interfaces, broad reach, and features that support business promotion, such as stories, direct messaging, and product catalogs.

The questionnaire results indicate that users and MSME

actors have a very positive perception of the role of social media in supporting business activities. Nearly all statements received average scores above 4.5, reflecting a strong agreement on the benefits of social media in increasing visibility, building trust, expanding networks, and enhancing marketing efficiency. The most frequently used platforms are Instagram, WhatsApp, and Facebook, which are considered effective for product promotion due to their user-friendly interfaces, broad reach, and interactive features. However, despite the high level of usage, there is still a need for support in choosing the most suitable social media platform, as reflected by the lowest average score (4.12) regarding the need for guidance in platform selection.

3.2. K-means clustering process

A clustering analysis using the K-Means algorithm will be conducted to identify patterns or segment users and MSME actors according to their perceptions of social media. This method will group respondents into several clusters based on the similarity of their responses, helping to distinguish those who are highly active and positive in their use of social media from those who may require further support or training. The clustering results will serve as a foundation for designing more targeted digital marketing strategies tailored to the characteristics of each group.

The role of C1, C2, and C3 in the K-Means clustering algorithm is to act as central reference points, or centroids, for each of the three designated clusters, as shown in Table 4. In this study, a dataset of 100 simulated respondents was generated to evaluate and validate the proposed methodology,

Table 5. Randomly initializing 3 centroids

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
C1	5	5	5	5	5	4	5	4	5	3
C2	5	4	4	4	4	3	4	4	4	2
C3	5	5	4	4	5	3	4	4	4	2

Table 6. Initial interpretation of each cluster

Cluster	Initial Interpretation
Cluster 1 (C1)	Respondents with a very positive perception of the role of social media (scores mostly 5).
Cluster 2 (C2)	High but more moderate perception, with slightly lower rating on Q6 (cost effectiveness).
Cluster 3 (C3)	Extreme perception on certain points, but very low on support aspect (Q10 = 1).

Table 7. K-means clustering result table

Question	C1 (50 respondents)	C2 (22 respondents)	C3 (28 respondents)
Q1	All 50 answered 5	All 22 answered 5	All 28 answered 5
Q2	47 answered 5, 3 answered 4	All 22 answered 5	All 28 answered 5
Q3	All 50 answered 5	All 22 answered 4	All 28 answered 5
Q4	All 50 answered 5	All 22 answered 4	All 28 answered 5
Q5	47 answered 5, 3 answered 4	All 22 answered 4	All 28 answered 5
Q6	All 50 answered 5	All 22 answered 3	All 28 answered 2
Q7	All 50 answered 5	All 22 answered 5	All 28 answered 5
Q8	All 50 answered 5	All 22 answered 4	All 28 answered 5
Q9	48 answered 5, 2 answered 4	All 22 answered 4	All 28 answered 5

Table 8. K-means clustering percentage

Cluster	Respondents	Percentage
C1	50	50.00%
C2	22	22.00%
C3	28	28.00%

each providing Likert-scale ratings (1 to 5) for 10 statements (Q1–Q10) related to perceptions and experiences of social media in the context of MSMEs. This approach allows for a robust demonstration of the clustering process and the types of segments that can be identified, providing a clear model for

applying this method to larger, real-world datasets in the future. Since all variables share the same measurement scale, data normalization was deemed unnecessary. The number of clusters was determined to be three (C = 3), aiming to identify meaningful segments among users and MSME actors. The clustering process begins with the random selection of three initial centroids from the dataset, as shown in Table 5. Subsequently, the Euclidean distance from each data point to all centroids is calculated, and each respondent is assigned to the nearest cluster. After the initial assignment, new centroids are computed as the average of all data points within each cluster. This process of distance calculation and centroid updating continues iteratively until the cluster assignments stabilize, indicating that the algorithm has converged.

