User-Centered Design and Usability Evaluation of a Cashless Canteen Ordering System for Students

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ABSTRACT

This study developed and tested a cashless canteen ordering system for students using a user-centered design process. Seventy-two respondents, mostly students, along with faculty, and IT practitioners reviewed a mobile prototype for browsing menus, managing a cart, and paying cashlessly. They rated it very positively overall (3.76 out of 4), with all areas scoring between 3.71 and 3.79. Ordering was rated highest, while cashless payment and handling busy hours were the weakest areas. Students gave slightly lower ratings than faculty and IT practitioners, especially for payment. However, because no actual waiting-time or queue data were collected, the study cannot prove that queues were reduced; testing the system during peak hours with timing data is the recommended next step.

Keywords: cashless canteen ordering, user-centered design, usability evaluation, student experience, digital payment

INTRODUCTION

In many Philippine universities, students only have a short break between classes, so many of them buy food at the same time. Since most canteens still use cash, every purchase involves giving change and recording sales by hand, which slows down transactions when many students are lining up. This often leads to long queues, crowded canteen areas, and students who either skip buying food or return to class late. Another concern is that students cannot easily tell whether their short break is enough for them to buy a meal.

Cashless payments and online ordering are common solutions to this problem. Schools and universities have used self-service kiosks, QR-code payments, RFID cards, and web-based canteen systems to make checkout faster and reduce manual record-keeping. However, making a system cashless does not automatically remove long queues. If students find the ordering or payment process confusing, they may still line up to ask for help or fix a failed payment. For the system to be effective, students should be able to order and pay on their own, quickly, and without assistance. User-Centered Design (UCD) helps address this by focusing on the needs and experiences of the people who will use the system. Based on ISO 9241-210, UCD involves understanding users' context, identifying their needs, designing a solution, and evaluating whether the design meets those needs. Although some canteen systems already involve users in their design, many studies do not clearly explain how users were involved or how the system was evaluated.

For this reason, this study designed and evaluated a cashless canteen ordering system for students using a UCD approach. It aimed to identify the problems students experience in the current cash-based process, use those needs to develop a prototype, and evaluate the system in terms of usability, efficiency and convenience, ordering and payment, and satisfaction. The study also identified areas that need improvement before the system can be used in an actual school setting. It focused on students' perceived usability and acceptance, and did not measure actual waiting time, queue length, errors, or the number of orders the system can process.

LITERATURE REVIEW

Cashless Payment and Digital Canteen Systems

A portable self-service kiosk was developed for campus canteens to address long checkout queues and improve [1]point-of-sale transactions through barcode scanning and QR code payments.[1] Similarly, a mobile-friendly, web-based cashless canteen management system was designed to address payment delays, manual record-keeping, and limited payment options in schools.[2]. An RFID-based cashless payment system was also implemented at the Fatahillah canteen of Darunnajah Islamic Boarding School in Jakarta, demonstrating the application of RFID technology in educational food services [10]. Another system included user authentication, e-wallet recharging, database management, and transaction notifications to provide a more organized payment process across different devices [11]

These studies show that cashless technology can be applied in different ways depending on the needs of the users and the institution.[9] Traditional cash-based transactions can also contribute to difficulties during short recess periods, particularly when many students need to purchase food at the same time [16]

Online Ordering and Pre-Ordering

Aside from payment, researchers have explored online ordering systems as a way to improve how students purchase food. One system allows students and faculty members to place and track orders while helping canteen staff organize transactions [3]. Another system provides options for selecting pickup times, making online payments, and receiving order notifications [6]. A digital platform also allows stall operators to manage menus, monitor orders, and update order statuses, giving them better control over daily canteen activities [8].

Pre-ordering has also been examined as an alternative to traditional walk-in ordering[4]. A separate three-year study examined the students' continued use of a canteen pre-ordering system and their meal-planning behavior over time [5]. The findings suggest that online ordering can change the way students plan and complete their food purchases, but the system also needs to take possible problems, such as unclaimed orders into account.

