A Design Approach for Developing a Service in Promoting Healthy Eating Behavior

by

Shekoofeh Gheitani

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Approved by

Christopher Arnold, Chair, Associate Professor Industrial Design
Tin-Man Lau, Ulm & Alumni Professor Industrial Design
Carlton Lay, Assistant Professor Industrial Design

Abstract

The transition from home to school and living independently make significant changes in freshman college students lifestyle. Research states that freshman college students do not have healthy eating behavior and barely meet their essential balanced nutrients while using dining hall facilities. Studies also show that freshman college students gain weight more than any other age group. During this period, their eating behavior can be affected by many internal and external factors, including Social activity, food choices, eating habits, dining hall facilities, available foods, friends, exams, stress, housing, etc.

This thesis aims to analyze how these factors can affect students' eating behavior and which ones are the most important when making food choices at dining hall facilities during their freshman year.

This study also provides a set of tools and methods for designers to determine how they can implement a healthy eating lifestyle into the students' lives. The result of this research is a practical mobile-based application project that helps freshman students make better food choices every day and balance their diets while using dining hall facilities.

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Chapter 1: Introduction

The American College Health Association has shown that College entry from high school may be one of the most critical periods associated with weight gain because of increased likelyhood when youths experience significant lifestyle changes. The effects of college attendance on weight gain may differ according to their lifestyle. Students living in university-provided dormetories on campus may be more likely to eat in university dining facilities with a food court atmosphere and limited food variety. Many colleges charge students mandatory fees for meal plans, which is especially true for freshman students.

On-campus food services offer a variety of healthy and unhealthy food (Baum ||, 2017), and many college students may not receive essential nutrients based on their poor eating behavior and food availability in dining hall facilities.

It has been well documented that negative eating habits, an active social lifestyle, and lack of nutrition knowledge are significant weight gain factors. There are common barriers and enablers for healthy/unhealthy eating behavior among first-year students such as fast foods, high-calorie food, ready access to various processed food options, stress, lack of information, etc. These factors can be influential in students' eating behavior. Many universities have been trying to find a solution to this problem, but still, evidence has shown that first-year college students do not meet the dietary guidelines recommendations and gain weight during their first year of school.

Problem statement

The transition from high school to college marks a life turning point during which health behavior paths may be influenced (Childers, Haley, & Jahns, 2011). First-year college students are beginning to live independently and make many more decisions about foods, money, lifestyle, etc. on their own. The reviewed studies' researchers predominantly supported and demonstrated the need for nutritional requirements, college students' eating habits, dietary information, weight management, barriers, healthy behaviors, and education (Abraham, Noriega, & Shin, 2018). Brown, O'Connor, and Savaiano warned the transition to college cause significant changes in dietary options; students mostly tend to poor food choices, which could cause considerable health problems.

First year college students inevitably face a new environment for meal choices as they transition to their college life and may have paid meals in advance. The majority of undergraduate freshman students eat at college dining facilities with limited healthy food options, along with having access to unhealthy food without limitations.

Brown, Flint, and Fuqua (2014) stated that many college students tended to make poor food choices according to convenience, taste, time, and price rather than nutritional values. Many research-based articles support the need to investigate college students' eating behavior to educate them. There is a lack of knowledge of dietary values among freshman students. It is crucial to meet daily dietary requirements for one's body to function correctly and maintain optimal health.

This study specifically investigated on first-year students to get an in-depth understanding of the problem and explore the relationship between student eating behavior at the dining hall and the transition from high school to college.

Need for study

It has been well documented that a diet lacking vegetables, fruits, and dairy products and consuming a high level of sodium and sugar are considered to be significant issues among freshman college students (Anding, Suminski, & Boss, 2001; Brunt & Rhee, 2008). An earlier study found that only 6.4% of college students have knowledge of high-quality eating habits. The rest may face health issues, such as the increased risk for the development of cardiovascular, diabetes, hypertension, and/or obesity (Engeland, Bjorge, Tverdal, & Sogaard, 2004). There are many dining services in dining halls that students can take advantage of during their school years, especially their first year while they are going to make decisions on their own after the transition from home to school:

- Dining services websites
- Campus dining apps for smartphones
- Nutrition writers services
- Online nutrition analyses
- Resources for students with restricted diets
- Nutrition Articles
- Sustainable and locally-sourced foods

- Hormone-free dairy products
- Availability of extensive salad bars and smaller meal portions
- Educational programs
- Nutrition education stations

Although these options offer many benefits for college students, their advantages might not be benefiting students as the research found that the percentage of overweight students increased from 21% to 32% among first-year students (Anderson and Shapiro, 2003). Therefore, it is critical to determine how universities which help students stay healthy while using dining hall facilities during their first year of school. This study will conduct in-depth user research to determine how designers can explore the causes of unhealthy eating behaviors and help freshman college students to encourage a healthy eating lifestyle on campus while using dining hall facilities.

Objectives

The objectives of this study were to

- Study the definition of a healthy lifestyle
- Study and summarize internal and external effects on making meal plan decisions
- Study the relationship between gaining weight and entering school
- Show how technology and social factors can affect eating behavior among students
- Study healthy food services and products
- Support freshman students for better eating behaviors and minimize the risk of diseases
- Organize the best design methods and tools for designing a healthy eating lifestyle among college students for designers.

Assumptions

This study is directed based on the following assumptions:

- Designers using this approach have a basic understanding and knowledge of user research, design methodologies, and user experience design.
- Designers should consider dining hall limitations to cover the solution.
- It is assumed that the physical environment is dining halls in mid-size universities like Auburn University.
- It is assumed that users come from different cultures and nationalities.
- This study assumes that this approach can be used across various mid-size universities all around the United States.
- Different schools may have different available foods for freshman students. So this study assumes that schools can at least provide the minimum range of foods for different tastes.
- The type of foods will be different depending on different locations/states, So this study assumes that the source of foods may vary based on locations.

