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# *DEVELOPMENT OF AN E-CANTEEN SYSTEM WITH EXTREME PROGRAMMING TO OPTIMIZE EFFICIENCY, TRANSPARENCY, AND ACCOUNTABILITY IN CANTEEN MANAGEMENT AT THE FACULTY OF ENGINEERING, MATARAM UNIVERSITY*

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***Abstract***

*The e-Canteen system enhances efficiency and user experience in electronic-based canteen services. The study aimed to develop a platform streamlining transactions, inventory management, and interaction between customers and canteen service providers. Before implementation, critical issues identified included manual inventory management and slow ordering processes, which created inefficiencies. The system allows customers to order, pay, and track stock availability online, leading to a more efficient and convenient purchasing process. For canteen service providers, automated inventory management helps optimize stock control and reduces manual errors, promising a more streamlined and error-free operation. The E-Canteen system offers significant benefits to both customers and service providers. Customers enjoy a more efficient and convenient purchasing process, while service providers benefit from optimized stock control and reduced manual errors, fostering a more productive and error-free work environment. Additionally, BLU Unram can monitor canteen performance, enabling data-driven decisions to improve services and policies. The system was developed using the Extreme Programming (XP) method, which ensured a user-centered design and rapid adaptation to feedback. Findings from the study demonstrated a 30% improvement in operational efficiency, with user satisfaction significantly increased according to internal surveys. The E-Canteen system addresses the operational challenges of managing canteen services and integrates smoothly with modern technological advancements, providing a scalable and adaptive solution for future growth. This system effectively resolves issues in traditional canteen management, offering benefits to customers and service providers regarding efficiency, convenience, and service quality.*

**Keywords**: *digitally, E-Canteen, Extreme Programming, Information System, University of Mataram, XP.*

## 1. INTRODUCTION

Rapid technological advances have profoundly affected many aspects of life, influencing how people interact, work, and carry out daily activities [1]. In today's fast-paced social environment, the speed and accuracy of information dissemination are critical, especially in institutions such as universities, where timely access to information is crucial to operational success [2]. This is especially true for the academic environment at the University of Mataram, where technology is increasingly important in improving service quality, streamlining operations, and enhancing the overall experience for students and staff. Technological innovations support various activities in the education sector, from academic administration to managing campus facilities, including the canteen [3]. The canteen, often considered a place to relax, eat, and interact socially, is an integral part of the university environment [4].

The canteen in the Faculty of Engineering, University of Mataram is one of the facilities provided by the university to make it easier for the academic community to find food, gather, and interact. Based on the results of observations, the canteen still relies on conventional manual operational methods. Observations revealed several inefficiencies, such as cash-based transactions, poor stock management, and lack of real-time menu or pricing data availability. These challenges result in slow service, limited menu choices, and reduced-price transparency, negatively impacting customer satisfaction. Thus, innovative solutions are needed to maintain the canteen in the Faculty of Engineering environment.

The implementation of online canteens has been widely developed in various sectors. In the research on e-canteen design at the Jakarta State Polytechnic, it was also stated that e-canteens can be a solution to facilitate user transactions like restaurants in a minor form [5]. The development of the e-canteen

information system at Hasanudin University was also based on the desire to facilitate food purchase transactions, minimize errors in price calculations, provide better user service, and open transparency in university canteen management [6]. Furthermore, this e-canteen application allows digitizing ordering, payment, and restaurant order delivery services relatively quickly compared to conventional business flows. Thus, consumer satisfaction with campus canteen services increases, and tenant employee productivity rises [7].

In response to these issues, a technology-based solution is needed to modernize canteen operations and improve customer experience and management efficiency. This study proposes developing an electronic canteen information system to optimize the ordering and payment process, simplify stock management, and increase transparency in pricing and promotions. The proposed system will allow customers to order, make payments, and receive up-to-date information on menu items and stock levels through a web-based platform. The system offers an automated inventory management tool for canteen service providers that will reduce the likelihood of stockouts and improve overall operational efficiency. To ensure that the system effectively meets the needs of users and canteen operators, the Extreme Programming (XP) software development methodology will be used. XP is known for its user-centered approach, which emphasizes frequent collaboration between developers and users to refine and improve the system throughout development. Previous studies have shown that XP is particularly effective in projects that require high adaptability to user feedback and changing requirements [8]. This methodology ensures that the final system is aligned with the needs of the university canteen staff and its customers, driving an iterative improvement process that ensures optimal usability and functionality [9].

