PRIORITIZING ON-CAMPUS COFFEE SHOP ATTRIBUTES FOR QUALITY IMPROVEMENT: AN AHP ANALYSIS OF UNIVERSITY STUDENTS' PREFERENCES

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ABSTRACT

This study applied the Analytic Hierarchy Process (AHP) in prioritizing the attributes of on-campus coffee shops as perceived by university students. Data were collected using online and paper-based questionnaires. The seven main studied attributes were food and beverage quality, location, environment, staff service, pricing, green practices, and well-known coffee shop chains. The first five attributes were subdivided into multiple sub-attributes. Food and beverage quality was the most important attribute, followed by pricing, location, staff service, environment, green practices, and well-known coffee shop chains. The top five sub-attributes were food and beverage hygiene, good value for money, food and beverage taste, travel convenience, and regular promotional offers. Coffee shop operators and university management can leverage this study's findings to improve the campus coffee shops' quality to meet students' preferences more effectively. Furthermore, this study demonstrates the application of the AHP in decision-making within the context of service quality management.

Keywords: food services; coffee shops; Analytic Hierarchy Process; AHP

1. Introduction

Providing campus food services is recognized as an integral element of the university experience (Lugosi, 2019). Coffee shops that offer a range of beverages and food items such as coffee, tea, sandwiches, bread, and cakes (Siew et al., 2018) stand out as popular choices among university students (Shanka & Taylor, 2005). These spaces are not only places to enjoy a meal, but also serve as environments for work, study, and socialization (Aguirre, 2017; Islam et al., 2019). To achieve high operational performance, coffee shop businesses must adapt their strategies by evaluating the importance of attributes from customers' perspectives (Karmaker et al., 2019). Several studies, such as Chen and Hu (2010), Chua et al. (2020), and Ponnam and Balaji (2014), have highlighted the vital role played by product characteristics in influencing consumers' purchase decisions.

Therefore, this study aimed to investigate the perceptions of students at a large university located in the suburb of a city in Thailand regarding the importance of coffee shop attributes. Multiple coffee shops, comprising both independent establishments and chains, are spread across this campus; the reasons for this abundance could be attributed to the

university's large size, the dispersion of buildings, and its peripheral location from the city. These coffee shops are operated under the supervision of the university management as they are situated on university property. The benefits of investigating how university students assign the importance of coffee shop attributes are twofold:

(1) on-campus coffee shop operators can utilize this study's findings to prioritize attributes and implement quality improvements that meet the preferences of students who comprise the largest customer demographic;

(2) university management can gain informed insights to guide and monitor on-campus coffee shop operations to enhance student satisfaction.

The Analytic Hierarchy Process (AHP) was used as the analysis tool because of its effectiveness in ranking in multi-criteria situations (Budimčević et al., 2018).

2. Literature review

2.1 Key attributes in selecting food services

This section reviews existing research on various food services, laying a crucial foundation for understanding the importance of coffee shop attributes. Exploring research across diverse areas of food service reveals the importance of several key attributes, including food quality, service, ambience, price, reputation, and green practices. For example, Namkung and Jang (2008) discovered that food presentation, taste, spatial layout, interior design, music, dependable and attentive service, and competent staff contributed to high customer satisfaction in mid-to-high-end restaurants in the United States. Similarly, Ryu and Han (2010) discovered a substantial effect of food quality, service, and physical environment on the satisfaction of quick-casual restaurant customers. Heung and Gu (2012) focused specifically on the impact of restaurant atmospherics, examining five key dimensions—facility aesthetics, ambience, spatial layout, employee factors, and external views—on dining satisfaction and behavioral intentions. Their study revealed that a restaurant's layout and external environment significantly enhance customer satisfaction and increase the likelihood of return visits.

Liu and Jang (2009) used importance-performance analysis (IPA) to investigate customer perceptions of three casual-dining Chinese restaurants in the United States. They discovered that food quality, service reliability, and environmental cleanliness were the key factors in generating customer satisfaction and favorable post-dining behavioral intentions. Liu and Tse (2018) used IPA to highlight the significant factors contributing to the success of full-service restaurants in the United States. They found that customers considered attributes such as thorough guest checks, timely service, overall dining experience, and appropriate lighting crucial. Nguyen et al. (2018) developed questionnaires based on the DINESERV and SERVPERF models. They used regression analysis to assess how five dimensions, namely tangibles, reliability, responsiveness, assurance, and empathy, affected customer satisfaction with quick-service restaurants in the United Kingdom. They reported that all dimensions significantly affected customer satisfaction, with the tangible dimension being the most influential.

Ponnam and Balaji (2014) demonstrated the variation in important attributes across five different restaurant patronage motives among customers of casual-dining restaurants—dining out, celebration, hanging out, taking away, and dating. For instance, dine-out customers placed greater importance on gourmet taste and variety of menus. In comparison, hang-out customers emphasized responsiveness, ambience, design and decor, and upscale image. Similarly, Chua et al. (2020) investigated the relative importance of determinants in selecting restaurants across various eating situations (quick meals, social occasions, business occasions, and celebrations) and restaurant segments (full service, quick casual, and quick service restaurants) with restaurant customers in Malaysia. Their study encompassed the following nine attributes: price, word-of-mouth, experience, variety of menu items, popularity, brand reputation, location, sales promotions, and online customer reviews. The results showed that the most critical factors depended on the eating-out occasions; customers emphasized menu prices for quick meals and social occasions, brand reputation for business occasions, and word-of-mouth recommendations for celebration occasions. Meanwhile, price was the most important attribute for all restaurant types.

