SECP1513-02 TECHNOLOGY AND INFORMATION SYSTEM DESIGN THINKING PROJECT REPORT

PROJECT TITLE: CAFETERIA CROWD MANAGEMENT AND FOOD WASTE (UNIFLOW)

GROUP: DATAVENTURE

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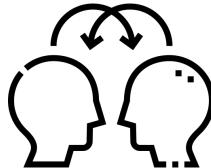
1. INTRODUCTION
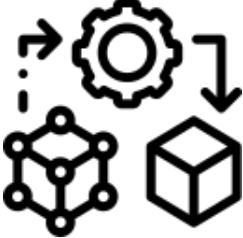
1.1 What is Design Thinking ?

Design thinking is an iterative process in which you seek to understand your users, challenge assumptions, redefine problems and create innovative solutions which you can develop a prototype and implement for testing.

The overall goal is to identify alternative strategies and solutions that are not instantly apparent with your initial level of understanding.

There are various models of design thinking, usually with three to seven steps. A common and widely used model includes these five key stages:

Step	Description
1. Empathize	The first stage of the design thinking process focuses on user-centric research to gain an empathic understanding of the problem. Empathy is crucial for human-centered design because it allows you to set aside personal assumptions and gain real insight into the users' actual needs.
2. Define	In the define stage, information gathered during the **Empathize** stage is organized. Observations are analyzed to define the core problems the team has identified up to this point. Defining the problem and problem statement must be done in a human-centered manner.
3. Ideate	During the third stage of the design thinking process, ideas are generated. Users and their needs have been understood in the **Empathize** stage, and observations have been analyzed in the **Define** stage to create a user-centric problem statement. With this solid background, the problem can be viewed from different perspectives, and innovative solutions to the problem statement can be ideated.

4. Prototype 	During the fourth stage, a scaled-down version of the product is designed to visualize the idea and find key solutions for it. The prototypes can be tested within the team. By the end of the **Prototype** stage, a better idea of the product's limitations and the problems it faces will be obtained.
5. Test 	During the final step, the complete product is rigorously tested using the best solutions identified in the **Prototype** stage. Although this is the last phase, the results are often utilized to redefine problems and investigate how users think, behave, and feel. Previous stages may be revisited for further iterations and refinements, ensuring that a deep understanding of the product and its users is ultimately obtained.

2.   DETAILED STEPS

Our group was tasked with creating a prototype with the theme of Cafeteria Crowd Management and Food Waste. Going through many discussion and brainstorming sessions, we manage to come out with our own ideas of innovation for our topic. We found out that students were having difficulty being seated at the cafeteria during peak hour and we also noticed that the trash bin was filled with leftovers. Therefore, we come up with multiple solutions to help both students to have a great time at the cafeteria and owners to help reduce food wastes.

Phases	Description & activities
Empathize Phase	● Google Form was created to gather the information and understand the issues faced by the students, which are the troubles the students have regarding crowds especially during peak hour and the amount of leftovers (if any) and the reason they cannot finish. ● An interview session between students and cafe owners was done to increase our understanding of the problem.
Define Phase	● The survey highlighted that during peak hours especially around 1 to 2 p.m. often causing severe shortage of tables and increasing amount of food waste. ● High demand for orders forces the kitchen staff to rush the meal preparation causing the food served undercooked or half-cooked.
Ideate Phase	● To improve the cafeteria experience, Smart Food Lockers and card readers were introduced to decrease the paying time. ● To help students find seats, we combined an AI Driven Camera system with table timers to track capacity and send notification into the app on their phone. ● The problem of food waste was tackled by engineering a smart bin that weighs food waste so it can be converted into organic fertilizer. ● An Application was built for the use of students and cafe staff.
Prototype Phase	● A visual model of our prototype was developed for the application by using Canva. ● The prototype explains each of the features while also showing the flow of how to use the app. ● The prototype allows us to identify any design improvements before moving on to the testing phase.
Test Phase	● The prototype will be given to the students and cafe staff for testing purposes to ensure the prototype runs smoothly and subsequently also receives feedback from the users. ● This phase allows us to gain insight of what to improve and add based on the users preferences.