Scope and limitation

This approach aims to aid designers in the United States and to be applied in all mid-size universities like Auburn University. The process may works well in all types of dining halls, but there are several limits in this study as follows:

- This research focuses on developing an approach to encourage better healthy eating behavior based on the dining hall's physical environment. In this case, other approaches or systems helping students to eat healthy may not be mentioned in this study due to its focus, but it does not mean the other processes and outcomes do not work toward healthy eating lifestyles.
- Culture, nationality, family, and ways of understanding healthy food definitions in other countries have different impacts on making food decisions among students. Someone from a different culture may define healthy food entirely differently based on their background compared to the others. This thesis mainly focuses on freshman college students from different cultures within a single environment, dining hall facilities. This research may not bring attention to eating habits and definitions from every cultures.
- Helping every individual to consume a well-balanced, healthy diet across different body types is complicated, and this approach may not fully cover essential nutrients.
- Freshman students living on campus may sometimes choose to eat off-campus, which may not be monitored by this approach.
- The research conducted for this study is limited to design for freshman students focusing on dining hall facilities. It does not cover all aspects that will influence all students as they live off-campus and no longer participate in pre paid meal plans.
- In time, researchers will update the Dietary Guidelines for Americans, so this approach is limited by time. Further study needs to be done in the future guidelines change (USDA, 2010).

This thesis's approach is not limited to school dining facilities. It can be applied in other places and other organizations, but designers will be required to consider other practical aspects related to other sites.

Anticipated outcomes

This approach will provide a set of tools and methods for industrial designers and user experience designers. It will guide them to understand dietry needs and problems in eating behavior among freshman college students allowing designers to help students turn away from their bad eating behavior and maintain a healthy eating diet during their first year of school. The readers of this study will learn the current state of healthy/unhealthy eating behavior, barriers, enablers, and the use of each design tool and method efficiently and adequately to discover the causes of unhealthy eating among freshman students. A practical mobile-based application project will be developed according to the use of methods and tools.

Chapter Two: Literature Review

Definition and Importance of Healthy Food

Evidence has shown that many Americans consume too much sugar, processed foods, and trans fats. On the other hand, they do not eat enough of the daily recommended amounts of fruit, vegetables, nuts, and seeds (Blondin, Mueller & Choumenkovitch, 2016).

In today's society, healthy food options exist in a variety of tastes and can be found in any restaurants or kitchen. However, it is difficult for people to give a clear definition of healthy eating. It is often difficult to differentiate between healthy or unhealthy meals, based on types and ingredients.

Consuming foods with positive nutritional content can help people live a longer, better, and healthier life. The right food decisions make the energy the human body needs with the essential nutrients to prevent diseases and dysfunction. To the contrary, as the right food helps people's health, the wrong foods can cause diabetes, high blood pressure, heart disease, and other significant health concerns (Fung, 2019). While some diets are extremes, all that is usually necessary is a balance of protein, fat, carbohydrates, fiber, vitamins, and minerals in our diets to sustain a healthy body. There is no general necessity to eliminate some ingredients or specific food from diets, but as an alternative choice, picking the best and healthiest options of the available food is continually the high-quality choice. Godfreyson(2012), a registered dietitian, claimed healthy eating is an eating pattern that helps you with your best physical activity, mental health, and emotional health. This includes making diverse and balanced food choices that meet your needs for nutrients and energy. Within the same year, Godfreyson proposed that enjoying your food and having a good relationship with your food, and feeling satisfied after

eating instead of feeling shame and guilt, can play a vital role.

Dietary Guidelines for Americans 2010

Every five years, The Dietary Guidelines for Americans emphasizes three critical goals for people in America;

1. Physical activity to manage weight and balance calories
2. Consume more fruits, vegetables, whole grains, fat-free or low-fat dairy products, seafood, and water
3. Consume lower sodium, saturated and trans fats, sugars, and refined grains

It is evident that physical activity, consuming fewer calories during a day, and making the right food choices can help people stay healthy and avoid obesity while reducing the risk of chronic diseases (Office of Disease Prevention and Health Promotion, 2010). Thus, the Dietary Guidelines for Americans, 2010 try to encourage people to have a healthy lifestyle and stay physically active.

MyPlate

The United States government has replaced MyPyramid with MyPlate because they believed that MyPyramid did not offer the best and easiest way to explain to people about an ideal balanced meal plan, and its complexity confused people about nutrition facts (USDA, 2011). MyPlate is easy to understand even for children, and as USDA (United States Department of Agriculture) representative said, “MyPlate is a new symbol for proper nutrition”.

In 2011, the U.S. Department of Agriculture (USDA) and the Department of Health and Human Service at the Harvard School of the Public School created The Healthy Eating Plate. My Plate is based on the latest nutrition research, and it follows market trends and agriculture policy.

Diet quality plays a vital role in the Healthy Eating Plate. The right choices of drink and food matter for health and the Healthy Eating Plate help citizens live healthier. It means:

- Balanced diet (consuming a variety of foods and nutrition)
- Focus on less saturated fat, sodium, and added sugar for foods and beverages
- Start with baby steps to achieve a better healthy lifestyle
- Help each person to eat healthy

There are so many factors that might affect healthy eating habits like environment, preferences, personal food choices, access to food, culture, social aspects, and motivation. My Plate helps people learn tips to follow a healthy journey that meets everyone's needs ("Healthy Eating Plate - Harvard Health," n.d.).