Usability and User-Centered Design

A study conducted at TAR UMT Johor Branch evaluated a canteen application based on usability, usefulness, and user satisfaction, with reliability and validity tests used to assess the research instrument [14].

A proposed mobile application combined online food ordering with vacant-seat detection, food recommendations, and sentiment analysis to address different challenges encountered by students in university canteens. [20]. The use of the Simple Additive Weighting (SAW) method was also explored to recommend menu items based on users' preferences and selected criteria [12]

System Development and Functionality

Different development methods and technologies have been used to create digital canteen systems[15]. Black Box Testing was also used to evaluate system functionality, with the results showing that the main features operated as intended [18]. Another proposed system used a Raspberry Pi as its main controller together with a QR code scanner, LCD, and Wi-Fi to support its operations [19]

A food ordering system for Sekolah Menengah Kebangsaan Tengku Ampuan Jemaah followed the Software Prototyping Model and used Visual Studio Code for development and Laragon for database management [24]. A Cortex-A9 and Android-based ordering and pricing statistics system was also developed to address manual pricing errors, inefficient ordering, and limited data analysis in traditional college canteens [23]

Additional features have also been explored in digital canteen applications. A delivery function was developed to support the accurate and timely distribution of food orders to students, staff, and canteen personnel [7] A nutrition ordering system was designed to allow college students to order food without waiting in long queues by combining a database with genetic algorithms [21]. Another study identified the need for further research into

the factors that influence students' online canteen purchasing behavior [22].The "vCanteen" platform also addressed high crowd density during lunch hours by combining online food ordering, virtual queuing, and machine-learning-based crowd estimation [25]. In addition, an automated canteen management system was proposed to make food ordering and payment more organized while supporting the use of technology in modern campus services [13]. Related research has also explored technological solutions for improving canteen service efficiency and customer satisfaction [17]

The present study is positioned accordingly. It does not claim to invent the cashless canteen system, and it does not claim that user-centered canteen systems are absent from the literature. It contributes a documented UCD process and a transparent, construct-level evaluation from a Philippine university, and it separates what students perceived from what the study did not measure. That separation is the main methodological difference from the studies in Table I.

Table I Comparison of the Closest Existing Canteen Systems and the Present Study

Study	Context and system	Evidence reported	Relation to this study
Subhana [5]	Al-Husna canteen, Indonesia; inventory and sales system	Design description; UCD applied to back-office tasks	Same method, different user (operators, not students)
Wong and Abdullah [15]	School canteen; food ordering application	Prototyping process and system features	Functional development; no post-use evaluation
Abdul Rahman and Othman [18]	School canteen; ordering system for teachers	Development and functionality	Different user group; no student evaluation
Sebastian et al. [3]	College canteen; Direct Dine platform	System concept and features	Feature-level; no reported student ratings
Present study	University canteen, Philippines; cashless ordering prototype	UCD process plus 25-item ratings from 72 respondents	Adds the full item set, reliability, dispersion, and bounded claims

Table 2.1 compares existing canteen systems with the present study to highlight the research gap and establish the methodological contribution of a transparent UCD evaluation.

METHODOLOGY

Research Design

The study used a descriptive-developmental design. The developmental component produced the artifact: requirements were elicited from students, a prototype was built, and the prototype was refined during walkthroughs. The descriptive component measured evaluations of the resulting artifact with a structured questionnaire. Data were mainly quantitative, with open-ended items supplying explanation and examples. The design is descriptive rather than experimental: no comparison condition was used, and the study does not attribute changes in canteen operations to the system.

User-Centered Design Process

Development followed the four activities of ISO 9241-210, summarized in Table II. The context of use was established through observation of the canteen during recess and lunch and through informal conversation with students and canteen staff. Requirements were elicited with a needs questionnaire and consolidated into a short set of design requirements: a menu that can be scanned quickly, a cart that can be reviewed and corrected before payment, a checkout that does not require a counter transaction, and an order summary that confirms what was ordered and paid for.