3. DETAILED DESCRIPTION

3.1 Problem

It is common to see the cafeteria filled with students especially during peak hour, this will subsequently cause trouble to both students and the staff of the cafe. The primary concern with crowd management is that students often did not get the chance to be seated at the cafe and the staff was short handed causing the food to take longer than usual. Moreover, some foods were half cooked because the staff were rushing to prepare orders for the extremely huge number of students.

In addition, while it is not peak hour, the amount of food waste was significantly greater because the number of dishes for the mixed rice remained unsold and customers often left food uneaten if it was not to their expectation.

These issues will negatively impact cafeteria customers' experiences. Consequently, the staff especially, the owner will incur losses and face negative feedback from customers. The student might have to find other solutions other than going to the cafeteria such as ordering Grab which is always much more expensive.

3.2 Solution

UniFlow Application	**Student feature** ● The users can check the busy level of the cafeteria, seat availability and food review from other users. ● The users can pre-order meals through the app. ● A built-in discussion forum for students to share and discuss food quality. ● The app will notify the students when there is still excess food left at the cafeteria, encouraging them to buy it before the end of the day. **Cafeteria staffs and owner feature** ● The system will analyse the sales, comment and the amount of food waste, then the system will suggest the optimal food preparation amount. ● The owner can directly view the feedback from the students.

AI Driven Camera System	● Monitors the number of students currently at the cafe and the number of seats available. ● The data will be sent into the system and will notify students if there are any seats left at their designated location. ● Collect the historical data and use the data to estimate the peak hour of the cafe. ● Recommend the best time to dine-in using notification from the app.
Smart Food Locker	● Works just like a normal vending machine. ● The staff will periodically replenish with fresh food. ● The Locker uses a Card Reader for payment. ● Reduce the time the student has to spend buying the food while also helping reduce the number of customers the staff have to serve.
Bins with a scale around the cafeteria	● Weigh the food waste of each student. ● If the waste was around 0g, they will be awarded with a star and title. ● The title will be shown below the student name while using the discussion board on the application. ● The student whose stars exceed 200, will be awarded with a certificate. ● Stimulate the competitive spirit for the student to gain more stars. ● The food waste will be converted into organic fertilizer.

3.3   Team Working

Our team distributed the task evenly among the members, which includes creating a Google Form for our survey, Interviewing other students and cafeteria owners, designing a prototype of the app and brainstorming the solutions for the given problems. While doing so, we maintain communication among us to ensure the tasks are going smoothly. We sometimes do meetings and online meetings to help update each member of their given task progress. In the meantime, Farah subsequently will update the github backlog for our team.
For the task distribution itself, Edwin was responsible for brainstorming ideas and creating a prototype. As for Faruq, he was tasked with interviewing and writing report with the help of others too while also the one responsible for the presentation. Finally for Farah, she is responsible for data collection which is Google Form and she also was the one who edited the video for the project.

4. DESIGN THINKING ASSESSMENT POINT

Our assessment aimed to optimize the cafeteria management system to address overcrowding and minimize food waste.

Firstly ,during the emphasize stage, we distributed Google Form through Whatsapp and interviewed students and owners at the cafeteria. This allows us to understand the problem more deeply and emphasize the condition of the cafeteria.

Then, for the define phase, our team analyzed the feedback from the Google Form and the interview session. We found out that during peak hours, especially around 1 p.m. to 2 p.m., seating was difficult for the students and the staff was troubled with the amount of orders. We summarise these key problems and go on with our next stage.

During the ideate stage, we brainstormed multiple solutions for the identified problems, some of it involves innovating products and creating an application for the students and staff usage.

In the prototype phase, we used Canva as our medium to build our visual model of our prototype. This prototype demonstrates the flow for the users to use while also explaining each of the features.