This study addresses both operational challenges in the canteen and a gap in the literature on digital canteen management systems, particularly in universities. While digital solutions are standard in other service sectors, their use in university canteens is under-explored. By developing and testing an e-canteen system at the Faculty of Engineering, University of Mataram, this research provides insights into how digital tools can enhance service quality, transparency, and customer satisfaction. The system offers a scalable model for other universities, improving operational efficiency, inventory control, and service quality through modern technology.

## 2. RESEARCH METHODS

This study used the Extreme Programming (XP) method to develop an e-canteen information system. Extreme Programming is a software engineering method in the agile software development category [10]. This method was chosen because it can increase the efficiency and flexibility of the development process while maintaining the quality of the resulting software [11].

### 2.1. Problem Formulations

The main problems in conventional canteen management at the Faculty of Engineering, University of Mataram, include slow cash transactions, ineffective stock management, limited menu choices, and lack of price transparency. This results in slow service, limited menus, and cleanliness problems. To overcome these problems, a technology-based solution is needed in the form of an e-canteen information system that can increase the efficiency, transparency, and accountability of canteen management.

### 2.2. *Extreme Programming Method*

Extreme Programming (XP) is a software development approach that emphasizes coding as the main activity at all stages or cycles of system development. XP is designed for small to medium teams, with team sizes ranging from three to a maximum of twenty project members. One of the characteristics of XP is pair programming, where two programmers work on one computer simultaneously [12].

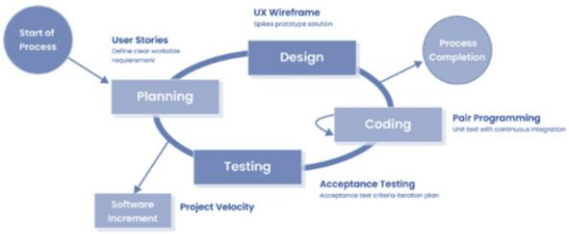


Figure 1. *Extreme Programming Flow*

Beck, Cunningham, and Jeffries developed the XP method based on four core values: simplicity, communication, feedback, and courage. The XP framework comprises four primary activity contexts: Planning, Design, Coding, and Testing [13]. The following is an explanation of each stage in this method:

#### 2.2.1. *Planning*

The planning stage focuses on getting an idea of the features and functionality of the software to be built. This process begins by collecting images or stories from clients that serve as a basic description of the software [14]. The following are the stages carried out in the planning process.

First, User stories are short and straightforward descriptions of the features users or clients desire. This study collected user stories from canteen managers, faculty staff, students as users, and decision-makers at the faculty level.

Once user stories are collected, features are prioritized based on their importance and impact on canteen operations. XP uses a planning game to determine which features to develop first. The most critical and low-risk features will be created in the early iterations. Some examples of priority features for an e-canteen system include an online ordering system, food stock management, a digital payment system, integration with popular payment methods (e-wallet, bank transfer), and a financial reporting system.

Based on the prioritized features, XP takes an iterative development approach, where each iteration includes the development, testing, and evaluation of the specified features. The team will set a schedule for each iteration (usually 1-2 weeks). Each iteration focuses on developing a specific feature that was prioritized during planning.

Next, XP does not emphasize heavy formal documentation but rather direct communication with the client. Any changes or adjustments to desired features will be immediately communicated and discussed during development.

Fast feedback loops are critical in XP, so the development team and the client need to communicate regularly to ensure all needs are met and adapted throughout the process.