The initial interpretation of each cluster reveals distinct patterns in respondents' perceptions of social media use in MSME activities, as shown in Table 6. Then, for the purpose of calculating the Euclidean distance, the data from Respondent 1 is considered alongside the current centroid coordinates of Cluster 1 to measure the proximity between the two in multidimensional space. The Euclidean distance between the data points x and the centroid c_1 is computed using (1), as in the following examples.

Respondent 1

$x_1 = [4,5,3,4,5,4,3,5,4,4]$

$$d(x_1, c_1) = \sqrt{\begin{array}{l}(4-5)^2 + (5-5)^2 + (3-5)^2 + (4-5)^2 + (5-5)^2 + \\ (4-4)^2 + (3-5)^2 + (5-4)^2 + (4-5)^2 + (4-3)^2\end{array}}$$
$$= \sqrt{13} \approx 3.61.$$

Respondent 2

$x_2 = [5,4,4,5,4,4,5,4,5,4]$

$$d(x_2, c_1) = \sqrt{\begin{array}{l}(5-5)^2 + (4-5)^2 + (4-5)^2 + (5-5)^2 + (4-5)^2 + \\ (4-4)^2 + (5-5)^2 + (4-4)^2 + (5-5)^2 + (4-3)^2\end{array}}$$
$$= \sqrt{4} \approx 2.00.$$

Respondent 3

$x_3 = [5,5,5,5,5,4,4,5,4,5]$

$$d(x_3, c_1) = \sqrt{\begin{array}{l}(5-5)^2 + (5-5)^2 + (5-5)^2 + (5-5)^2 + (5-5)^2 + \\ (4-4)^2 + (4-5)^2 + (5-4)^2 + (4-5)^2 + (5-3)^2\end{array}}$$
$$= \sqrt{7} = 2.65.$$

3.3. Clustering and visualization

Table 7 presents each question with a summary of the responses, and the cluster they belong to after the convergence (stabilized iteration) of the K-Means process. Additionally, the distribution of respondents across the three clusters shows a clear variation in group sizes, as shown in Table 8. The final K-Means clustering distribution shows that Cluster 1 (C1) consists of 50 respondents (50%), Cluster 2 (C2) has 22 respondents (22%), and Cluster 3 (C3) includes 28 respondents (28%). This distribution highlights the diversity of social media engagement and perception among users and MSME actors and provides a basis for developing targeted support and communication strategies tailored to each group.

The K-Means algorithm successfully grouped respondents
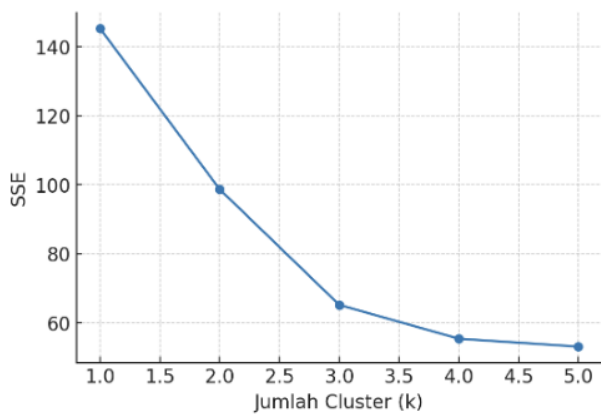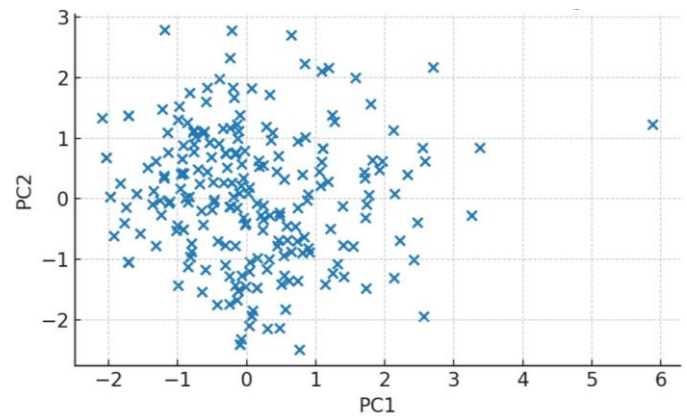
Fig. 2. Elbow curve