Yi et al. (2018) demonstrated the importance of brand image in shaping customer expectations regarding the ambience, food quality, and service quality of restaurants. However, the perceived price did not significantly impact these expectations. Foroudi et al. (2021) underscored the importance of brand image in the Pakistani restaurant sector, as it affected brand reputation, and subsequently influenced revisit intentions and generated positive word-of-mouth.

In addition to these attributes that can be classified into food and beverage quality, location, pricing, environment, staff service, and well-known brands, researchers have shown an increasing interest in food service establishments' green or sustainable practices. For example, DiPietro et al. (2013) discovered that customers preferred restaurants that adopted green practices; similarly, Kim and Hall (2020) found that sustainable restaurant practices positively influenced customer loyalty.

Coffee shops have also been the focus of research on key attributes. Chen and Hu (2010) studied the effect of 19 attributes classified into five factors—coffee quality, service, food and beverage, atmosphere, and extra benefits—on functional and symbolic perceived values. Multiple regression analysis showed that coffee quality and food and beverage significantly influenced both types of perceived values. Using structural equation modeling, Lee et al. (2018b) found that atmosphere, employee attitudes, information technology service, and coffee quality impacted the satisfaction of coffee shop customers, which influenced their store loyalty. Hsiao and Chen (2020) also highlighted the crucial impact of outdoor atmospherics, including traffic flow, the surrounding environment, parking spaces, and building characteristics, in shaping customer impressions and influencing their café choices. Hashim et al. (2017) conducted multiple regression analyses and found that product quality and price significantly influenced Generation Y's coffee shop visit frequency in Malaysia, but store location and atmosphere did not. Dhisasmito and Kumar (2020) examined the perceptions of coffee shop customers in Jakarta, Indonesia, using confirmatory factor and structural equation modeling to explore the impact of service quality, price fairness, and store atmosphere on customer satisfaction and loyalty. Service quality and price fairness significantly impacted

customer satisfaction, which, in turn, significantly influenced customer loyalty, whereas store atmosphere did not considerably affect customer satisfaction.

Several studies have concentrated on students' views regarding food services on college campuses and revealed consistent findings that food quality and pricing were the predominant factors influencing students' preferences. Kim et al. (2004) surveyed customers of a food court at Oklahoma State University to determine the impact of five factors—service, food quality, menu, atmosphere, and convenience—on their overall satisfaction. Using regression analysis, they found that all categories substantially affected overall satisfaction, with food quality viewed as the most crucial factor, particularly freshness, attractiveness, and nutrition. Klassen et al. (2005) discovered that students were concerned with the price value and food quality (i.e., healthiness) of campus food services and that most students were likely to eat quick meals near their buildings to avoid walking long distances. Park et al. (2013) used IPA and entropy value analysis to examine customer perceptions regarding the expectations and performance of food services at a university in the midwestern United States. The study's factors were divided into convenience, restaurant theme, and service quality. Price and value, food quality and taste, and cleanliness, under the service quality dimension, were determined to be the three most important attributes of university food services. Similarly, Kwun et al. (2013) identified price value, cleanliness, and food quality as the three most significant factors regarding campus food services from the perspective of hospitality college students.

2.2 Application of AHP in assessing food services

Saaty (2008) created the AHP to estimate priorities (or weights) for problems involving multiple criteria and selected the best alternatives based on the calculated priorities. In the AHP approach, the decision problem is structured into a hierarchy, starting with the first level indicating the decision goal or objective, followed by problem-related criteria, and if required, sub-criteria at subsequent levels. If necessary, alternatives are assessed at the lowest level of the hierarchy. The priorities of the criteria or sub-criteria are determined based on pairwise comparisons judged by respondents using a specially constructed questionnaire.

The AHP involves decision-makers undertaking pairwise comparisons of the importance or dominance of each element (i.e., criteria or sub-criteria) against another element in the same hierarchy level with respect to their parent element specified at the level immediately above. Regarding the comparison rating, the participants assign a rating of one if they judge the compared elements to be of equal importance; otherwise, a scale ranging from two (slightly more important) to nine (significantly more important) is used to rate the more important elements (Chua Chow & Luk, 2005).