Lastly, we provide the prototype to the students and cafe staff and owners for evaluation. This testing phase helps us ensure the system functionality and subsequently allow us to gather the final feedback for necessary improvement.

5. DESIGN THINKING EVIDENCE

5.1 Empathize Phase

For the empathy phase, we conducted interview sessions with two UTM students and one UTM staff who regularly go to the cafeteria in their daily lives. Below is the list of question asked during the interview:

UTM Cafeteria Staff
- How do cafeteria staff decide the amount of food needed to be prepared everyday ?
- What do you do if there is food excess after closing time ?

UTM Students
- Can you walk me through your typical lunch routine and what time you usually go and why that specific timing ?
- Do you usually finish everything on your plate ?

All Respondents
- If there is an application developed for students for offer, crowd management, or even for available seats do you think it is efficient ?

We also generated a survey using Google Forms to get more information from a wider range of people.

Figure 1.0

Figure 1.1

Figure 1.2

Figure 1.0 - 1.2: Interview with respondents

Figure 2.0

Faculty: *

○ Faculty of Civil Engineering

○ Faculty of Mechanical Engineering

○ Faculty of Electrical Engineering

○ Faculty of Chemical & Energy Engineering

○ Faculty of Computing

○ Faculty of Science

○ Faculty of Social Sciences & Humanities

○ Faculty of Built Environment & Surveying

○ Faculty of Management

○ Other: _____

Figure 2.1

Preferred cafeteria: *

☐ Arked Meranti

☐ Arked Angkasa

☐ Arked Perdana

☐ Arked Lestari

☐ Faculty's Cafeteria

☐ Rafi

☐ Other: _____

Figure 2.2

Cafeteria Experiences

1. What time do you usually visit the cafeteria? *

○ 9:00am - 11:00am

○ 11:00am - 12:00pm

○ 12:00pm - 2:00pm

○ After 2:00pm

2. How long do you typically wait in line? *

○ Less than 5 minutes

○ 5 - 10 minutes

○ 10 - 15 minutes

○ More than 15 minutes

Figure 2.3

3. How satisfied are you with the current waiting time? *

○ Very satisfied

○ Satisfied

○ Neutral

○ Dissatisfied

○ Very dissatisfied

4. What type of meals do you prefer the most? *

○ Heavy meals

○ Noodles/pasta

○ Sandwiches/burgers

○ Snacks/light meals

○ No preferences

Figure 2.4

5. How often do you finish all the food you buy from the cafeteria? *

○ Always

○ Rarely

○ Never

6. If you leave leftovers, what is the main reason? *

☐ Serving size is too big

☐ Food taste/quality

☐ Not hungry enough

☐ Bought too many items

Figure 2.5

7. Would you support smaller portion with cheaper price options to reduce food waste?   *

○ Yes

○ Maybe

○ No

8. What improvement would reduce cafeteria crowding the most? *

☐ Increase number of payment counter

☐ Pre-order or reservation system

☐ Improved queue management

☐ Doing a door-to-door delivery service

☐ Other: _____

Figure 2.6

9. How often do you experience difficulty finding a seat? *

○ Always

○ Often

○ Sometimes

○ Rarely

○ Never

10. Would you like the cafeteria to provide real-time updates on crowd levels and *
waiting time?

○ Yes

○ Maybe

○ No

Figure 2.7

Figure 2.0 - 2.7: List of questions in Google Forms

5.2   Define Phase

The define phase is where we accumulated all the information obtained from the Google Form. The results allow us to analyze and understand the problem faced by the students and staff better so we could come up with solutions that meet their needs.