Design moved from paper wireframes to an interactive mobile prototype, and walkthrough feedback was used to remove steps that respondents hesitated over. Evaluation used the questionnaire described in Section III-E.

The process is iterative in principle. In this study one full design-evaluation cycle was completed, and the findings in Section IV are the input to the next. The interfaces produced in that cycle are shown in Figs. 1 to 3: the home screen, the menu and selection screen, and the payment screen with the order summary.

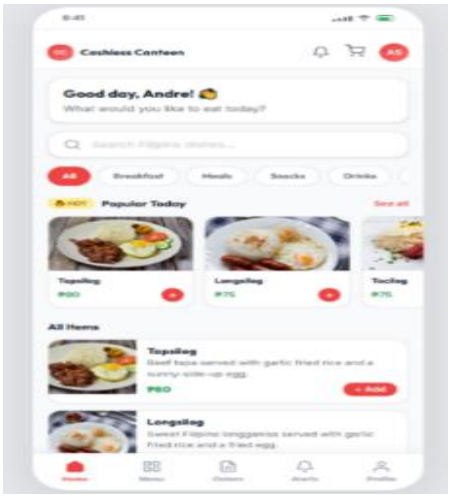


Fig. 1. Homepage interface of the proposed cashless canteen ordering system.

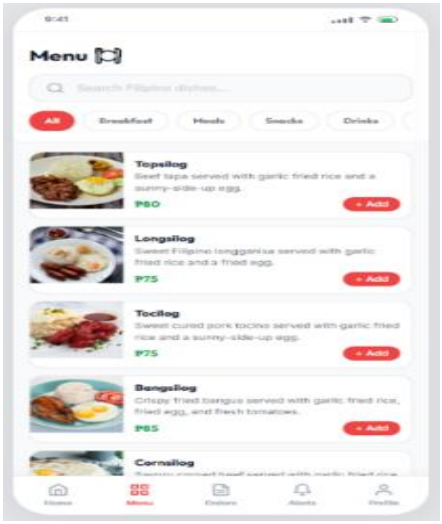


Fig. 2. Menu and food selection interface of the proposed cashless canteen ordering system

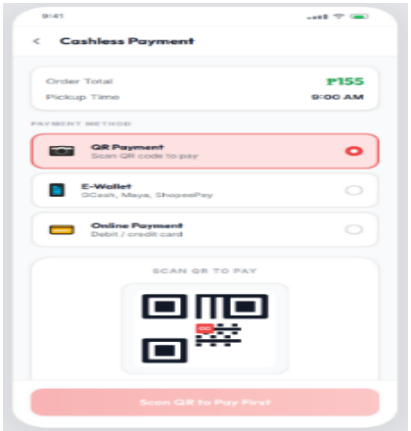


Fig. 3. Cashless payment interface showing the order summary and multiple payment options (QR Payment, E-Wallet, and Online Payment).

Table II User-Centered Design Activities, Methods, and Outputs

UCD activity	What was done	Output
Understand context of use	Observation of the canteen at recess and lunch; informal interviews with students and canteen staff	Description of peak-period constraints and the current ordering flow
Specify user requirements	Needs questionnaire on difficulties, required features, and preferred payment methods	Design requirements: fast menu scanning, cart review, counter-free checkout, order confirmation
Produce design solutions	Paper wireframes, then an interactive mobile prototype; walkthrough feedback used to remove hesitant steps	Working prototype (Figs. 1–3)
Evaluate against requirements	25-item evaluation questionnaire (Section III-E)	Dimension-level ratings and improvement priorities (Section IV)

Table 3.1 outlines the ISO 9241-210 UCD activities, methods, and outputs, detailing how user requirements were elicited, prototyped, and evaluated.