The answers from decision-makers are used to create pairwise comparison matrices, each of which illustrates the relative importance of the elements on the left to those on the top with respect to their parent element in the level above, with the diagonal values of one representing the self-comparisons within each element, as shown below (Equation 1):

$$\begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \\ \vdots \\ A_n \end{array} \begin{array}{c} \begin{array}{ccccc} A_1 & A_2 & A_3 & \cdots & A_n \end{array} \\ \begin{bmatrix} 1 & a_{12} & a_{13} & \dots & a_{1n} \\ a_{21} & 1 & a_{23} & \dots & a_{2n} \\ a_{31} & a_{32} & 1 & \dots & a_{3n} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ a_{n1} & a_{n2} & a_{n3} & \dots & 1 \end{bmatrix} \end{array} \quad (1)$$

The AHP presupposes that the importance score of one element relative to another has a reciprocal property. For instance, a_{21} is equal to $\frac{1}{a_{12}}$ (Saaty, 2008). These matrices are employed to determine the local priority (i.e., local weight) of each element with respect to its parent element. Each element's global priority (i.e., global weight) with respect to the overall goal is calculated by multiplying its local priority by the global priority of its parent element. Subsequently, pairwise comparisons of the alternatives, if required, are conducted to determine their local priorities with respect to each sub-criterion or criterion (i.e., some criteria may have no sub-criteria). Each alternative is subsequently ranked based on its overall priority, which is determined by summing the products of its local priorities and global priorities of the associated criteria or sub-criteria (Saaty, 2006, p.16).

AHP problems frequently involve the opinions of multiple individuals, necessitating information aggregation. The two primary aggregation methods are the aggregation of individual judgments and the aggregation of individual priorities (AIP). The former generates aggregated matrices from the pairwise comparison matrices of all individuals, which are subsequently used to determine element priorities. The element priorities for the latter method are generated by aggregating the priorities of all individuals (Forman & Peniwati, 1998; Saaty, 2008).

The AHP has also been applied in some studies related to food service attributes. Chua Chow and Luk (2005) used the AHP to evaluate the service quality of fast-food restaurants in Canada based on the SERVQUAL dimensions. Empathy was the most important factor, followed by tangibles, assurance, reliability, and responsiveness. Ko and Chiu (2006) used the AHP to analyze the opinions of 15 coffee shop experts regarding the attributes that affected the success of a new coffee shop in Taiwan. Professional service, reasonable prices, and food quality were the top three most important attributes in achieving coffee shop customer satisfaction. Min and Min (2011) used the AHP to compare the performance of fast-food restaurant chains in the United States based on the following five criteria: service image, menu choices, location, accessibility, and drawing power. Each criterion was divided into multiple attributes. According to their findings, the food taste categorized under the drawing power was deemed the most important attribute in comparing fast-food restaurants.

Siew et al. (2018) used the AHP to evaluate the preferences for coffee shops among undergraduate students in Malaysia. They found cleanliness to be the most important attribute, followed by flavor, store atmosphere, sales promotion, service speed, price, and location. Padillo et al. (2022) used the AHP to rank four attributes—value, food, service, and atmosphere—based on their impact on customer loyalty to single-dish restaurants in

the Philippines, with value identified as the most important, followed by food, service, and atmosphere. Regarding sub-attributes, dining experience, taste, and good value for money ranked the top three in sustaining customer loyalty, whereas music was the least significant.

3. Method

3.1 Analytic hierarchy for this study

This study identified the attributes (i.e., criteria) and sub-attributes (i.e., sub-criteria) of coffee shops by conducting interviews with eight students to determine their preferences for selecting coffee shops. Additionally, a review of the existing literature on the food service industry was conducted. Excessive pairwise comparisons have the potential to overwhelm respondents (Saaty & Ozdemir, 2003). Therefore, this study carefully identified attributes and corresponding sub-attributes specifically relevant to on-campus coffee shops to limit the number of pairwise comparisons, fostering efficient decision-making and consistent results. The AHP hierarchy in Figure 1 illustrates the attributes and sub-attributes of this study. The hierarchy aims to assess the importance of seven main attributes at the second level and sub-attributes at the third level. The attributes included in this study were the food and beverage quality, location, environment, staff service, pricing, green practices, and well-known coffee shop chains. The first five attributes were further classified into sub-attributes as specified below, whereas the last two attributes are regarded as overall evaluations, making their subdivision unnecessary.

Food and beverage quality: Food and beverage taste, menu variety, and food and beverage hygiene
Location: Travel convenience, proximity to accommodation or study sites, and parking convenience
Environment: Decor, store cleanliness, outside atmosphere, and working space and free Wi-Fi
Staff service: Courtesy, fast service, staff appearance, and ability to recommend products
Pricing: Low price, good value for money, and regular promotional offers

The definitions and sources for these sub-attributes are in Appendix A.

Given the study's focus on determining the strategic prioritization of attributes for coffee shops based on university students' perceptions, a comparison of coffee shops was not conducted.