Age:

22 - 24
11.4%

19 - 21
88.6%

Figure 3.0

Gender:

Male
42.9%

Female
57.1%

Figure 3.1

Faculty:

Faculty Education S…
2.9%
Not a UTM student
2.9%
Faculty of Science
11.4%
Faculty of Civil Engin…
2.9%
Faculty of Managem…
5.7%
Faculty of Built Envir…
5.7%
Faculty of Chemical…
8.6%

Faculty of Electrical…
11.4%

Faculty of Computing
48.6%

Figure 3.2

Preferred cafeteria:

no preference
2.9%
Arked Meranti, Arke…
2.9%
Arked Meranti, Arke…
2.9%
Arked Lestari
5.7%
Arked Angkasa, Fac…
2.9%
Arked Meranti, Facul…
5.7%
Arked Meranti
22.9%

Arked Angkasa
2.9%

Arked Meranti, Rafi
22.9%

Rafi
17.1%

Figure 3.3

1. What time do you usually visit the cafeteria?

11:00am - 12:00pm
25.7%

After 2:00pm
20.0%

9:00am - 11:00am
5.7%

12:00pm - 2:00pm
48.6%

Figure 3.4

14

2. How long do you typically wait in line?

More than 15 minutes
2.9%

10 - 15 minutes
20.0%

5 - 10 minutes
45.7%

Less than 5 minutes
31.4%
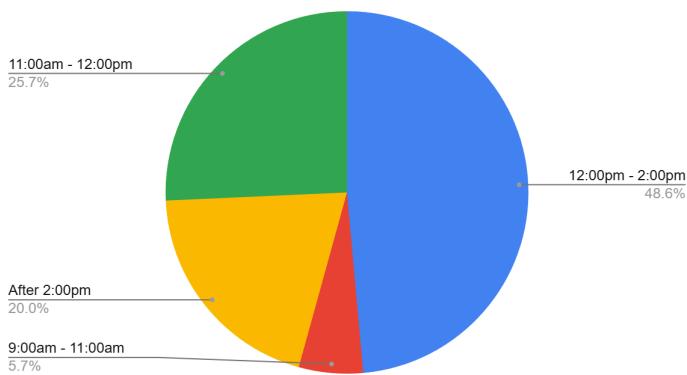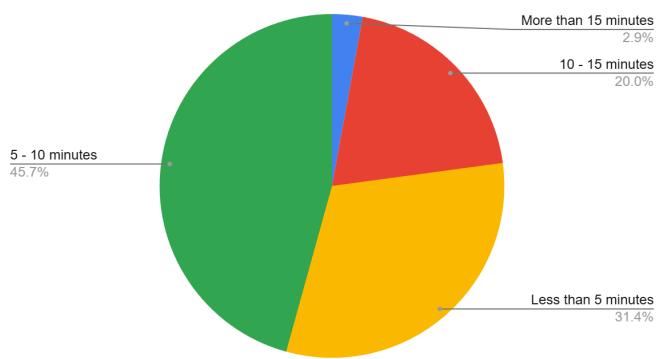
Figure 3.5