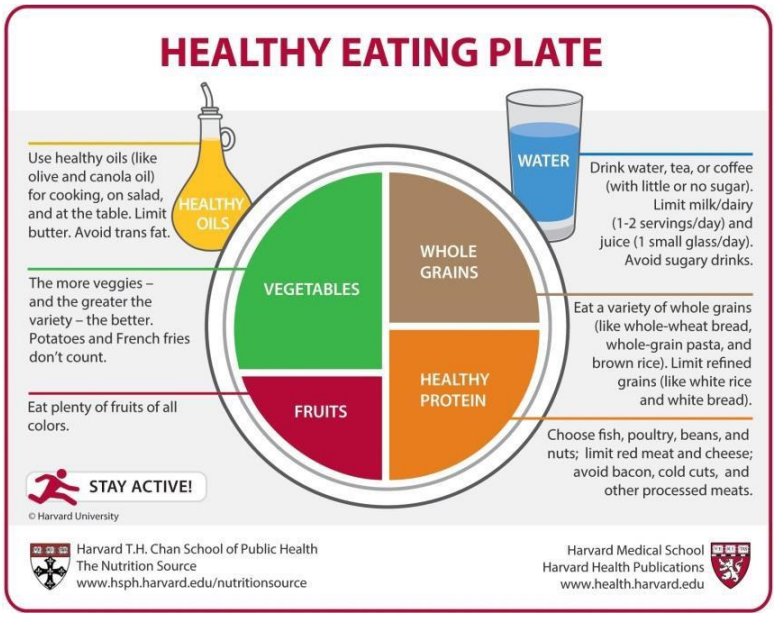

Figure 1 my plate (Levine, Abbatangelo-Gray, Mobley, McLaughlin, & Herzog, 2012)

- **Vegetables and fruits –half of the Plate:** full of color and variety in vegetables.

  Reminder: Potatoes are not among vegetables because of their negative effects on blood sugar.

- **Whole grains – ¼ of the Plate:** Wheat, barley, wheat berries, quinoa, oats, brown rice, and foods made with them.

- **Protein power – ¼ of the Plate:** It consists of seafood like fish, poultry, all beans, and all nuts.

- **Vegetable oils:** Consume healthy oil vegetables like peanut, olive, canola, corn, sunflower, walnut, soy, etc. Avoid the other oils which contain trans fats. It is essential to remember low fat does not mean healthy.

- D**rink:** Drink a good amount of water, coffee, or tea**.** Do not consume drinks with sugar.

- **Stay physically active:** The red line around the Plate is a reminder to say it is essential to stay active for your weight control.

In the MyPlate strategy, half of a meal should consist of fruits and vegetables. Grains and protein sources should complete the other half equally. The consumption of dairy products with each meal is highly recommended. Whole grains should be at least half of the grains. Protein resources and all dairy products need to be low-fat or fat-free. The vegetable portion includes frozen, fresh, and canned vegetables alongside vegetable juice. Every person needs to have a certain number of vegetables every day (USDA, 2011).

MyPyramid

MyPyramid has been launched by USDA to assist Americans to make healthy meal decisions for every day. MyPyramid's message emphasized to physical activity, variety, proportionality, moderation, gradual improvement, and finally, personalization (Lichtenstein, Rasmussen, Yu, Epstein, & Russell, 2008).

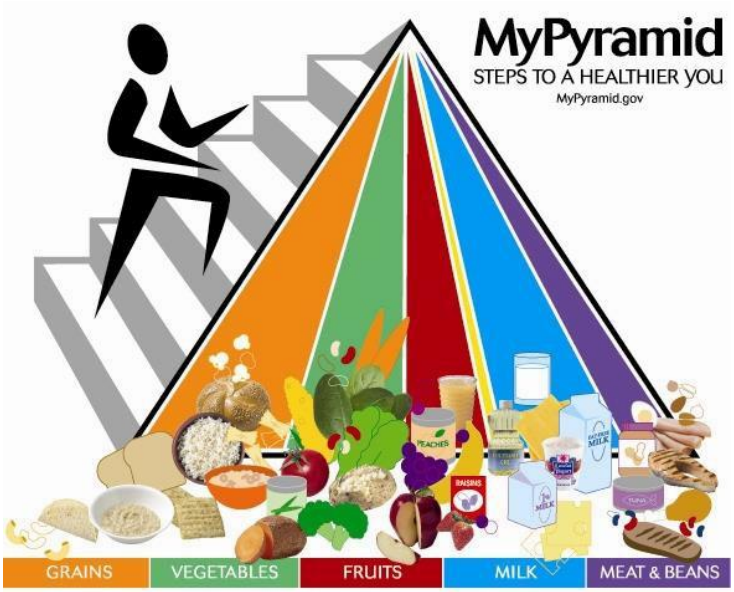

Figure 2 MyPyramid (Gao, Wilde, Lichtenstein, & Tucker, 2006)

Dietary guidelines have been frequently modified over the past years and have been updated with the latest research to ensure everything is included in the guidelines. As suggested by different diet guidelines, the most powerful guidelines should support the users for a balanced diet, personalization, physical activity, nutritional dietary knowledge. With these guidelines available as a free and widely available resources, the users can monitor their daily nutrition and whatever their body might need on their meal plans. On the contrary, most people claim that they do not follow the right path with the knowledge of healthy eating behavior and still have so

many unhealthy habits in their meal plans (Sogari, Velez-Argumedo, Gómez, & Mora, 2018).

Obesity statistics

In order to have a good understanding of obesity and overweight statistics, it's better to see what obesity exactly means. In general, doctors categorize people into one of four main groups as either underweight, healthy weight, overweight, or obese. These groups are determined by considering:

BMI (body mass index). The Centers for Disease Control and Prevention have shown that obesity is categorized into three different groups;

- Class 1: BMI of 30 to < 35
- Class 2: BMI of 35 to < 40
- Class 3: BMI of 40 or higher. Class 3 obesity is sometimes categorized as "extreme" or "severe" obesity.

The following table shows an example of how BMI works (CDC);

Adult Body Mass Index (BMI)

Height	Weight Range	BMI	Considered
5' 9"	124 lbs or less	Below 18.5	Underweight
	125 lbs to 168 lbs	18.5 to 24.9	Healthy weight
	169 lbs to 202 lbs	25.0 to 29.9	Overweight
	203 lbs or more	30 or higher	Obese
	271 lbs or more	40 or higher	Class 3 Obese

Table 1 Adult Body Mass Index (BMI) (Azad & Zamani, 2014)

The National Health and Nutrition Examination Survey (NHANES) found that BMI highly

correlates with the percentage of body fat. One particular study conducted by Berrington et al. (2010) assessed that a BMI between 20 to 24.9 kg/m2 has the lowest risk of disease and death among healthy people.