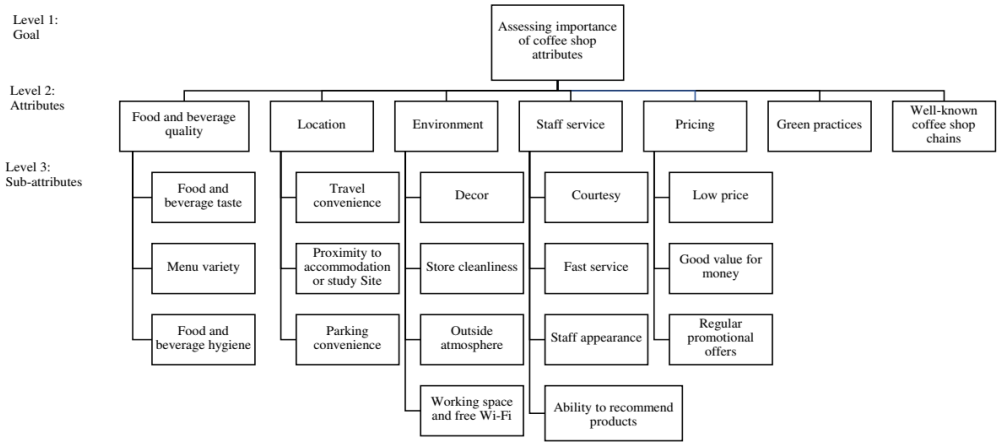

Figure 1 Hierarchical structure of attributes and sub-attributes

3.2 Data collection

This study centered on university students as the target population. Data collection involved using both online and paper-based questionnaires, with the aim of accommodating respondents' preferred mode of participation, while convenience sampling was employed due to the lack of a predefined sampling frame. The online questionnaire link was distributed to students via social media platforms such as Line and Facebook. Paper-based questionnaires were distributed in classes comprising students from various majors, with the permission of the class instructors, and in regularly utilized student spaces such as common dormitory areas and study lounges. The students were provided with an information sheet that outlined the survey's purpose and ensured their anonymity. The information sheet allowed the participants to make informed decisions regarding their participation.

Upon choosing to participate, the students were instructed to compare the relative importance of each pair of the seven attributes at the second level of the AHP hierarchy, resulting in 21 pairwise comparisons. Subsequently, comparisons were conducted at the third hierarchical level for the sub-attributes within the food and beverage quality, location, and pricing, each involving three pairwise comparisons. Additionally, comparisons were conducted for the sub-attributes within the environment and staff service attributes, each comprising six pairwise comparisons. In total, each respondent provided 42 comparisons during the study. Saaty's standard rating scale ranging from 1–9 was adopted, where one denotes equal importance, and nine denotes the extreme importance of one element over another (Saaty, 2008). The pairwise comparison questions are in Appendix B.

Ethical approval was granted by the Suranaree University of Technology Human Research Ethics Committee (COA No. 79/2562). A total of 317 responses were collected through online questionnaires (144) and paper questionnaires (173) between August 2022 and May 2023. Of these collected responses, 14 contained missing data, resulting in a final sample size of 303 responses for further analysis.

The Mann-Whitney U tests, which are non-parametric tests, were used to evaluate the homogeneity between the raw online and paper AHP data, as the data were not normally distributed according to the result of the Shapiro-Wilk tests. The results of the Mann-Whitney U tests were mixed; 15 out of 42 variables had p-values greater than or equal to 0.05, indicating homogeneity, while the remaining variables had p-values below 0.05, suggesting non-homogeneity. To ensure a comprehensive analysis of priorities, the data from both groups were combined. This approach preserved an adequate sample size and captured a broader representation, particularly because some responses would later be removed due to inconsistencies.

3.3 Data analysis software

The AHP analysis was conducted using the AHP for survey data (ahpsurvey) package (Cho, 2019) in R software version 4.2.3 (R Core Team, 2023), which can generate multiple pairwise comparison matrices and compute individual priorities and consistency ratios from all responses simultaneously. Moreover, it can calculate the aggregated priorities based on all responses.

4. Results

4.1 Forming pairwise comparisons matrices

For each respondent, a pairwise comparison matrix for the attributes at the second level of the analytic hierarchy and five pairwise comparison matrices for the sub-attributes at the third level of the hierarchy were generated. The completed pairwise comparison matrices for the attributes and sub-attributes derived from the answers of a single respondent, as an illustrative example, are provided in Appendix C.

4.2 Determining the consistency ratio of each pairwise comparison matrix

The responses obtained from the AHP may contain some level of inconsistency because they are based on subjective judgments. For example, the response is considered inconsistent if the respondent ranks A as being twice as important as B and B as twice as important as C, but A is not four times as important as C. The consistency level of pairwise comparisons can be measured by the consistency ratio (CR), which is calculated as follows (Saaty, 2008):

$$CR = \left(\frac{\lambda_{max} - n}{n - 1}\right)\left(\frac{1}{RI}\right) \quad (2)$$

where λ_{max} is the maximum eigenvalue of the pairwise comparison matrix, n is the number of elements in the matrix, and RI is the random consistency index, whose values depend on n as shown in Table 1 (Cho, 2019).