#### 2.2.2. *Design*

At the design stage, a UML model is created from the proposed system design according to the needs of the research object. [15]. This stage also involves designing database tables and user interfaces based on client stories collected at the planning stage.

#### 2.2.3. *Coding*

The coding stage focuses on implementing the designed system model into the program code [16]. The main goal is to produce a software interface that matches the design that has been made. Implementation is done through pair programming to ensure high code quality.

#### 2.2.4. *Testing*

In the testing stage, the system is tested using black box testing and user acceptance test (UAT) methods to ensure the results are as expected [17]. This testing helps detect and fix bugs and ensures that the system meets user needs.

User Acceptance Testing (UAT) in creating an e-canteen website aims to ensure that the system developed meets end users' needs, such as students, staff, and canteen managers. UAT is carried out by involving users directly to test critical features, such as food ordering, stock management, and digital payments, through scenarios in accordance with the user stories collected. User feedback is collected through surveys or interviews to identify bugs, technical issues, and aspects that need to be improved, which are then analyzed for further improvement. UAT results contribute to validating system functions, increasing user satisfaction, and reducing the risk of errors in operations. With UAT, developers can ensure that the e-canteen website functions optimally and meets user expectations, improving the system's overall quality before full implementation.

## 3. RESULTS AND DISCUSSION

This section presents the results of each stage passed in developing the e-canteen system, from planning to testing. The results will be analyzed and discussed to identify how the developed system can meet user needs and overcome previously identified problems. This discussion will also assess the effectiveness of the features implemented in the system and provide recommendations for future improvements.

### 3.1. *Planning*

The planning stage begins with direct interviews and field observations in the canteens of Mataram University to identify various problems canteen users and managers face.

Table 1. Observation Results

| No | Category | Observation Result |
|---|---|---|
| 1 | Queues and Service Times | Long Queues occur at 10:00, 12:00, and 15:00 WITA, especially during lecture breaks and lunchtime. These queues cause customer congestion and long waiting times. |
| 2 | Food Preferences | The most purchased types of food are heavy meals such as fried chicken rice and noodles. However, the variety of food available is minimal, and students often ask for certain foods that are not available. |
| 3 | Cleanliness and Order | The canteen has sufficient trash facilities, but used plates pile up on tables, and food wrappers are often scattered under tables. This indicates a lack of adequate hygiene management. |
| 4 | Customer Interaction and Service | Due to the long queues, the canteen staff were less responsive to student complaints or questions. Students also felt less satisfied with the variety of food available and wanted price transparency to make it easier to calculate total spending. |
| 5 | Use of Technology | Even though the QRIS payment method is available, its use is still rare for several reasons, including a lack of information or inactive QRIS. |
| 6 | Discounts and Promotions | The Unram canteen has not implemented a promotion and discount system that can attract more customers. |

Based on this observation, the e-canteen system was designed to overcome these problems, especially in reducing queues, increasing food variety, and providing a more efficient payment system. The Extreme Programming method was used to iteratively integrate user feedback and ensure that the system

meets the identified needs using user stories in Table 2.

Table 2. User Stories

| No | User | User Stories |
|---|---|---|
| 1 | Canteen Manager | I want to see food stock in real-time to make it easier to manage inventory.<br>I want to know the income within a certain period. |
| 2 | Customers | I want to order food through the website easily and quickly, so I don't have to queue at the canteen.<br>I want to be able to pay cashlessly. |
| 3 | BLU | I want to get sales reports automatically to help maintain the canteen |

### 3.2. *Design*

After identifying the system requirements, the next stage is design. Various diagrams visualize the interactions and relationships between components in the e-canteen system at this stage.

**a. *Use Case* Diagram**

Use Case Diagrams to describe how users achieve goals and help developers understand system interactions. Each use case can involve multiple actors and have relationships such *as include, extend, and generalization* [12].