The CDC researchers also found that 33.8% of American adults are obese. By now so many organizations like the American Medical Association, the American Association of Clinical Endocrinologists, the American College of Endocrinology, the Endocrine Society, the Obesity Society, the American Society of Bariatric Physicians, and the National Institutes of Health (NIH) consider obesity a vital and critical problem among Americans.

Eating behavior in colleges

Ongoing research has been investigating weight gain in university students and its causes. As mentioned before, freshman college students typically gain around 15 pounds during the first year, and they may face obesity in the future (Gow, 2010). During some examination of college students, several reasons were found to be associated with each other contributing to weight gain:

- A decrease in physical activity within the first year
- Excessive consumption of junk food
- Snacking
- High baseline weight
- High level of stress
- Living in dormitories
- Social media and many other internal and external reasons.

In order to improve the quality of food related behaviors and prevent obesity it is crucial to develop adequate knowledge among the university-age population during their first year to help them make positive food choices. As indicated by others, college-aged students who enter college gain weight more than those who do not go to university (Modka, 1999)

In an earlier study by Li et al. (2011), measures for nutrient intakes were assessed using a 17- item multifactor screener that was designed to estimate the servings of fruits and vegetables, the percentage of energy from fat, and the amount of dietary fiber. Participants were asked to indicate:

1) how many times they prepared their own meals in the last week (0-21 times or more);

2) how many times they had fast food in the past week (0-21 times or more);

3) how many times they ate in the campus dining hall (0-21 times or more);

4) how often they read food labels before buying (1=never, 5=always);

5) how many times they had breakfast in the past week (0-7 times or more); and

6) other than breakfast, how many times they skipped a meal in the last week (0-14 times or more).

In the end, the research showed that female students had less fiber and low serving counts of fruits and vegetables in their daily meal plans. Females students seemed to be more interested healthy food choices when compared to males in terms of the other factors; meanwhile, female students still consumed less fiber and fewer fruits and vegetables (Li, 2011). In order to have better dietary behavior among students, it is critical to improve their knowledge about healthy eating lifestyles and give them enough information about their daily nutrient intake.

In another examination of college students, several reasons were defined as barriers healthy eating like: alcohol, access to unhealthful foods, food diversity, sleep, breakfast, social aspects, nutrition knowledge, stress levels, depression, role modeling, absence of nutritionists, lack of physical activity, etc. (Gow, 2010).

Definition of the freshman 15”

It is well documented that obesity rates in the United States have dramatically increased over the past 30 years. The most recent epidemiologic data indicate that 33.8% of adults are now considered obese, and 68% are either overweight or obese (Flegal, Carroll, Ogden, & Curtin, 2010). Incidence rates reveal that the point of the most significant increase in overweight and obesity occurs between the ages of 18 and 29 (Gordon-Larsen, Adair, Nelson, & Popkin 2004). In particular, college students appear to be even more prone to weight gain than those who do not attend college (Mokdad et al., 1999).

The majority of studies about the Freshman 15 have been conducted in the United States. It cannot be definitely stated that it occurs in other cultures. For example, a study from the Netherlands found that freshman girls, on average, gained 0.8 lb during a year (Nederkoorn, Houben, Hofmann, Roefs, & Jansen, 2010). According to the Belgium study, students gained weight around 2.2 lb kg during their first semester at their college (Deliens, Clarys, Van Hecke, De Bourdeaudhuij, & Deforche, 2013). A researcher from the United Kingdom reported that students gain almost 3.3 lb within the first year, but data was self-reported (Serlachius, Hamer, & Wardle, 2007). As a result, findings regarding weight gain among first-year students in Europe and the U.S. are different, thus this study will focus on U.S. freshman college students.

During the first year at college in the U.S. evidence has shown that students gain roughly 15 pounds during the first year. In general, college students experience weight gain significant more than the average gain of their non-college peers.

The rate of weight gain among freshman college students is 5.5 times greater than the average number. The weight changes among university college students are caused by a variety of factors such as:

- Stress
- Time
- Management
- GPA pressure
- extracurricular activities
- Financial problems
- Transportation issues
- New living environments

Other factors include having healthy/unhealthy eating habits acquired prior to approval, living in a dorm, which can be disorienting, and making independent decisions about their own lifestyle (Melikian, 2017). The American College Health Association has shown that the transition from high school to college is one of the most critical factors in weight gain among students as they experience a change in lifestyle. First year, college students may experience a significant decrease in physical activity and exercise, which could be due to an increase in the largely sedentary activity of studying. Second, many college students have poor eating habits.

The effects of college attendance on weight may differ according to living arrangements. Students living on-campus university-provided housing may be more likely to eat in university dining halls with a food court atmosphere and limited food variety. On-campus food offerings may be more likely to include high-fat or fried foods (Baum, 2017). Therefore, for many college students, the transition from home to living on their own increases the risk of gaining weight based on these factors.

Weight Changes Factors in Freshmen College Students

An earlier study conducted by Edmond and colleagues (2004) categorized students in three levels (Edmond, 2004);

- The summer before going to college
- First semester
- The end of the spring semester

They considered factors such as: body weight as the main factor, as well as height, body type, nutrition intake, and physical activity.

This research's finding revealed that female students' body weight increase considerably, around 5.2 lb all through the first six months enrolled in school. Also, there were other increases (Edmond, 2004):

- BMI: 22.3 kg/m2 to 23.1 kg/m2
- waist circumference: 76.9 to 79.4 cm
- No change in nutrition intake

- A decrease in physical activity
- A decrease in television use
- An increase in computer user

In general, both men and women have different healthy/unhealthy habits that could affect changes in weight and eating behavior like physical and psychological factors. Students try to find ways to eat healthily as they are continuously exposed to unhealthy behavior; alcohol, convenience, money, time, lack of healthy food in dining hall facilities, the transition from home to school, dorm living, cooking. There are many barriers and enablers for students to stay healthy on campus, but regardless of all the facilities, they still gain weight and tend to eat unhealthy food during their first year. Let's see how these factors can affect their eating behavior during their first school year.