Table 1
Random consistency index (RI)

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.53	0.88	1.11	1.25	1.34	1.41	1.45	1.49

Perfect consistency (i.e., CR = 0) in all respondents' responses may not be attainable; hence, some degree of inconsistency has been allowed in the AHP analysis. A CR value less than or equal to 0.1 is typically considered acceptable. However, there is variability in the literature, with some studies adopting a more flexible threshold of 0.20 (Dolan, 2008; Ho et al., 2005). A comparative analysis was conducted using both the 0.10 and 0.20 thresholds. Responses with CR values exceeding the threshold value in at least one comparison matrix were excluded from further analysis in this study. Of the 303 responses, 255 (84%) were excluded under the 0.10 threshold, leaving 48 for analysis, while 206 (68%) were excluded under the 0.20 threshold, leaving 97 for analysis. Using a 0.10 threshold resulted in a significant loss of responses compared to the 0.20 threshold. Therefore, to prevent excess data loss while still maintaining an acceptable level of consistency, a threshold value of 0.20 was adopted. Thus, the remaining 97 responses were used for subsequent AHP analysis.

4.3 Determining priorities

The global priorities of each attribute and the local priorities of each sub-attribute were determined using the eigenvalue method as follows in Equation (3):

$$AW = \lambda_{max} W \tag{3}$$

where A is a pairwise comparison matrix; λ_{max} is the maximum eigenvalue of matrix A; and W is the priority vector of elements in matrix A.

This study employed the AIP method, where the global priorities of attributes and the local priorities of sub-attributes from all responses were aggregated to evaluate the collective perception of university students regarding the importance of coffee shop attributes while simultaneously considering individual preferences (Forman & Peniwati, 1998). The geometric mean was used to aggregate the priority of each element to be consistent with AHP principles (Forman & Peniwati, 1998; Saaty, 2008) as shown in Equation (4):

$$w_c = \left(\prod_{r=1}^{N} w_{c,r}\right)^{\frac{1}{N}} \tag{4}$$

where w_c is the aggregated priority of element c; $w_{c,r}$ is the priority of element c as perceived by respondent r; and N is the total number of respondents.

The final global priorities of attributes and local priorities of sub-attributes were derived by normalizing the aggregated priorities. This ensures that the global priorities across all attributes sum to 1, while the local priorities for the sub-attributes within each attribute category also sum to 1 (Saaty, 2006; Saaty, 2008). Table 2 presents the global priorities of the seven attributes, the local priorities of their corresponding sub-attributes, and the global priorities of the sub-attributes. The analysis indicated that the "food and beverage quality" was the most important attribute, followed by "pricing," "location," "staff service," "environment," "green practices," and "well-known coffee shop chains." Further examination of the local priorities revealed that "food and beverage hygiene" was the most crucial sub-attribute within the "food and beverage quality" attribute. "Good value for money" was the most important sub-attribute within the "pricing" attribute. "Travel convenience" ranked the highest in importance under the "location" attribute. "Courtesy" was the most important sub-attribute within the "staff service" attribute.

"Store cleanliness" was the most important sub-attribute within the "environment" attribute.

The global priority of each sub-attribute was calculated by multiplying its local priority by its parent attribute's global priority. This analysis revealed that the five sub-attributes with the highest global priority were "food and beverage hygiene," "good value for money," "food and beverage taste," "travel convenience," and "regular promotional offers." In contrast, the sub-attributes with the lowest global priorities were "staff's ability to recommend products," "decor," and "outside atmosphere."

For supplementary purposes, Kendall's coefficient of concordance (W) was used to measure the agreement of rankings across three groups of responses: those with CR ≤ 0.2, those with CR ≤ 0.1, and all responses. High Kendall's W values (above 0.7) (see Appendix D) indicate strong agreement in the rankings of attributes and sub-attributes across these groups (Schmidt, 1997), demonstrating the robustness of the rankings. As noted earlier, the results, as well as the discussion and conclusions, are based on priorities derived from responses with CR ≤ 0.2. Using a single consistency threshold provides a clear basis for prioritizing attributes and sub-attributes to guide improvements. The threshold of CR ≤ 0.2 was chosen to include more responses while maintaining acceptable consistency (Pauer et al., 2016).

Table 2
Priorities of attributes and sub-attributes

Attributes and sub-attributes	Global priorities of attributes (ordered by values)	Local priorities of sub-attributes (ordered by values)	Global priorities of sub-attributes
Food and beverage quality	0.1854		
Food and beverage hygiene		0.4231	0.0784
Food and beverage taste		0.3822	0.0709
Menu variety		0.1947	0.0361
Pricing	0.1807		
Good value for money		0.4158	0.0751
Regular promotional offers		0.2970	0.0537
Low price		0.2873	0.0519
Location	0.1521		
Travel convenience		0.3567	0.0543
Proximity to accommodation or study site		0.3287	0.0500
Parking convenience		0.3146	0.0479
Staff service	0.1476		
Courtesy		0.2818	0.0416
Fast service		0.2578	0.0381
Staff appearance		0.2530	0.0373
Ability to recommend products		0.2074	0.0306
Environment	0.1422		
Store cleanliness		0.3126	0.0445
Working space and free Wi-Fi		0.2978	0.0423
Decor		0.2111	0.0300
Outside atmosphere		0.1786	0.0254
Green practices	0.1143	–	–
Well-known coffee shop chains	0.0779	–	–