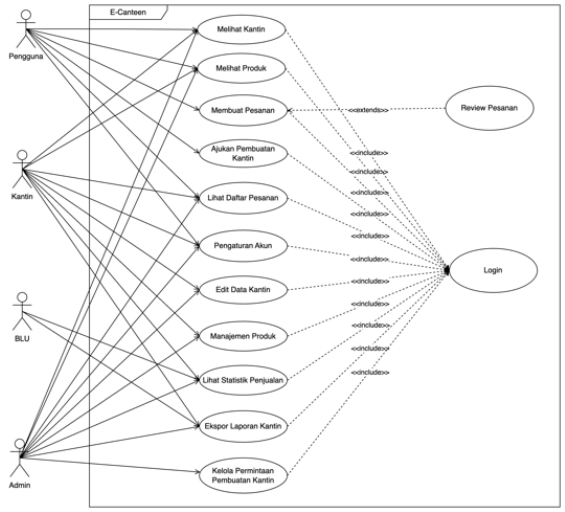


Figure 2. *Use Case* Diagram

This diagram shows the interaction between four main actors: user (Customer), Canteen, Admin, and BLU (Public Service Agency). Users can perform various activities, including viewing the list of canteens, taking orders, and giving reviews. The Canteen manages orders and products, while BLU and Admin have roles in managing and monitoring the canteen's performance.

**b. *Class* Diagram**

Class Diagrams show relationships between classes by including class names, attributes, and methods. This diagram clearly illustrates the system structure, including the data stored and the functions that can be performed by each class [13].

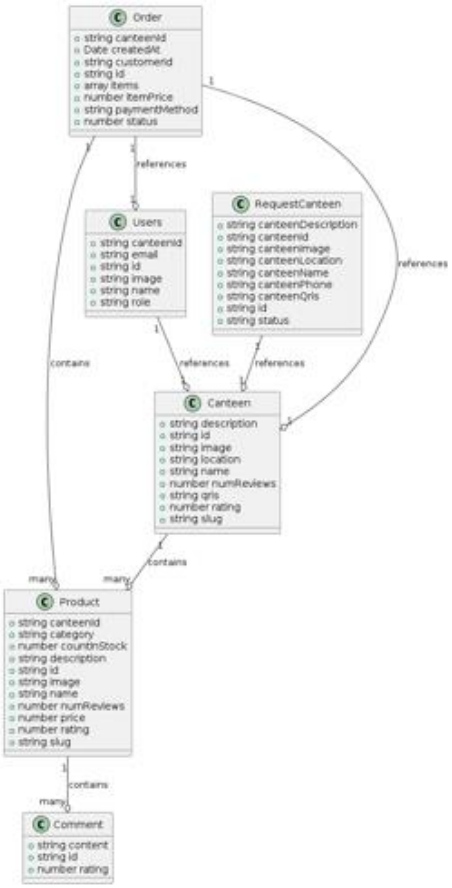


Figure 3. *Class* Diagram

The Class Diagram illustrates the structure and attributes of the system's main classes, such as 'Canteen,' 'Product,' 'Order,' 'Users,' and 'Request Canteen.' It also shows the relationships between classes and how they interact to support the system's operation.

**c. Entity Relationship Diagram (ERD)**

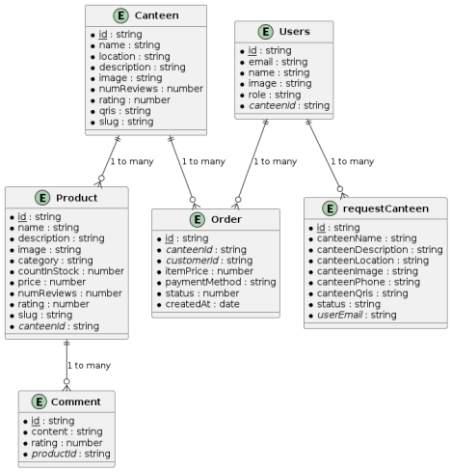


Figure 4. Entity Relationship Diagram

ERD is used to visualize the data structure and relationships between entities in the system [14]. This diagram includes main entities such as 'Canteen,' 'Product,' 'Comment,' 'Order,' 'RequestCanteen,' and 'Users.' The relationships between these entities

support various operations such as inventory management, transactions, and submission of new canteen creations.