3. How satisfied are you with the current waiting time?

Dissatisfied
2.9%

Satisfied
25.7%

Very satisfied
17.1%

Neutral
54.3%
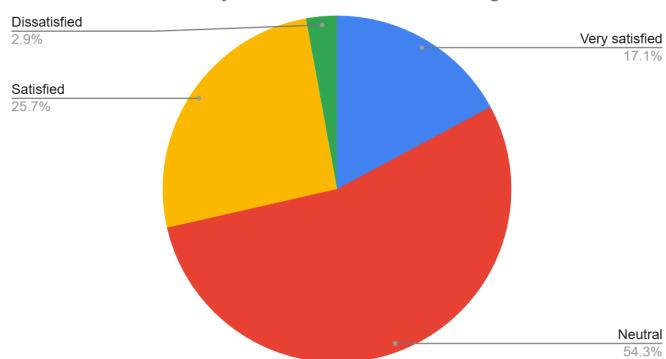
Figure 3.6

4. What type of meals do you prefer the most?

Snacks/light meals
2.9%

No preferences
11.4%

Noodles/pasta
14.3%

Heavy meals
71.4%
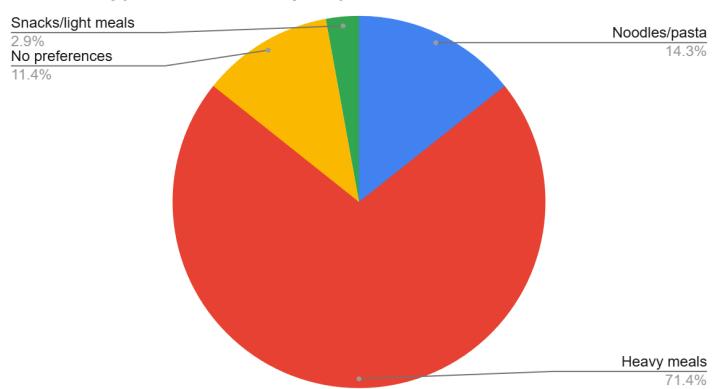
Figure 3.7

5. How often do you finish all the food you buy from the cafeteria?

Rarely
20.0%

Always
80.0%
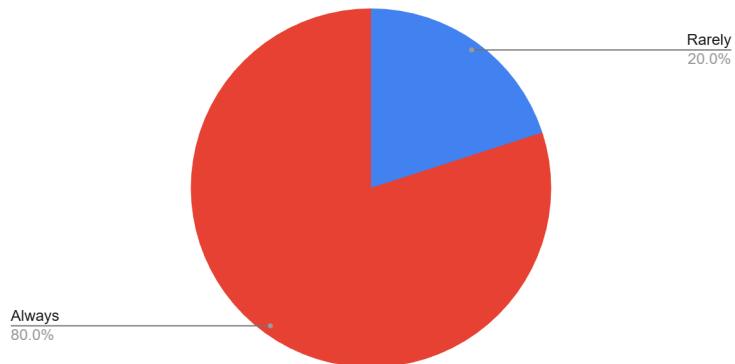
Figure 3.8

6. If you leave leftovers, what is the main reason?

Serving size is too bi…
8.6%

Food taste/quality, N…
5.7%

Food taste/quality, B…
5.7%

Serving size is too bi…
2.9%

Bought too many items
11.4%

Not hungry enough
5.7%

Serving size is too bi…
2.9%

Serving size is too bi…
8.6%

Food taste/quality
28.6%

Serving size is too big
20.0%
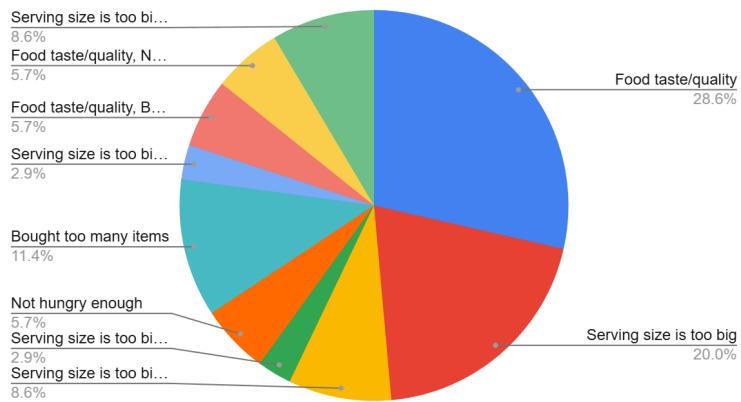
Figure 3.9