5. Discussion and conclusion

This study employed the AHP to rank the attributes of coffee shops according to their perceived importance among university students. The analysis was based on the priorities derived from responses with CR ≤ 0.2. The findings revealed that "food and beverage quality" was the most important attribute, followed by "pricing," "location," "staff service," "environment," and "green practices." The attribute of the coffee shops being well-known chains was found to be the least important. The five most important sub-attributes were "food and beverage hygiene," "good value for money," "food and beverage taste," "travel convenience," and "regular promotional offers." The significance attributed to the "food and beverage quality" in this study aligns with prior research conducted in the food service industry (Namkung & Jang, 2008; Liu & Jang, 2009; Ryu & Han, 2010). Studies focused on coffee shop services, such as those conducted by Chen and Hu (2010), Hashim et al. (2017), and Lee et al. (2018a), also highlighted the importance of coffee quality. Furthermore, Dhisasmito and Kumar (2020), Hashim et al. (2017), and Ko and Chiu (2006) identified price as a key factor in coffee shops. Additionally, these results are consistent with Kwun et al.'s (2013) and Park et al.'s (2013) findings, which indicated that college students prioritize food quality, pricing, and location when considering on-campus food services.

This research has implications for campus coffee shop operators in prioritizing attribute improvement to meet students' preferences, as they are their main customers. First, coffee shop owners should prioritize the hygiene and taste of their food and beverage offerings to better align with the preferences of students. Second, they should prioritize offering students good value for money and regular promotions rather than concentrating solely on low prices. Third, coffee shops should be in areas that provide travel convenience and are near student accommodations or study sites.

University management can leverage these findings to facilitate enhancements in campus coffee shop operations, ensuring they better align with students' preferences. Specifically, university administrators should strategize the placement of campus coffee shops by considering convenient accessibility for students. A strategic location can increase foot traffic and customer engagement, increasing sales and customer satisfaction. They should advise coffee shop operators to prioritize hygienic products and tasty menu items at reasonable prices.

This study used the AHP to prioritize attributes for the efficient allocation of resources while ensuring explicit outcomes for on-campus coffee shops. It does not imply that the less important "staff service" and "environment" should be disregarded. Similarly, although "green practices" may not have been ranked as high as other attributes, coffee shops should still address this factor to demonstrate their commitment to responsible business practices. The finding that the attribute of "well-known coffee shop chains" was ranked as the least important among university students highlights an opportunity for independent coffee shops on campuses. By prioritizing crucial attributes such as improving food and beverage hygiene and taste, offering reasonable prices, and implementing appealing regular promotions, independent coffee shops can thrive. Furthermore, it is unnecessary for university management to prioritize selecting well-known coffee shop brands for campus operations. Instead, the focus should be on

selecting establishments, whether independent or part of renowned chains, that consistently offer high-quality products at reasonable prices.

This study provides insights into the importance of the attributes of coffee shops as perceived by university students. However, its focus was specifically on providing recommendations to prioritize quality improvements for coffee shop operators and university management within a particular university. As such, the findings may have limitations in representing a broader population. Future research should include a more diverse selection of university students to enhance the generalizability of the study's findings and explore potential differences or similarities in opinions across various campuses. Comparing the performance of various coffee shops could also provide deeper insights into customer preferences. Despite efforts to simplify the survey, some participants still found it overwhelming, leading to inconsistent responses that had to be excluded. Future studies could revise the survey further to help participants provide more consistent and thoughtful answers. From a theoretical and methodological perspective, this study also contributes to the discipline by providing an exemplary research case of following best practices for conducting and reporting AHP studies (Saaty, 2020). For this purpose, criteria sources, definitions, questionnaires, data, software details and related documentation were discussed to support the research validity of the AHP study as recommended in the extant literature (Mu et al., 2020; Mu & Stern, 2018).

Data Availability Statement: The data from this study are available upon request; please contact the corresponding author for replicability and transparency reasons.

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APPENDIX A
Attributes and sub-attributes