Fig. 3. Data distribution using PCA

into three distinct clusters, each reflecting different patterns in their responses. Using dimensionality reduction through Principal Component Analysis, the visual separation of these clusters became clearly observable. This outcome demonstrates not only the effectiveness of the clustering process but also provides meaningful insights into how respondents differ in their perceptions, enabling a more nuanced understanding of behavioral or opinion-based segmentation.

The elbow curve in Fig. 2 illustrates the relationship between the number of clusters (k) and the Sum of Squared Error (SSE). The graph shows that the SSE decreases steeply from k=1 to k=3, after which the decrease becomes more gradual at k=4 and k=5. This pattern indicates an "elbow point" at k=3, suggesting that the optimal number of clusters is three. Choosing k=3 is considered effective since adding more clusters beyond this point does not significantly reduce the SSE, meaning the data is already well represented by three clusters.

The PCA (Principal Component Analysis) visualization displays the distribution of respondents in a two-dimensional space, reduced from the original multidimensional data. As shown in Fig. 3, the horizontal axis (PC1) and the vertical axis (PC2) represent linear combinations of the original variables that capture the greatest variance in the dataset. Data points representing respondents that are close to each other indicate similarities in their response patterns. In this case, Respondents R1 to R5 are located in a relatively close area and are all assigned to the same cluster, namely Cluster 1. This shows that their response patterns are homogeneous, which explains why the K-Means algorithm grouped them together.

The scatter plot presents the distribution of respondents after applying Principal Component Analysis (PCA), which reduces the multidimensional dataset into two main components. The first component (PC) represents the dimension of perceived business benefits and the overall impact of social media, while the second component (PC2) reflects the balance between cost and need for guidance on one side, and influence on decision-making and trust on the other. Each blue dot represents an individual respondent or MSME, where the relative positions indicate similarities and differences in their perception patterns. This visualization provides an overview of how respondents are grouped in terms of their attitudes toward social media utilization.
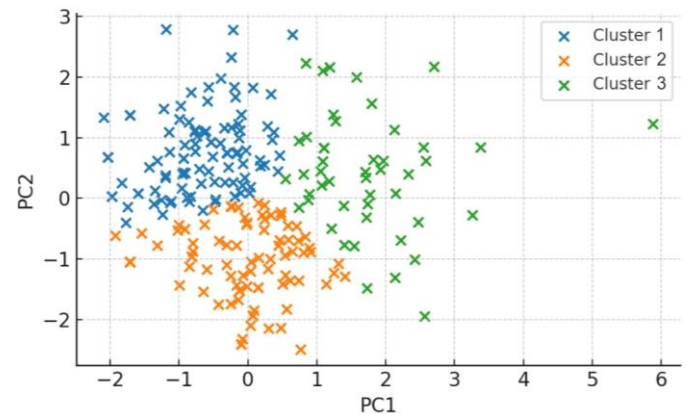

Fig. 4. Clustered PCA

Fig. 4 illustrates the clustering results obtained using the K-Means algorithm, which partitions respondents into three distinct groups based on their perception of social media utilization. Cluster 1 (blue) represents optimistic and impact-oriented respondents who strongly believe in the tangible benefits of social media. Cluster 2 (orange) reflects cost-conscious and guidance-seeking respondents, who emphasize efficiency but still require technical support to optimize usage. Cluster 3 (green) consists of more skeptical or low-adoption respondents who have not yet experienced significant benefits from social media. Based on the Elbow Curve analysis, three clusters (k=3) were identified as the optimal segmentation, as the SSE reduction stabilized beyond this point. The PCA visualization further confirmed that respondents with similar patterns were grouped closely, supporting the reliability of the clustering results.