7. Would you support smaller portion with cheaper price options to reduce food waste?

No
5.7%

Maybe
37.1%

Yes
57.1%

Figure 3.10

16

8. What improvement would reduce cafeteria crowding the most?

Increase number of pa… 2.9%
Doing a door-to-door d… 2.9%
Pre-order or reservatio… 5.7%
Increase number of pa… 2.9%
Increase number of pa… 2.9%
Increase number of pa… 14.3%
Pre-order or reservatio… 11.4%
Improved queue mana… 11.4%
Improved queue mana… 11.4%
Pre-order or reservatio… 11.4%
Pre-order or reservatio… 8.6%
Increase number of pa… 11.4%
Increase number of pa… 2.9%
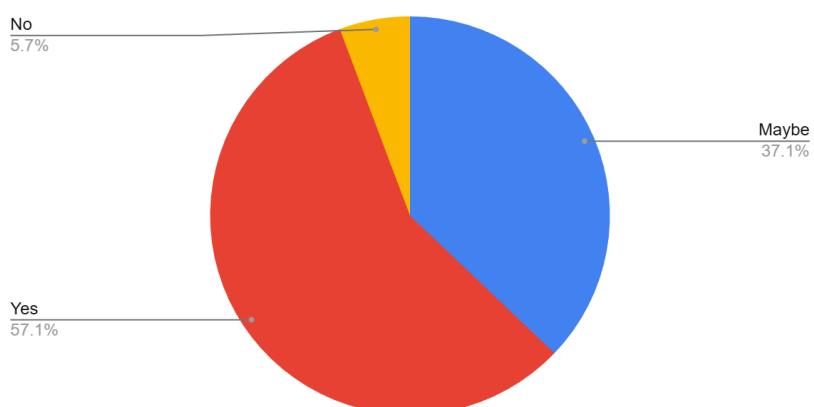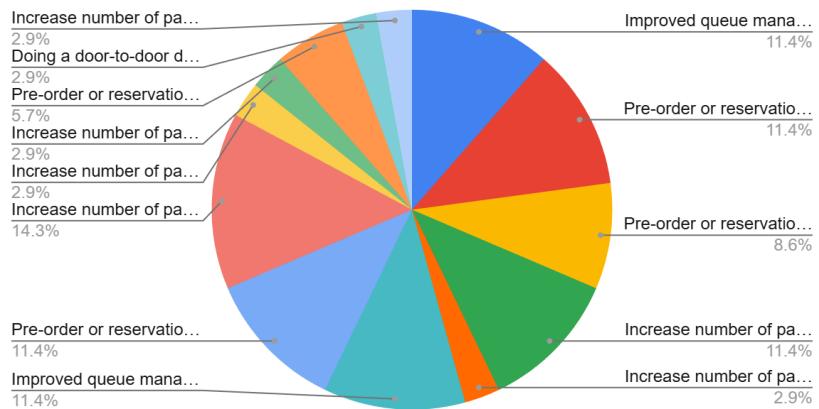
Figure 3.11

9. How often do you experience difficulty finding a seat?

Never 2.9%
Rarely 17.1%
Often 17.1%
Always 17.1%
Sometimes 45.7%
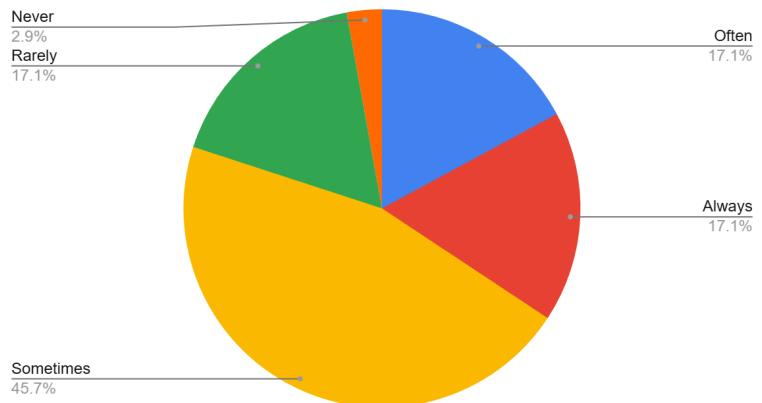
Figure 3.12