### 3.3. *Coding*

The Coding stage is where the previously created system framework is implemented into an interface that can interact with the user. The following are the results of the Coding stage that has been completed.

**a. Users**

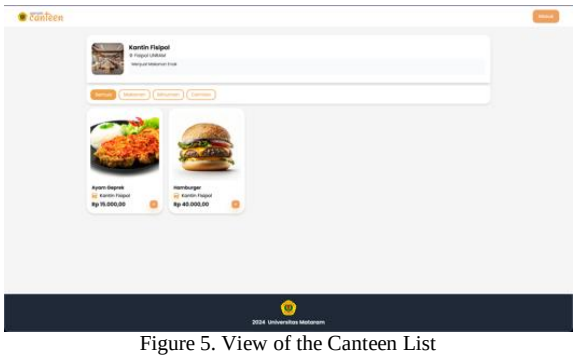

Figure 5. View of the Canteen List

Users can view the list of available canteens, including essential information such as Figures, names, and locations. This feature makes it easy for users to choose a canteen that suits their preferences.

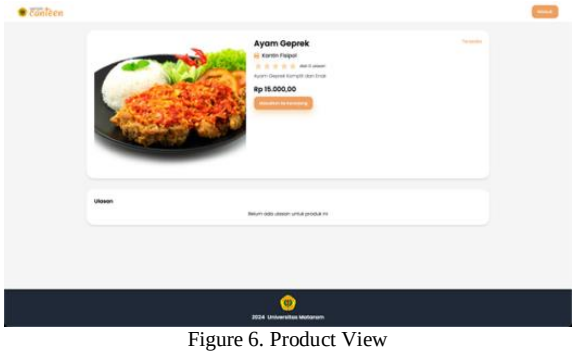


Figure 6. Product View

Users can view the products in each canteen, with detailed information such as name, price, and description. This helps users in knowing the food or drink options available.

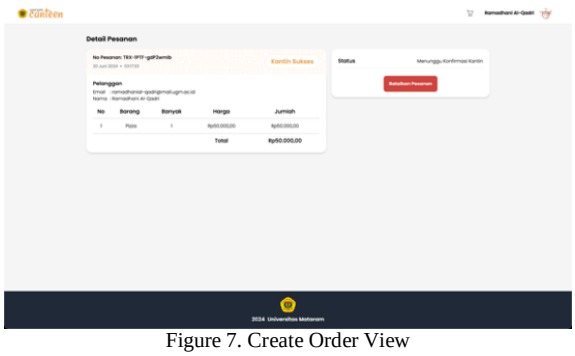


Figure 7. Create Order View

Users can order food or drinks and view the order details before proceeding to payment using the available QRIS method. This feature ensures the ordering and payment process runs efficiently and quickly.

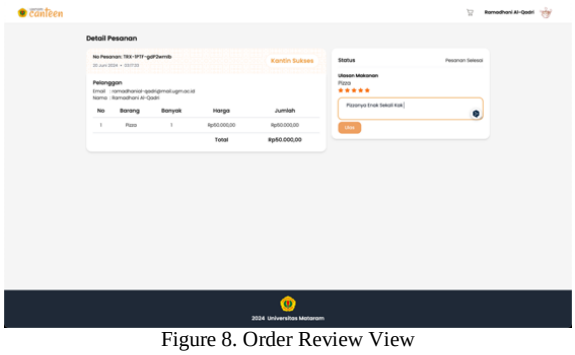


Figure 8. Order Review View

After the order is completed, users can provide reviews and ratings, helping the canteen improve the quality of service and products.

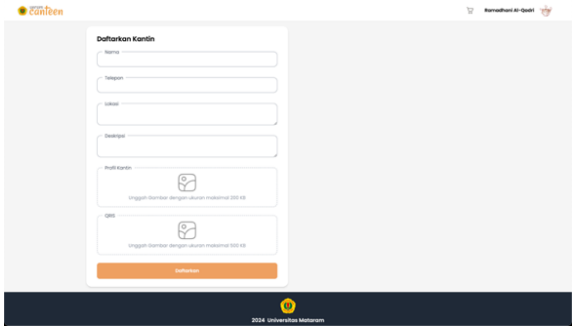


Figure 9. Canteen page creation view

Users can submit a request to create a new canteen by filling out the form provided. This provides an opportunity to expand the canteen business on the e-canteen platform.