Physical Activity

Physical activity plays an important role when trying to stay healthy. It has been well documented that physical activity (P.A.) also reduces the likelihood of being overweight and when it's mixed with healthy food choices, may lead to losing weight (Office of Disease Prevention and Health Promotion, 2010) Studies have shown that lack of P.A. paired with a caloric diet after entering college could be considered a primary risk factor for weight among college students. According to the current data from Youth Risk Behavior Surveillance, the percentage of college students who meet standard levels of physical activity is 40%, whereas 55% of high school seniors meet P.A.'s recommended P.A. guidelines (Kaan, Warren, and WHarris, 1996). Changes in lifestyle and the transition from home to school play important roles

in keeping them from maintaining their past daily routines and habits.

Guidelines published by the USDHHS for recommended levels of physical activity. Seeks to helps people stay physically active reducing the risk of chronic diseases. Besides these benefits, P.A. has other benefits, such as reducing the chance of cardiovascular diseases, type 2 diabetes, metabolic syndrome, and certain cancers. P.A. also helps to strengthen bones and muscles, improve mental health and mood, and increase longevity (Centers for Disease Control and Prevention, 2011). Considering physical activity, such as walking and running, two hours and thirty minutes of activity a week could bring the most health benefits (CDCP, 2011).

Sleep

Poor sleep habits may lead to obesity and laziness among people, especially students. Ideally, researchers say, college students, especially freshman students, need at least seven hours of sleep per night. An earlier study by the University of Colorado found that sleeping five hours a night could cause gaining weight among college student around two pounds, which is considerable. When students don't sleep enough, their brain cannot function at its best and students struggle to make smart choices; related to this, sleep-deprived students eat more and are most interested in fat, junk, and sugar consumption. People who do not sleep well are more interested in overeating the next day (Breus, 2018).

Knowledge

According to the Eun-Jeong examination of college students, there was a significant increase in the consumption of vegetables and fruits after attending a general nutrition class (Eun-Jeong and Caine-Bish, 2009, p.106). Studies have shown that nutrition education among college

students can play an important role in their daily food plans As indicated by others, nutritional knowledge may prevent bad eating habits among college students. Research result from Iowa State University showed that female students who participated in nutrition classes were more likely to control their body weight gain (Matvienco, Louis, & Shafer, 2001).

Madrid University also conducted research on college students, showing that students who had nutritional knowledge attemp to eat less sugary foods and monitor their portion size during every meal (Navia, Requejo, Mena, & Sobaler, 2003). They also found that people are more eager to learn about nutrition nowadays, but that nutrition knowledge has not grown simultaneously. A survey conducted by Britta Thielemann (2012) examined the relationship between eating behavior and college students' weight. In this study, the demographics highlighted included: gender, class standing, age, number of meals consumed per day, where the participants learned the most about nutrition, and the number of nutrition courses taken in college, in addition to height and height and weight.

A BMI calculator was used to calculate each participant's weight. Each college student's resulting BMI was compared to the data recorded before and after they had taken the nutrition course. Table 7 and 8 show that students who have not taken nutrition class have a significantly

Table 7. *t*-test of the Impact of Nutritional Knowledge on Weight

Nutritional Knowledge	N	Mean	Std. Deviation	t	df	Sig. (2-tailed)
No nutrition courses	88	174.41	39.58	6.25	565	.000
One or more nutrition course(s)	479	148.26	35.40			

Table 2 t-test of the impact of nutritional knowledge on weight (Britta, 2012)

higher BMI and weight (P<0.001) than students who have taken at least one nutrition class (Britta, 2012).

Table 8. *t*-test of the Impact of Nutritional Knowledge on BMI

Nutritional Knowledge	N	Mean	Std. Deviation	t	df	Sig. (2-tailed)
No nutrition courses	88	25.17	4.39	3.64	566	.000
One or more nutrition course(s)	480	23.22	4.65			

Table 3 t-test of the impact of nutritional knowledge on BMI (Britta, 2012)

It has been well documented that a regular daily meal plan for a college student contains a managed range of sugar, fat, and sodium (Anding et al., 2001; Brunt & Rhee, 2008; Davy et al., 2006; Hendricks et al., 2004; Silliman et al., 2004; Huang et al., 2003). Table 2 shows a strong connection between nutritional knowledge and eating behavior as well as their impact on college students' weight and BMI (Britta, 2012, p.25). The result shows that students with nutritional knowledge consumed a lower amounts of meat, sugar, and fast food daily, resulting in lower body weight than those who did not have such knowledge (Britta, 2012, p.25).

Living on campus or off campus

In 1996, data was collected in order to determine the amount of nutrition intake and P.A. habits among college students living on or off-campus (Brevard & Ricketts, 1996). They gathered information via a two-page questionnaire answered by the students. That survey requested personal information such as residence, age, gender, weight status, cigarette smoking,

oral contraceptive use, exercise mode, intensity, and frequency. Among 140 participants, 84 were female lived on- campus, 39 lived off campus), and 20 of the participants were males (4 of the men lived on- campus, and 16 lived off campus). There was a significant difference in nutrition intake among off- campus and on-campus students. A significantly higher percentage of energy from protein was seen in students who lived off-campus, particularly men who lived off-campus (Brevard, & Ricketts, 1996).

Barriers and Enablers for Healthy Eating Behavior on Campus

Many studies have highlighted the most common barriers and enablers to healthy and unhealthy eating. Behaviors are strongly related to time constraint, the high price of food items and their availability, lack of motivation for better food choices, a lack of knowledge (Menozzi, Sogari, & Mora, 2015). Nutritionists and related programs play important roles in making students aware of the barriers and enablers during their transition from adolescence to adulthood in schools. So consulting for college students when developing healthy eating behavior across the campus is vitally important.