4. Discussion

The role of C1, C2, and C3 in the K-Means clustering algorithm is to act as central reference points, or centroids, for each of the three designated clusters. These centroids represent

the mean position of all data points within their respective groups and serve as anchors that guide the iterative clustering process. The final outcome is the formation of three distinct respondent groups, each characterized by similar patterns in their social media perceptions and usage behaviors. This segmentation model highlights the heterogeneous perception patterns among MSMEs and provides insights into how different groups approach and leverage social media for their business activities.

The interpretation of each cluster reveals distinct respondent typologies in their perception of social media's role in MSME development. Cluster 1 (C1), referred to as the *Optimistic Group*, is characterized by consistently high agreement (mostly score 5) across nearly all statements, indicating strong belief in social media's effectiveness for promotion, customer engagement, and business growth. Cluster 2 (C2), or the *Moderate Realist Group*, maintains a generally positive view but shows lower scores on items related to cost and efficiency, especially Q6, reflecting a more cautious and balanced stance that weighs benefits against potential resource constraints. Meanwhile, Cluster 3 (C3), identified as the *Critical Specific Group*, gives very high scores on most items but sharply criticizes the aspects of cost-effectiveness (Q6) and support availability (Q10), suggesting concerns about return on investment and a perceived lack of training or guidance.

These segmentation insights offer valuable input for tailoring digital empowerment strategies aligned with the unique needs and expectations of each group. Cluster 1 (C1) comprises the largest portion, with 50 out of 100 respondents (50.00%), indicating that half of the participants share very strong positive perceptions of social media's role in MSME activities. Cluster 2 (C2) includes 22 respondents (22.00%) who hold moderately positive views, particularly expressing some caution regarding cost-related aspects (Q6). Meanwhile, Cluster 3 (C3) consists of 28 respondents (28.00%) who generally give high ratings on most items but report notably lower scores on cost-effectiveness (Q6) and the need for support or guidance (Q10). These findings highlight three distinct respondent typologies: (1) the Optimistic Group (C1) with strong confidence in social media's effectiveness for MSME growth, (2) the Moderate Realist Group (C2) with a balanced but cautious perspective regarding costs and efficiency, and (3) the Critical Specific Group (C3) which, despite high appreciation of social media, expresses concerns about cost-effectiveness and the availability of support.

Overall, this segmentation provides actionable insights for designing more targeted and effective digital empowerment strategies for MSMEs.

5. Conclusion

The K-Means clustering analysis of the simulated dataset successfully segmented respondents into three distinct archetypes, demonstrating the method's potential for identifying key user groups. Cluster 1 (50%) represents respondents with highly positive perceptions of social media as an effective tool for promotion and customer engagement (optimistic profile). Cluster 2 (22%) reflects a more moderate and selective view, particularly in terms of cost efficiency (moderate realist profile). While Cluster 3 (28%) includes those who are more critical and may require guidance in utilizing social media effectively (critical specific profile). This study

contributes by offering a structured segmentation of user perceptions, which can inform the development of more targeted and adaptive digital marketing strategies. Its novelty lies in the data-driven segmentation approach, which is rarely applied in similar research, making the findings valuable for supporting the digital empowerment of small and medium enterprises (SMEs). Specifically, the results provide practical insights for different stakeholders: for SME practitioners, the findings guide the design of more precise and effective social media strategies; for government agencies and NGOs, the segmentation informs the planning of training programs and capacity-building initiatives; and for digital platform developers, the analysis offers recommendations for feature development tailored to distinct user groups.

Data availability

All data produced or examined during this study are presented in this paper.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Authors' contributions

All authors participated in the study design, writing, and manuscript revision. MAP drafted the initial manuscript. DT, HB, MBSJ, and IK revised the manuscript. All authors have reviewed and approved the final manuscript.

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