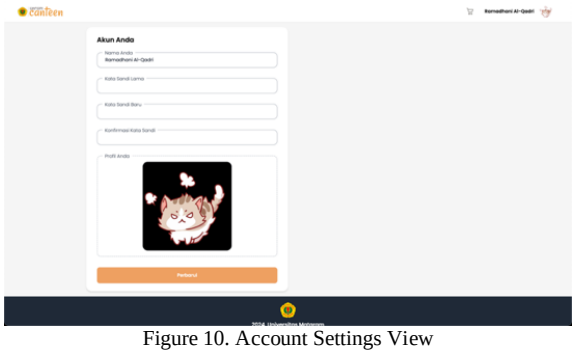


Figure 10. Account Settings View

Users can manage their account information by updating their name, password, and profile figure.

**b. Canteen Page**

The canteen can view a list of incoming orders from users, monitor the order status, and ensure orders are processed correctly.

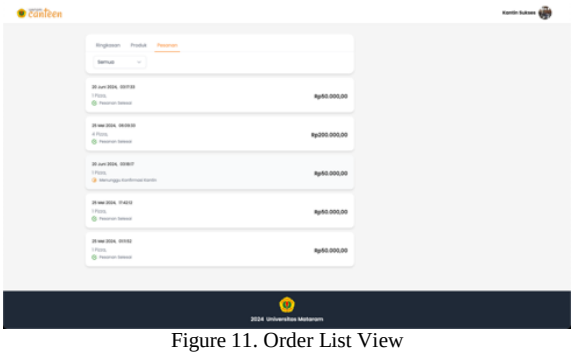

Figure 11. Order List View

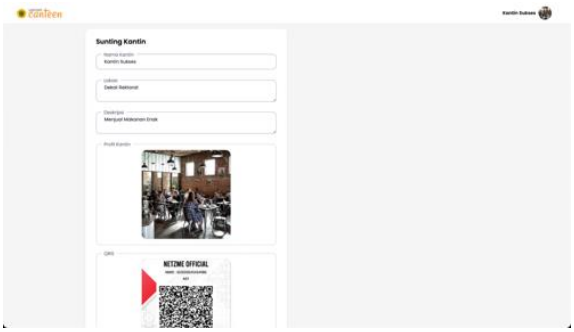

Figure 12. View Editing Canteen Data

Canteens can update information about their canteens, such as location, description, and payment code with QRIS.

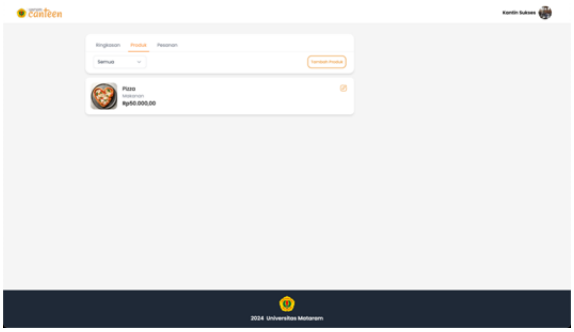

Figure 13. Product Management View

Canteens can add, edit, or delete their products, ensuring the menu is always current.

Figure 14. Sales Statistics View

The canteen can view their sales statistics, which helps understand sales performance and make better decisions.

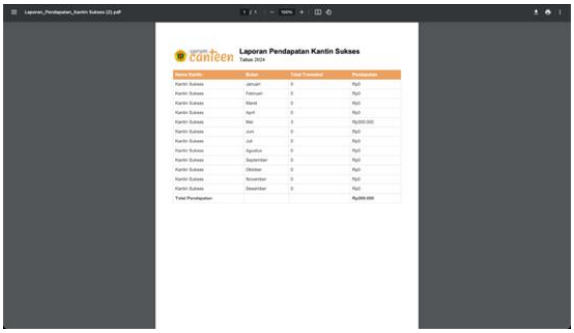

Figure 15. Canteen Report Export View

The canteen can export sales reports in PDF format for accounting and reporting purposes.