Respondents and Sampling

A total of 72 respondents evaluated the system: 56 students (77.8%), seven faculty members (9.7%), and nine IT practitioners (12.5%). The student respondents came from the researchers' institution and from other higher-education institutions in Metro Manila and nearby provinces, while the faculty members and IT practitioners were invited because they could evaluate the system based on their teaching and technical experience. Since the questionnaire was administered online, the respondents were selected through convenience sampling rather than random sampling from a single campus. Respondents were included if they had experience with campus canteen services, basic familiarity with mobile applications, and confirmed their consent before answering. Table III presents the composition of the respondents. Including faculty members and IT practitioners provided a broader perspective beyond the students' views; however, because of this, the overall mean does not represent students alone, so the student respondents' results were also reported separately in Section IV-H.

Table III Profile of Respondents (n = 72)

Characteristic	Category	f	%
Sex	Male	47	65.3
	Female	25	34.7
Age	Below 18	5	6.9
	18–20	19	26.4
	21–23	27	37.5
	24 and above	21	29.2
Respondent type	Student	56	77.8
	Faculty	7	9.7
	IT practitioner	9	12.5

Table 3.2 presents the demographic profile of the 72 respondents, detailing the distribution by sex, age, and respondent type to contextualize the sample.

Ethical Considerations

The study was reviewed and approved by the Office of Student Affairs (OSA) Committee. The questionnaire opened with a data-privacy notice and a consent statement grounded in the Data Privacy Act of 2012 (R.A. 10173), which every respondent accepted before answering; participation was voluntary, could be stopped at any point, and carried no academic consequence. Five respondents (6.9%) were below 18 years of age; they gave assent, and their parents or guardians granted consent on the same terms. Responses were collected between 7 and 23 September 2026. No names, e-mail addresses, or institutional affiliations are reported in this paper, and responses are presented only in aggregate.

Research Instrument

The evaluation used a 25-item questionnaire rated on a four-point scale from Strongly Agree to Strongly Disagree. It covered six areas: usability, efficiency and convenience, ordering process, cashless payment, usefulness and relevance, and satisfaction and acceptance. Faculty members checked the questions for clarity, relevance, and focus to ensure content validity. Based on 72 responses, the questionnaire showed very high internal consistency (Cronbach's alpha = .96), although this may be partly due to the uniformly high ratings. A four-point scale was used to require a clear opinion, but it removed the neutral option.

Table IV Structure of the Evaluation Instrument and Internal Consistency

Dimension	**Items**	**Content covered**	**α**
Usability	10	Understanding, learning, navigation, layout, clarity	.93
Efficiency and convenience	5	Convenience, waiting time, busy hours, speed, organization	.86
Ordering process	3	Step clarity, cart review, presentation of items and prices	.79
Cashless payment	2	Ease of understanding, comfort with payment	.80
Usefulness and relevance	3	Usefulness, relevance, meeting expectations	.84
Satisfaction and acceptance	2	Design satisfaction, willingness to use	.84
Whole instrument	25	All dimensions	.96

Table 3.3 details the structure of the 25-item evaluation instrument, showing the six assessed dimensions, item counts, and their high internal consistency (Cronbach's α).

Table V Four-Point Scale, Weighted-Mean Ranges, and Verbal Interpretation

Response	**Weighted-mean range**	**Verbal interpretation**
4	3.26 – 4.00	Strongly Agree
3	2.51 – 3.25	Agree
2	1.76 – 2.50	Disagree
1	1.00 – 1.75	Strongly Disagree

Table 3.4 defines the four-point Likert scale, establishing the weighted-mean ranges and corresponding verbal interpretations used to evaluate the system.

The four bands divide the 1.00–4.00 range into equal intervals of 0.75, so any mean at or above 3.26 is verbally interpreted as Strongly Agree. The convention is applied consistently in Section IV, including to the lowest item. It is the reason why that item is described as comparatively rather than absolutely weak.