Research result from Iowa State University showed that female students who participate in nutrition classes better control their body weight gain (Matvienco, Louis, and Shafer, 2001). An earlier survey was conducted among Cornell University students (n = 35) in six semi- structured focus groups in 2018. This study aimed to focus on barriers and enablers among students for having healthy eating lifestyles on campus during the school period. All the participants were asked to list "five healthy habits" and "five unhealthy habits." The results show that most of the students considered themselves to followers of healthy eating behavior and believed that they already maintained a healthy diet. The participants' characteristics are summarized in the table

below. Individuals were from different backgrounds and different ages and university years.

Table 1. Short version of the Focus Group questions guide.

Question Type	Questions
Opening and warm-up questions	Presentation of the research topic and participants (demographic characteristics and some general eating habits like "what do you have for breakfast?)
Introduction/Projective techniques	Could you list five habits related to healthy and unhealthy eating? Could you mention the first types of food/food products you consider healthy?
Transition questions (to move into and between key questions)	How do you think the concept of healthy eating has changed? Were you involved in cooking preparations in the past? What changes happened in your cooking habits since you started college?
Main key questions	What different eating behaviors do you have between eating out and at home? What is for you the meanings of the word "healthy" and "unhealthy"? What is your eating behavior to stay healthy? What are the consequences of having a healthy eating behavior? How may have the community (e.g., colleges) impacted on your healthy and unhealthy habits? How can a parent/guardian positively/negatively influence on children's eating behavior?
Projective technique (i.e., showing images of overweight/underweight adults/children)	What comes into your mind (e.g., thoughts) when you see these images on obesity, overweightness, and a healthy body weight?
Ending	Are there any other opinions related to the topic? Is there anything else you would like to share?

Table 4 Short version of the focus group questions guide (Navia, Requejo, Mena, and Sobaler, 2003)

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Madrid University also conducted research on college students, which shows that students who had nutritional knowledge try to eat less sugary foods and mostly monitor their portion during every meal. (Navia, Requejo, Mena, and Sobaler, 2003).

Table 2. Characteristics of focus group participants (n = 35).

Group Characteristics	Responses	%	Mean ± SD
Race/ethnicity	White/Caucasian	80	
	Asian (excluding South Asian)	11	
	African American	6	
	South Asian	3	
Gender (female)		66	
Age (years)			20.4 ± 1.5
Body Mass Index (BMI)			23.2 ± 4.5
Field of study	Business	42.9	
	Scientific	34.3	
	Humanistic	14.3	
	Info not provided	8.5	
Students with an extra job	Job	42.9	
	No job	40	
	Info not provided	17.1	
Physical activity			
	No exercise	15.2	
	Exercise 1 time per week	21.2	
	Exercise 3 times per week	42.4	
	Exercise 5 times per week	21.2	
Self-assessment weight status			
	Underweight	9.1	
	Normal weight	66.7	
	Overweight	21.2	
Population Area (size of the city)			
	<5000 inhabitants	15.1	
	Between 5000 and 50,000 inhabitants	27.3	
	>50,000 inhabitants	57.6	

Table 5 Characteristics of focus group participants Table 1 Characteristics of focus group participants (Navia, Requejo, Mena, and Sobaler, 2003)

There is another survey about how campus dining halls influence students' behaviors.

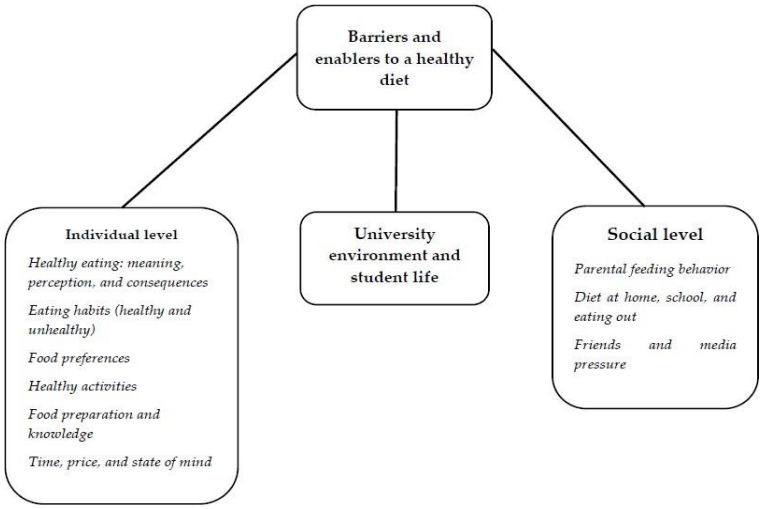


Figure 1. Factors influencing healthy eating behaviors of college students.

Figure 3 Factors influencing healthy eating behaviors of college students (Navia, Requejo, Mena, and Sobaler, 2003)

According to this research, most participants are aware of a healthy diet and unhealthy eating behavior, but following it seemed challenging. They also consider themselves more knowledgeable than the past generations but believe that the availability of unhealthy food and transition from home to school affects their food decisions. The research framework consisted of individuals (intrapersonal), Social (interpersonal), university environment (community setting), and students' life factors as eating habits affect.

1. Individual (interapersonal):

   Healthy eating (perception and consequences), Eating habits (healthy and unhealthy), food preferences, healthy activities, food preparation and knowledge, time, price, and state of mind.

2. Social (interpersonal):

   The effects of parents' eating behavior, diet types at home, school, and eating out, friends, and media pressre

3. university environment (community setting):

   Dining hall facilities, dorms, campus.

The result reported that common barriers to prevent students from having a healthy eating lifestyle are;

- time constraints
- unhealthy snacking
- convenience
- high-calorie food
- stress

- high prices of healthy food
- rush hours in dining halls
- easy access to junk food.

The evidence from this research shows that eating behavior could get better by improving food knowledge and education, personalized balanced diet, Socializing with people who care about their meal plans, and being physically active (Sogari et al., 2018).

In order to help students develop healthy eating behavior, consulting and motivation are important as most of them are aware of the necessity of food choices. For instance, socializing and interaction between individual and university administrators could help them find ways to follow the right path for the food decision making process. In further analyses, dining hall facilities should try helping students understand the effects of unhealthy eating behavior and the causes it might have.