### c. Admin

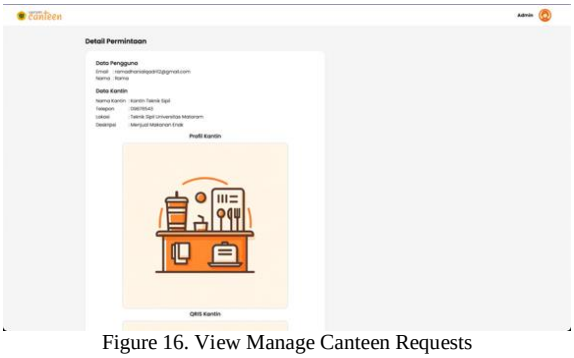

Figure 16. View Manage Canteen Requests

Admin can manage and review new canteen creation requests, ensuring quality standards and consistency within the application.

### d. Public Service Agency (BLU)

BLU can monitor the performance of all canteens through sales reports, assisting in performance evaluation and strategic decision-making.

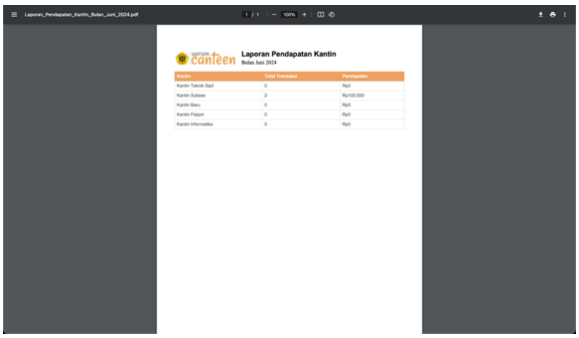

Figure 17. Canteen Sales Report View.

## 3.4. *Testing*

At this stage, system testing is carried out to ensure that the E-Canteen application meets user needs and can function well in a natural environment. Testing is conducted using a questionnaire involving users who have tried this application. Some parameters measured in the questionnaire include ease of use, clarity of information, convenience of the

interface display, and effectiveness in reducing waiting time and queues in the canteen.

To facilitate analysis, the results of this questionnaire are presented in tables and graphs showing the percentage of answers from respondents. This graph provides a figure of the level of user satisfaction with various aspects of the E-Canteen application, helps evaluate the success of system implementation, and determines areas that require further improvement. With the following information: Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D), and Strongly Disagree (SD).

Table 1. Questioner Results

| No | Question | SA | A | N | D | SD |
|---|---|---|---|---|---|---|
| 1 | How easy is it for you to find the food you want? | 3 | 2 | 2 | 1 | 0 |
| 2 | How straightforward is the menu and price information displayed on the application? | 1 | 3 | 2 | 1 | 1 |
| 3 | How do you rate the appearance of the application interface? | 2 | 2 | 3 | 1 | 0 |
| 4 | How easy is the process of ordering food through the app? | 2 | 2 | 3 | 0 | 1 |
| 5 | How satisfied are you with the online ordering feature on this app? | 4 | 3 | 0 | 1 | 0 |
| 6 | How effective is this app in reducing waiting time and queues in the canteen? | 4 | 2 | 1 | 0 | 1 |
| 7 | How do you rate the food rating and review feature? | 3 | 2 | 1 | 2 | 0 |
| 8 | How satisfied are you with the app's price transparency and promotional information features? | 3 | 3 | 1 | 1 | 0 |
| 9 | How satisfied are you overall with the E-Canteen app? | 4 | 3 | 1 | 0 | 0 |