10. Would you like the cafeteria to provide real-time updates on crowd levels and waiting time?

Maybe 28.6%
Yes 71.4%
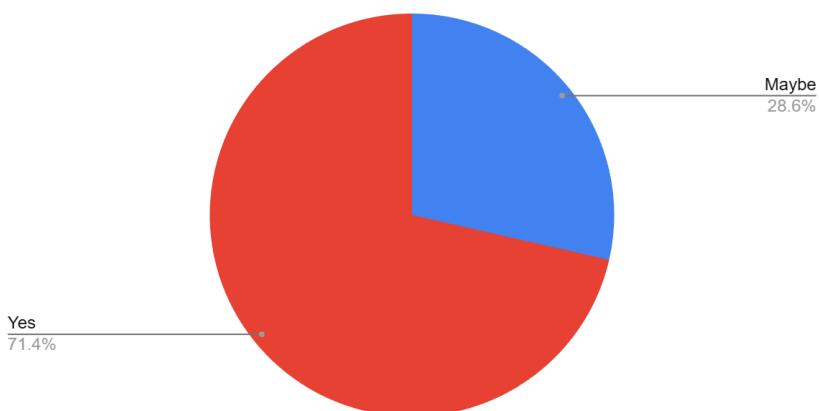
Figure 3.13

Figure 3.0 - 3.13: Results gathered from Google Form

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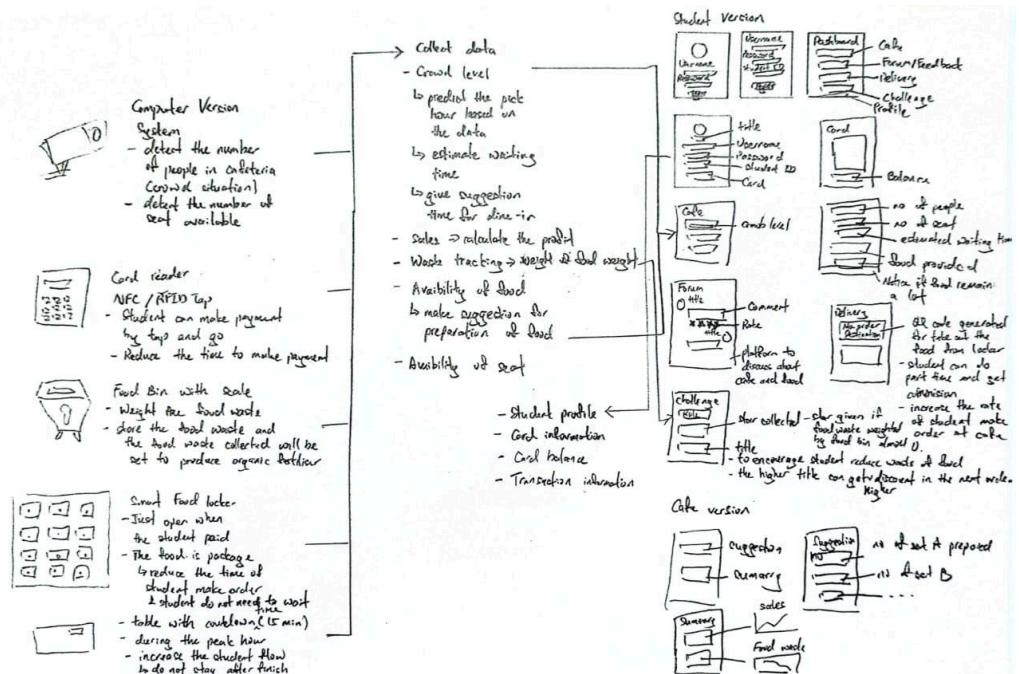
5.3   Ideate Phase

During the ideate phase, our team discussed and decided the most efficient solution for the students and staff based on the results above. After several brainstorming sessions, we came up with **UniFlow** to help in controlling the cafeteria crowd and food waste management.

Figure: Group meeting during ideate phase

5.4   Prototype Phase

During the prototype phase, we created a prototype of the tool mentioned during the ideate phase based on the define phase. Therefore, the prototype is as shown below:

5.5   Testing Phase

During this testing phase we had a user try it out and share their thoughts. They gave positive feedback and were very impressive on how it helps and made a great impression because it meets their expectations.

6. REFLECTIONS

6.1   FARAH ADILAH BINTI AZMAN (A25CS0217)

   a) What is your goal/dream with regard to your course/program?