Data-Collection Procedure

Respondents reviewed the prototype's ordering flow, including menu selection, cart review, and the payment screen shown in Figs. 1 to 3, and then completed the questionnaire through an online form. The form was open from 7 to 23 September 2026 and could be completed in one sitting. Open-ended items asked which feature was most useful, which part was difficult or confusing, what should be added or improved, and what would make the system more convenient for students. Responses were recorded anonymously for analysis; the form's consent statement, age band, and respondent type were retained as variables.

Data Analysis

The study summarized respondents using frequency and percentage, then calculated weighted means for each item, dimension, and the overall questionnaire. Standard deviations and 95% confidence intervals were used to show how responses varied. Cronbach’s alpha measured the questionnaire’s internal consistency. Student responses were compared descriptively with those of faculty and IT practitioners, but no statistical significance tests were done because the expert groups were small and the sample was purposive. The study did not measure actual task completion, time, errors, or queue length; this limitation is acknowledged rather than hidden.

Table VI Analyses Performed and Their Purpose

Data	Treatment	Purpose
Respondent profile	Frequency and percentage	Describe the sample and its subgroups
Item ratings	Weighted mean, standard deviation	Rate each statement and show dispersion
Dimension ratings	Mean of item means, 95% CI	Summarize the six evaluation dimensions
Internal consistency	Cronbach's alpha	Report the reliability of the instrument
Overall evaluation	Mean of the 25 items	Single figure for overall evaluation
Student subgroup	Descriptive comparison	Separate student perception from expert judgement

Table 3.5 summarizes the statistical treatments applied to the data and their specific purposes, ranging from descriptive profiling to reliability analysis.

RESULTS AND DISCUSSION

Respondent Profile

Table III summarizes the 72 respondents: 47 male (65.3%) and 25 female (34.7%); 56 students (77.8%), seven faculty members (9.7%), and nine IT practitioners (12.5%); and an age distribution concentrated between 18 and 23 (46 respondents, 63.9%), with five respondents (6.9%) below 18. The students came from the researchers' institution and from other higher-education institutions in Metro Manila and nearby provinces, so the sample describes potential users of a campus canteen system rather than the population of one campus.

Overall Evaluation

Across 25 items and 72 respondents (1,800 ratings), the overall mean was 3.76 (SD = 0.34, 95% CI [3.69, 3.84]). The mean of the six-dimension means was also 3.76, so the two ways of aggregating agree. Of the 1,800 ratings, 78.0% were 4 (Strongly Agree), 20.7% were 3 (Agree), and 1.3% were 2 or 1. The distribution is strongly skewed toward the top of the scale, and the six-dimension means occupy a range of only 0.08 points, from 3.71 to 3.79 (Table VII). The narrow spread is the most informative feature of the result. The evaluation discriminates weakly between dimensions: the difference between the highest and lowest dimension is smaller than several differences between items inside one dimension. The ranking in Table VII should therefore be read as relative standing within a uniformly positive response, not as a profile of strengths and weaknesses separated by meaningful gaps.

Table VII Dimension-Level Means, Dispersion, and Verbal Interpretation

Dimension	Mean (SD)	95% CI	Interpretation
Usability	3.78 (0.35)	3.70–3.86	Strongly Agree
Efficiency and convenience	3.74 (0.41)	3.65–3.83	Strongly Agree
Ordering process	3.79 (0.36)	3.71–3.88	Strongly Agree
Cashless payment	3.71 (0.46)	3.60–3.81	Strongly Agree
Usefulness and relevance	3.75 (0.39)	3.66–3.84	Strongly Agree
Satisfaction and acceptance	3.79 (0.44)	3.68–3.89	Strongly Agree
Overall (25 items)	3.76 (0.34)	3.69–3.84	Strongly Agree

Table 4.1 presents the dimension-level means, standard deviations, and 95% confidence intervals, showing uniformly positive evaluations across all six constructs.