Attributes and sub-attributes	Description	Sources
Food and beverage quality		
Food and beverage hygiene	Cleanliness of food and beverage	Kwun et al. (2013); Liu & Jang (2009); Liu & Tse (2018); Min & Min (2011); Park et al. (2013); Yi et al. (2018)
Food and beverage taste	Flavor of food and beverage	Chen & Hu (2010); Kim et al. (2004); Lee et al. (2018b); Liu & Jang (2009); Liu & Tse (2018); Min & Min (2011); Namkung & Jang (2008); Padillo et al. (2022); Park et al. (2013); Ponnam & Balaji (2014); Siew et al. (2018); Yi et al. (2018); Interview
Menu variety	Range of different food and beverage options	Chen & Hu (2010); Chua et al. (2020); Kim et al. (2004); Kwun et al. (2013); Liu & Jang (2009); Liu & Tse (2018); Min & Min (2011); Padillo et al. (2022); Park et al. (2013); Ponnam & Balaji (2014); Interview
Location		
Travel convenience	Ease of travel to coffee shops	Klassen et al. (2005)
Proximity to accommodation or study site	Close to accommodation (e.g. dormitory) or study buildings	Klassen et al. (2005); Min & Min (2011)
Parking convenience	Availability of parking spaces near coffee shops	Hashim et al. (2017); Hsiao & Chen (2020); Klassen et al. (2005)
Environment		
Store cleanliness	Cleanliness of coffee shops' space	Chen & Hu (2010); Kim et al. (2004); Klassen et al. (2005); Kwun et al. (2013); Liu & Jang (2009); Liu & Tse (2018); Min & Min (2011); Interview
Working space and free Wi-Fi	Provision of tables, chairs, and free Wi-Fi for customers to work at coffee shops	Lee et al. (2018b); Interview
Decor	Interior and exterior decor of coffee shops	Chen & Hu (2010); Heung & Gu (2012); Kim et al. (2004); Liu & Jang (2009); Liu & Tse (2018); Namkung & Jang (2008); Ponnam & Balaji (2014); Interview
Outside atmosphere	Surrounding atmosphere of coffee shops	Heung & Gu (2012); Hsiao & Chen (2020); Interview
Staff service		
Courtesy	Friendly and willing-to-serve staff	Chen & Hu (2010); Dhisasmito & Kumar (2020); Kim et al. (2004); Klassen et al. (2005); Lee et al. (2018b); Liu & Jang (2009); Liu & Tse (2018); Min & Min (2011); Namkung & Jang (2008); Padillo et al. (2022) Park et al. (2013);
Fast service	Staff providing fast service	Chen & Hu (2010); Kim et al. (2004); Klassen et al. (2005); Kwun et al. (2013); Park et al. (2013); Siew et al. (2018); Yi et al. (2018).
Staff appearance	Staff dressed in clean and neat attire	Liu & Jang (2009); Liu & Tse (2018); Padillo et al. (2022)

Attributes and sub-attributes	**Description**	**Sources**
Ability to recommend products	Knowledgeable staff in suggesting products	Kim et al. (2004); Liu & Jang (2009); Liu & Tse (2018); Namkung & Jang (2008); Interview
Pricing		
Good value for money	Reasonable pricing that reflects product quality	Dhisasmito & Kumar (2020); Klassen et al. (2005); Ko & Chiu (2006); Kwun et al. (2013); Liu & Tse (2018); Padillo et al. (2022); Park et al. (2013); Interview.
Regular promotional offers	Frequent promotions, such as discounts or buy-one-get-one-free deals	Chen & Hu (2010); Chua et al. (2020); Ko & Chiu (2006); Siew et al. (2018); Interview
Low price	Low prices of food and beverage	Kwun et al. (2013); Interview
Green practices	Environmental consciousness (e.g., use of eco-friendly materials)	DiPietro et al. (2013); Kim & Hall (2020); Interview
Well-known coffee shop chains	Widely recognized coffee shop brands	Chua et al. (2020); Foroudi et al. (2021); Kim et al. (2004); Yi et al. (2018); Interview

APPENDIX B
Pairwise comparison questions

Instruction

Please compare the level of importance of the coffee shops' attributes and sub-attributes and mark X on the importance comparison scores according to your opinion.

No.	Item A	Comparison scores																	Item B
		A is more important than B								Equal	B is more important than A								
Attributes																			
1	Food and beverage quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Location
2	Food and beverage quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environment
3	Food and beverage quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Staff service
4	Food and beverage quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pricing
5	Food and beverage quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Green practices
6	Food and beverage quality	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Well-known coffee shop chains
7	Location	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environment
8	Location	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Staff service
9	Location	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pricing
10	Location	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Green practices
11	Location	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Well-known coffee shop chains

No.	Item A	Comparison scores																	Item B
		A is more important than B								Equal	B is more important than A								
12	Environment	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Staff service
13	Environment	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pricing
14	Environment	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Green practices
15	Environment	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Well-known coffee shop chains
16	Staff service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pricing
17	Staff service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Green practices
18	Staff service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Well-known coffee shop chains
19	Pricing	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Green practices
20	Pricing	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Well-known coffee shop chains
21	Green practices	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Well-known coffee shop chains
Sub-attributes of food and beverage quality																			
1	Food and beverage taste	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Menu variety
2	Food and beverage taste	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Food and beverage hygiene
3	Menu variety	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Food and beverage hygiene
Sub-attributes of location																			
1	Travel convenience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Proximity to accommodation or study site
2	Travel convenience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Parking convenience
3	Proximity to accommodation or study site	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Parking convenience
Sub-attributes of environment																			
1	Decor	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Store cleanliness
2	Decor	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Outside atmosphere
3	Decor	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Working space and free Wi-Fi
4	Store cleanliness	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Outside atmosphere
5	Store cleanliness	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Working space and free Wi-Fi
6	Outside atmosphere	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Working space and free Wi-Fi
Sub-attributes of staff service																			
1	Courtesy	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Fast service
2	Courtesy	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Staff appearance
3	Courtesy	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Ability to recommend products
4	Fast service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Staff appearance
5	Fast service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Ability to recommend products

No.	Item A	Comparison scores																	Item B
		A is more important than B								Equal	B is more important than A								
6	Staff appearance	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Ability to recommend products
Sub-attributes of pricing																			
1	Low price	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Good value for money
2	Low price	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Regular promotional offers
3	Good value for money	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Regular promotional offers