   My goal with regard to my program is to become a data engineer in the banking field. I aim to build and manage large data systems that support financial operations and decision making. Through this program, I hope to gain strong technical skills in data processing, database and even system development to contribute in improving data-driven solutions in the banking industry.

   b) How does this design thinking impact on your goal/dream with regard to your program?

   Design thinking helps me in understanding real user needs before developing technical solutions. In the banking field, this approach is important to ensure that the data systems are secure, efficient, and user-oriented. It encourages me to think creatively when solving complex data problems. This mindset will help me in designing better systems that meet the industry requirements.

   c) What is the action/improvement/plan necessary for you to improve your potential in the industry?

   To improve my potential in the industry, I plan to strengthen my technical skills in data engineering tools and programming languages. I will also try to participate in internships that are related to data and finance. Additionally, I aim to improve my communication skills through teamworks and presentations. This continuous learning and staying updated with current industry trends will also help me to stay competitive.

6.2   WAN FARUQ JAZLI BIN WAN AHMAD JAFFRY (A25CS0372)

   a) What is your goal/dream with regard to your course/program?

   My dream while majoring in this program is to become a skilled data engineer so that I can work for my dream company, Petronas. I aim to manage databases and data warehouses with high precision, while also optimizing data architecture so that I can become a vital backbone for Petronas

   b) How does this design thinking impact on your goal/dream with regard to your program?

   By learning Design Thinking, my perspective shifted from just writing code to solving actual human problems. I learned to identify the root cause before developing solutions. To be a Data Engineer at Petronas, I must understand why data matters so that I can create solutions that aren't just functional, but are precise, logical, and tailored to the people using them

c) What is the action/improvement/plan necessary for you to improve your potential in the industry?

The action I should take to improve my marketability is to refine my technical skill in data engineering, especially database and data pipeline. I also needed to increase the number of programming languages while also refining them to the level of professional. The most important skill that I should strengthen is my soft skills, which is teamwork and my communication skills.

6.3 EDWIN WONG JING HAO (A25CS0215)

a) What is your goal/dream with regard to your course/program?

My goal is to acquire the knowledge and skills required to become a professional data engineer so that I can obtain a high-paying job in the future. Besides, I also aim to build a foundation in data processing, data modeling and data system design. This knowledge can also become the basic for my further explanation into more advanced and specialised fields, such as artificial intelligence, algorithm optimization and data-driven research.

b) How does this design thinking impact on your goal/dream with regard to your program?

Design thinking improved my problem solving skills. I learned the importance of understanding real user needs before proposing solutions. It highlights that effective outcomes are not defined solely by technical complexity but by relevance and usability. This project also gives me a chance to connect theoretical knowledge with practical application. As a result, I can become an industry-ready graduate who is able to develop a solution that addresses genuine problems.

c) What is the action/improvement/plan necessary for you to improve your potential in the industry?

To improve my potential in the industry, I need to continuously learn new knowledge and apply them through practical and project-based learning. I should also improve my soft skills like communication skills and team working. It is important for me to develop a portfolio on Linkedin, github and my personal website to ensure that I can get a high paying job easier in the future.

7. TASK DISTRIBUTION

No	Member	Task
1.	FARAH ADILAH BINTI AZMAN (A25CS0217)	● Report writing (Design Thinking Evidence) ● Data collection ● Video
2.	WAN FARUQ JAZLI BIN WAN AHMAD JAFFRY (A25CS0372)	● Report writing (Introduction, Detailed Steps, Design Thinking Assessment Point) ● Interview ● Presentation slides
3.	EDWIN WONG JING HAO (A25CS0215)	● Report writing (Detailed Description, Design Thinking Assessment Point) ● Prototype design ● Prototype sketch

8. REFERENCES

1. Aryati Bakri. (2024). *Introduction to design thinking*. Universiti Teknologi Malaysia, Faculty of Computing.
2. Dam, R. F. (2025, December 14). The 5 stages in the design thinking process. *The Interaction Design Foundation*. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process

9. Video Assignment For Design Thinking

https://youtu.be/8ATcdtBz3I4?si=rZJmZzhD4rJxMjEd