Usability

Usability obtained 3.78 (SD = 0.35). The ten items ranged from 3.72 to 3.85. The highest was the statement that an order can be completed without confusion (3.85, SD = 0.36), and the lowest was the statement that the layout is organized and easy to follow (3.72, SD = 0.56). The layout item also had the largest dispersion in the dimension, which indicates divided rather than uniformly lukewarm responses. Three of the ten usability items sit at 3.81 or above (instructions and labels, confusion-free completion, and moving between sections), which is consistent with a prototype built around a small number of screens and a persistent navigation bar. The layout result is the more useful one for the next iteration: respondents could use the system but were less convinced by how the screens were arranged, which is a visual-hierarchy problem rather than a functional one.

Efficiency and Convenience

The efficiency and convenience dimension scored 3.74, with "handling busy hours" receiving the lowest score (3.67). However, this remains within the "Strongly Agree" range, reflecting user caution rather than dissatisfaction. This lower score highlights that the survey measured anticipated benefits rather than observed performance, and acknowledges that food preparation remains a bottleneck regardless of payment speed. Ultimately, this serves as a design signal for future iterations to focus on optimizing peak-hour operations.

Ordering Process

Ordering process obtained 3.79 (SD = 0.36), the highest dimension mean in the study. The steps for selecting and ordering food scored 3.81, the review of selected items before confirmation 3.85 (SD = 0.36), and the presentation of food items, prices, and order details 3.72. The review item and the confusion-free completion

item in the usability dimension are the two highest of the 25 (both 3.85), and both concern the same design feature: the opportunity to check an order before committing to it. Their agreement is better treated as one finding measured twice than as two independent strengths. The lower score for price and detail presentation (3.72, SD = 0.51) points to a specific gap: respondents could check the order, but the information on the summary screen was not always clear enough to check it against.

Cashless Payment

Cashless payment received the lowest rating (3.71), mainly because some respondents were unfamiliar with e-wallets or had limited internet data or wallet balance. They suggested adding payment options such as GCash, QR codes, cards, or paying at pick-up, along with clearer instructions for first-time users. The issue was not rejection of cashless payment, but that the system assumed users already knew how to use it and had reliable connectivity. This shows that onboarding and payment guidance—not the technology itself—are the main areas to improve.

Usefulness and Satisfaction

Usefulness and relevance obtained 3.75 (SD = 0.39), with usefulness for the respondent's canteen needs at 3.72, relevance of the features to students and canteen users at 3.75, and meeting expectations at 3.76. Satisfaction and acceptance obtained 3.79 (SD = 0.44), with satisfaction with the overall design at 3.79 (SD = 0.50) and willingness to use the system at 3.78 (SD = 0.45).

Willingness is the more consequential figure and the more fragile one. Stated willingness to use a prototype after reviewing it is not the same as continued use after deployment, and the longitudinal evidence on pre-ordering suggests that intention survives only if the system also solves the problems that appear after novelty fades, such as uncollected orders and unclear order status [10].

Student and Expert Ratings

Students (n = 56) gave an overall mean of 3.72 (SD = 0.36, 95% CI [3.62, 3.81]), faculty members (n = 7) 3.94, and IT practitioners (n = 9) 3.92. The 0.20-point gap between students and the two expert groups is larger than any gap between dimensions. It is widest on cashless payment, where students averaged 3.64 while both expert groups averaged at or above 3.89, and on efficiency and convenience (3.69 for students against 3.87 and 3.94).

Two readings are possible and the data cannot separate them. Experts may have judged the design against technical criteria and found it sound; alternatively, they may have been less sensitive to the practical frictions that students described. The second reading is the more consequential, because students are the intended users, and it supports treating the student subgroup as the primary evidence rather than the pooled mean. It also illustrates why expert review does not substitute for user evaluation.