APPENDIX C
Sample pairwise comparison matrices for attributes and sub-attributes from a single respondent

Table C1
A sample pairwise comparison matrix for attributes

Attributes	Food and beverage quality	Location	Environment	Staff service	Pricing	Green practices	Well-known coffee shop chains
Food and beverage quality	1	2	6	4	2	9	8
Location	1/2	1	5	3	1	8	7
Environment	1/6	1/5	1	1/3	1/5	4	3
Staff service	1/4	1/3	3	1	1/3	6	5
Pricing	1/2	1	5	3	1	8	7
Green practices	1/9	1/8	1/4	1/6	1/8	1	1/2
Well-known coffee shop chains	1/8	1/7	1/3	1/5	1/7	2	1

Table C2
A sample pairwise comparison matrix for the sub-attributes of the food and beverage quality

Sub-attributes of the food and beverage quality	Food and beverage taste	Menu variety	Food and beverage hygiene
Food and beverage taste	1	1/4	1/8
Menu variety	4	1	1/5
Food and beverage hygiene	8	5	1

Table C3
A sample pairwise comparison matrix for the sub-attributes of location

Sub-attributes of location	Travel convenience	Proximity to accommodation or study sites	Parking convenience
Travel convenience	1	3	7
Proximity to accommodation or study sites	1/3	1	5
Parking convenience	1/7	1/5	1

Table C4
A sample pairwise comparison matrix for the sub-attributes of environment

Sub-attributes of environment	Decor	Store cleanliness	Outside atmosphere	Working space and free Wi-Fi
Decor	1	1	3	1/4
Store cleanliness	1	1	3	1/4
Outside atmosphere	1/3	1/3	1	1/6
Working space and free Wi-Fi	4	4	6	1

Table C5
A sample pairwise comparison matrix for the sub-attributes of staff service

Sub-attributes of staff service	Courtesy	Fast service	Staff appearance	Ability to recommend products
Courtesy	1	1/3	1/7	1/9
Fast service	3	1	1/5	1/7
Staff appearance	7	5	1	1/3
Ability to recommend products	9	7	3	1

Table C6
A sample pairwise comparison matrix for the sub-attributes of pricing

Sub-attributes of pricing	Low price	Good value for money	Regular promotional offers
Low price	1	3	6
Good value for money	1/3	1	4
Regular promotional offers	1/6	1/4	1

APPENDIX D
Kendall's coefficient of concordance (W) for ranking agreement

Table D1
W for ranking of attributes across groups of responses

Attributes	Responses with CR ≤ 0.2 (n = 97)		Responses with CR ≤ 0.1 (n = 48)		All responses (n = 303)		W
	Global Priorities	Ranks	Global Priorities	Ranks	Global Priorities	Ranks	
							0.8730
Food and beverage quality	0.1854	1	0.1672	1	0.1633	3	
Location	0.1521	3	0.1406	5	0.1195	5	
Environment	0.1422	5	0.1510	4	0.1582	4	
Staff service	0.1476	4	0.1514	3	0.1847	1	
Pricing	0.1807	2	0.1612	2	0.1821	2	
Green practices	0.1143	6	0.1328	6	0.1194	6	
Well-known coffee shop chains	0.0779	7	0.0959	7	0.0729	7	

n = number of responses

Table D2
W for ranking of sub-attributes across groups of responses

Sub-attributes	Responses with CR ≤ 0.2 (n = 97)		Responses with CR ≤ 0.1 (n = 48)		All responses (n = 303)		W
	Local Priorities	Ranks	Local Priorities	Ranks	Local Priorities	Ranks	
Food and beverage quality							1
Food and beverage taste	0.3822	2	0.3485	2	0.3886	2	
Menu variety	0.1947	3	0.2482	3	0.1682	3	
Food and beverage hygiene	0.4231	1	0.4033	1	0.4432	1	
Location**:**							0.7778
Travel convenience	0.3567	1	0.3488	1	0.3696	1	
Proximity to accommodation or study site	0.3287	2	0.3303	2	0.3137	3	
Parking convenience	0.3146	3	0.3210	3	0.3166	2	
Environment**:**							0.9111
Decor	0.2111	3	0.2292	3	0.1982	3	
Store cleanliness	0.3126	1	0.2848	2	0.3306	1	
Outside atmosphere	0.1786	4	0.1961	4	0.1499	4	
Working space and free Wi-Fi	0.2978	2	0.2900	1	0.3214	2	
Staff service:							0.7333
Courtesy	0.2818	1	0.2568	2	0.3193	1	
Fast service	0.2578	2	0.2425	3	0.2546	2	
Staff appearance	0.2530	3	0.2605	1	0.2444	3	

Ability to recommend product	0.2074	4	0.2402	4	0.1817	4	
Pricing:							1
Low price	0.2873	3	0.3123	3	0.2427	3	
Good value for money	0.4158	1	0.3681	1	0.4544	1	
Regular promotional offers	0.2970	2	0.3197	2	0.3029	2	

n = number of responses