One particular study by Stok et al. shows that the social aspects of dining facilities are another highlight. Researchers should not just focus on individual factors about the decision-making process among students. Participating in different events, living in dorms, and communicating with students from different cultures and eating behavior are also a part of food choices. It is important to understand that there are various barriers and enablers for healthy eating behaviors among college students. Still, results revealed that the factors below may serve as the most important barriers among students for having healthy eating behavior.

- food skill programs
- availability of nutritionist
- the college food environment (dining halls),
- social aspects of dining facilities,

- time constraint,
- stress,
- repetitive food choices,
- food decision making,
- and a lack of motivation.

There was another well-documented survey , by Swanstrom in 2017, that attempted to research behaviors at a mid-western university. The survey sought to determine what factors impact students' food choices on a daily basis while students were at school (Swanstrom, 2017). Questions were developed at the beginning to have a quantitative focus group approach;

1. *When you think of "healthy food" on campus, what location comes to mind?*
2. *If someone says they eat healthy, what does this mean to you?*
3. *How do time, convenience, and cost affect your ability to make healthy food choices on campus?*
4. *What information do you need to make healthy food choices?*
5. *Where do you find your nutrition information for the campus food?*
6. *What are your thoughts about the Meal Plans options offered here at this university?*
7. *If students choose unhealthier items when healthy choices are available, what influences that choice?*
8. *When you consider healthy food options at this university, what 3 things come to mind?*
9. *If you could implement any suggestion to encourage healthy eating at this university, what would you recommend and why?*

Everything included; college students are under significant time pressure with school exams and assignments, part-time and full-time jobs, physical activity, and social activity. One student mentioned, "It is kind of hard when you are running from class to class to be able to sit down and eat something quick.". Many participants talked about the lack of time when they want to grab their favorite food, and most of the time, they could not because it takes time to wait in the long linea at the dining hall, and it makes it difficult to stay on their healthy diet.

Another student said that "I like to go there, but the lines are super long and, so I have gone somewhere else because it doesn't take a long time". Some students talked about cooking at their dorm or going to the closest restaurant as they don't have time to schedule time to go to the dining hall every day.

Convenience is another factor to consider for food choices at dining hall facilities. One participant mentioned, "My biggest problem is that it is too convenient … I wasn't even hungry, but this yogurt looked good, so I just bought it, and I ate it."

In this case study, freshman student were required to pay for their meal plans as the cases at many universities across the country. The problem was that some freshman students have special diets for some reasons like Gluten intolerance or Celiac disease, and they struggle to fulfill their special requirements in the dining hall which is one of the biggest challenges for them. If they are lucky enough to find the option, they are often pricier than the other foods and have to pay more than $250 on average, over their plan. As these studies mentioned, healthy options are available at dining hall facilities, but what drives students to choose junk food and unhealthy choices when both options are available? According to this survey, healthy options are limited and pricey compared to unhealthy foods. With the challenge of obesity among freshman students it is crucial to help students with their eating behavior (Swanstrom, 2017). Consequently, colleges must try to create healthy eating facilities for students.

Universities' Reports About Students Eating Behavior

New York University has also reported that many students have poor eating habits like eating fast foods, low consumption of fruits, vegetables, and dairy, and the bad habit of skipping their meal plans. If they can have a balanced diet regularly, it could help students with (NYU reports, 2019):

- Energy level
- Stress
- Concentration
- Performances in the school

And the factors that could affect their eating behavior is:

- Time
- Healthy options at dining halls
- Friends eating habits
- Nutritional knowledge

Key Facts from the NYU report:

- Students gain weight during their first 3-4 months of college
- 24.3% of students have obesity
- Drink a high amount of soft drinks
- College students eat fast food around three times during a week

According to NYU recommendations, colleges need to reduce the access to unhealthy food on campus, increase access to water and low-calorie drinks, develop healthy recipes for dining hall facilities and provide nutritional knowledge for each food at dining halls (NYU report, 2016).

Conclusion of Research

Taken together, this research indicated that there is a need for universities and dining hall facilities that provide solutions regarding the creation of a practical user experience that gives the freshman college students a way to develop a healthy eating lifestyle when using dining hall facilities. Students need to have a service/system to help them maintain healthy eating behavior when using dining hall facilities. Going forward, more research needs to be done on the existing services and products that are already trying to help the healthy eating behavior system to help people, especially freshman college students.

Chapter 3 Methods

Overview

This chapter provides a set of design tools intended to help designers facilate a healthy eating lifestyle for people. It is vital to remember every problem, every situation, and every target user is different and present its own challenges. The following design tools and methods will help the designers find out how they can encourage a healthy eating lifestyle in the people' lifestyles. Nevertheless, designers should not apply just these tools and methods in their design process; other tools and guidelines may also be considered based on different situations.

In chapter two, different barriers and enablers for a healthy eating lifestyle were identified. Now, after a short review of the different aspects of eating behavior, the benefits of each design method/tool will be highlightedregarding capabilities and features each has.

The Kipling Method

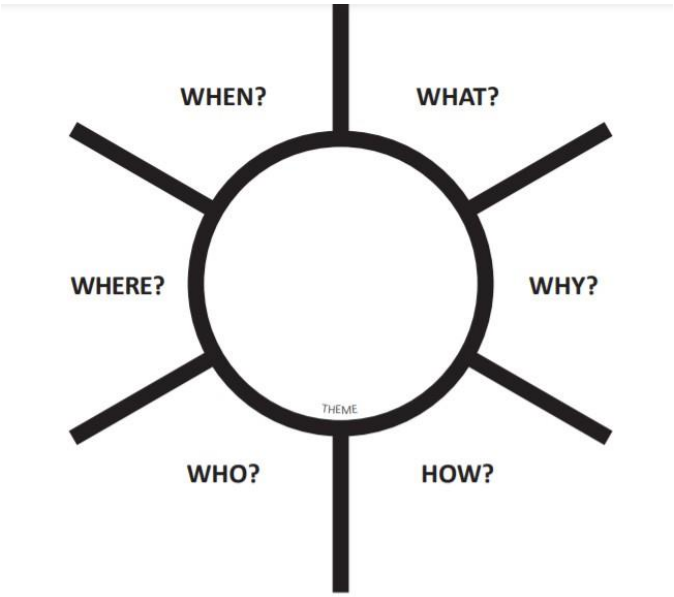
Six Honest Serving-men (5W1H)

The primary goal of this method is to help take different viewpoints when defining problems healthy eating behavior among different groups of people. Designers need to create as many questions as possible related to habits, conditions, activities, social impacts, behavior, impacts, etc. These questions represent various aspects of the problem and could determine the user's most essential and common issues.