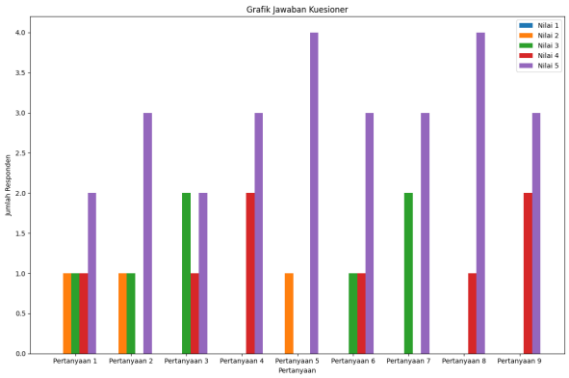


Figure 17. Questionnaire Result Graph

The following graph illustrates the percentage distribution of respondents' answers to each question. Most respondents positively assessed the ease of use, clarity of information, and effectiveness of the features provided in the E-Canteen application.

This shows that this application has improved the user experience of online food ordering at the canteen. With these results, it can be concluded that the E-Canteen system has great potential to be widely implemented, although some aspects still need improvement to improve overall user satisfaction.

## 4. DISCUSSION

The results of the development of the Faculty of Engineering, Mataram University e-canteen system were evaluated by comparing them with related research that had been conducted previously. This system was developed using the Extreme Programming (XP) method, which showed increased efficiency and transparency in canteen management compared to conventional systems.

The results of this study indicate that the e-canteen system has succeeded in overcoming the main problems identified in conventional canteen management, such as long queues, inefficient stock management, and lack of price transparency. This is the system's main objective, namely, to increase operational efficiency and user satisfaction.

A comparison with related studies shows this system has advantages over other approaches. For example, developing an Android-based canteen application using the waterfall method makes it more challenging to change flexibility and changes according to user needs [18]. With its emphasis on iteration and feedback, the XP method allows for more adaptive development, which is evident in the results of the e-canteen system, which is more responsive to user input and real-time needs.

From the observations and questionnaires, features such as online ordering, price transparency, and automatic stock management in the e-canteen system have significantly increased user satisfaction. These results align with the research, which showed that mobile web-based systems provide ease of access and management benefits. However, this system shows advantages in price transparency and reduced waiting time, which has received less attention in previous studies. [19].

On the other hand, although this system provides positive results, several areas still need improvement, such as rating and review features and the user interface. Although the e-canteen system has effectively addressed many problems, there is room for further improvement to better suit user needs and industry standards.

Overall, the University of Mataram's e-canteen system has met many of the needs identified in this study and shows great potential for implementation in other institutions with some adjustments. Comparison with related studies strengthens the conclusion that the XP method is a practical choice for developing dynamic and responsive systems. However, challenges in its implementation still need to be considered for future development.

## 5. CONCLUSION

In this study, the Faculty of Engineering, University of Mataram e-canteen system was

successfully developed using the Extreme Programming (XP) method, effectively addressing critical challenges in conventional canteen management such as limited menu options, price transparency, and inefficient stock management. The system notably improved service speed and user satisfaction, significantly reducing waiting times and queue lengths. These results underscore the advantages of the XP method, particularly its iterative nature and responsiveness to user feedback, which resulted in a system that adapts effectively to user needs.

While the system has shown positive outcomes, certain aspects, such as the rating and review features and user interface design, require further refinement. These areas of improvement highlight the potential for enhancing user engagement and overall system usability. Additionally, the study acknowledges some limitations, such as the potential challenges in scaling the system to larger institutions and ensuring widespread user adoption. Future research could explore hybrid development approaches or tailor the system for different institutional contexts, addressing specific operational needs that may arise in larger or more complex environments. The findings of this research contribute to the broader field of digital canteen management systems by demonstrating the practical benefits of using agile, user-centered development methods like XP. Moving forward, continuous improvements to the system and further studies on its scalability and integration with other institutional processes will be essential in maximizing its impact. The success of this study emphasizes the importance of adaptive software development in creating responsive and effective technological solutions that meet the evolving demands of users in real-time.

## ACKNOWLEDGEMENTS

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