Table VIII Item-Level Means and Standard Deviations

Statement	**M**	**SD**
Usability (α = .93)		
The proposed system is easy to understand and use	3.78	0.42
I can learn how to use the system without much assistance	3.79	0.41
The instructions and labels in the system are easy to understand	3.81	0.40
I can complete an order without experiencing confusion	3.85	0.36
The system is simple enough for students to use independently	3.75	0.55
I can easily move from one section of the system to another	3.81	0.40

The buttons, menus, and navigation options are easy to identify	3.79	0.41
The layout of the system is organized and easy to follow	3.72	0.56
The information on each screen is presented clearly	3.79	0.47
I can easily find the features I need when using the system	3.74	0.48
Efficiency and convenience (α = .86)		
The system provides a more convenient way to order food from the canteen	3.82	0.39
The system could reduce the time spent waiting in line to order food	3.71	0.52
The system could make ordering easier during busy canteen hours	3.67	0.61
The ordering process is faster compared with traditional manual ordering	3.74	0.56
The system could make canteen transactions more organized and efficient	3.76	0.46
Ordering process (α = .79)		
The steps for selecting and ordering food are clear and easy to follow	3.81	0.40
I can easily review my selected items before confirming my order	3.85	0.36
The food items, prices, and order details are clearly presented	3.72	0.51
Cashless payment (α = .80)		
The cashless payment process is easy to understand	3.71	0.52
I would feel comfortable using the available cashless payment option	3.71	0.49
Usefulness and relevance (α = .84)		
The proposed system would be useful for my usual canteen needs	3.72	0.45
The features of the system are relevant to students and canteen users	3.75	0.47
The system meets my expectations for a school canteen ordering system	3.76	0.43
Satisfaction and acceptance (α = .84)		
I am satisfied with the overall design and features of the proposed system	3.79	0.50
I would use this system if it were implemented in our school	3.78	0.45

Table 4.2 provides a detailed breakdown of the item-level means and standard deviations for all 25 statements, highlighting specific feature strengths and areas for improvement.

DISCUSSION

The results showed that respondents generally accepted the system, with most giving high ratings. The order-review feature received the highest scores, while cashless payment and handling busy hours received the lowest. Although the system is expected to save time, the study did not measure actual waiting time or queue length.

Therefore, the system is recommended for a pilot test during peak hours, with improvements focused on making payment easier and more reliable for first-time users.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The canteen ordering prototype was easy for its intended users to use. Of 72 respondents, it received a high overall rating of 3.76 out of 4.00, with all six evaluation areas rated as "Strongly Agree." Ordering was rated highest (3.79), while cashless payment was rated lowest (3.71). The weakest individual item was confidence in handling busy periods (3.67), though it still fell within the highest rating range. The main areas for improvement are therefore payment setup and performance during peak hours—not overall user satisfaction. Students gave slightly lower ratings (3.72) than faculty (3.94) and IT practitioners (3.92), especially regarding cashless payment. However, the study did not measure whether queues became shorter, so it cannot claim that the system is ready for full institution-wide adoption.

Limitations

The study has several limitations: it used a small convenience sample of 72 people, so its results cannot be generalized to all students or other canteens. All feedback was self-reported, with no actual measurements of waiting time, errors, queue length, or system performance. Most ratings were very high, which may hide differences in opinion, and the questionnaire's reliability was based only on internal consistency. The four-point scale also forced respondents to choose a side, leaving no neutral option. Finally, participants only reviewed the prototype rather than using it during real, busy canteen service, so problems such as payment delays during peak hours may not have appeared. Overall, the study reflects users' perceptions, not proven real-world performance.

Recommendations

Based on the findings, recommendations are proposed across three areas. For system design, developers should implement a first-time payment walkthrough, expand payment options (including GCash, QR, cards, and a pay-at-pick-up fallback), ensure connectivity tolerance with offline retry features, and add real-time order tracking and stock indicators. For operations, a peak-hour pilot should be conducted to measure actual waiting times, queue lengths, and unassisted order completion to validate the system's operational efficiency. For future research, studies should incorporate the System Usability Scale (SUS) for standardized benchmarking, collect live task-completion and timing data to compare perceived versus actual usability, and conduct longitudinal, multi-institutional evaluations to assess long-term adoption across diverse student populations.

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