Whatever the issue , use 5W1H to manage and expand thinking. The answers of 5W1H will give a true story to form decisions about the next steps and see where people need help in their behavior.

Information Gathering and Problem Solving:

- **What** happened?
- **Who** was involved?
- **When** did it take place?
- **Where** did it take place?
- **Why** did it happen?
- **How** did it happen?



METHOD: **TREASURE OF INNOCENCE**

1. WHAT?	**3. HOW?**	**5. WHERE?**
What is it?	How does it work?	Where is it used?
What is it for?	How could it work?	Where does it take place?
What is the situation?	How can it be resolved?	Where is it from?
2. WHY?	**4. WHO?**	**6. WHEN?**
What is its argument?	Who uses it?	When does it take place?
What is its unique value proposition?	Who interacts?	How long does it take?
Why does it occur?	Who is involved?	What dates are important?

Figure 44 template of the Kipling Method

https://manualthinking.com/methods/treasure-of-innocence/

Here are some examples to find out what kind of questions are needed to learn more about healthy eating behavior among the user groups (HCI Stanford group, 2018):

- How many servings of fruits or vegetables should you eat each day?
- How many minutes of exercise or activity do you need each day? Do you exercise regularly?
- What will keep your body strong and healthy?
- Is it ok to eat sweets/candy every day?
- List two good sources of protein?
- What will keep your bones strong and healthy?
- Tell us what you *wish* you did for your health.
- What good health habits do you already have? How do they help you?
- What health habits would you like to have? Why?
- How interested are you in health news in general?
- What benefits are there in eating a balanced diet?
- Which food groups should you have at least five portions of a day?
- How many glasses of water should you drink in a day?
- At least how many hours should you sleep each day?
- What is a healthy habit?
- At least how many meals do you have to eat each day?
- At least how many minutes of exercise should you be getting each day?
- What nutrient is primarily made of starches and sugars that provide the body with most of its energy?

"According to the Five W's and One H Method, these six interrogative pronouns are the

source of all questions and your analysis will be more completed, and you will formulate better solutions and decisions" for people who need help with their healthy eating behavior (Zhang, 2016).

Empathy Maps

Using empathy maps for visualizing user attitudes and behaviors helps designers align to deep understanding among end-users. The mapping process also reveals any ommisions in existing user data (Ferreira, Silva, Oliveira, & Conte, 2015).

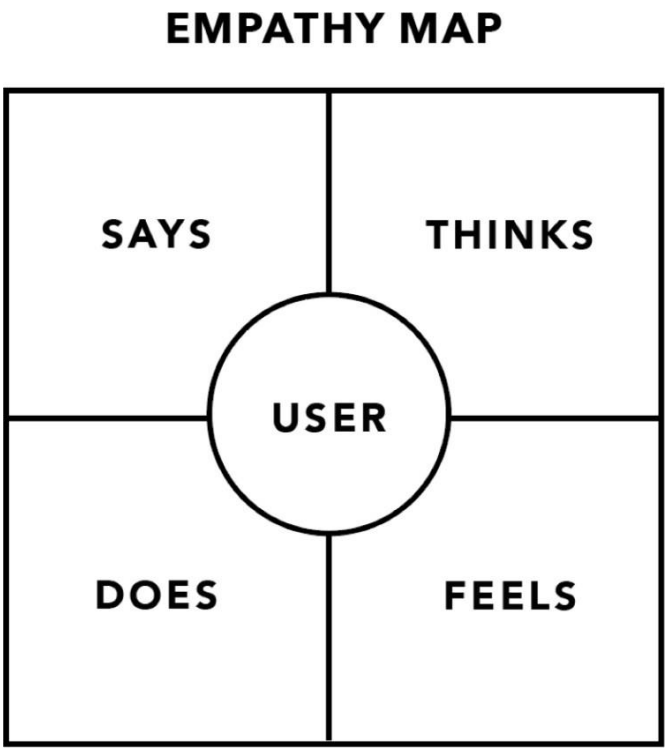


Figure 5 Empathy Map (Gibbons, 2018)

- **Think:** The Thinks quadrant captures what people are thinking throughout the healthy eating behavior and habits. Below are examples of what people might think about healthy eating behavior:
  - *"Thinks anything artificial is harmful to health."*
  - *"Sugar is terrible."*
  - *"Chemicals are bad."*
  - *"People should stick to eating only fresh, organic food for the sake of longevity and good health."*
  - *"Everyone is out to make money and kill you *surprising."*
  - *"Thinks other people get their info online or from friends/peers."*
  - *"What is "healthy" for one person isn't always for others."*
  - *"Food defines us and is an essential part of the upbringing."*
  - *"Food choices pose no restrictions in social life b/c live in an area with lots of options and restaurants are accommodating; thinks it might be harder to customize elsewhere geographically."*
- **Says:** The Says quadrant contains what the user says out loud in an interview or some other usability study. Ideally, it has verbatim and direct quotes from research. Here are some examples of what people might say about healthy eating behavior:
  - *Exercise is linked to nutrition.*
  - *No foods should be off-limits.*
  - *Food is life; food is child-raising.*
  - *Food restrictions are inconsequential in social life.*
  - *Nutritional information on packaged is not relieable.*
  - *Anything that's not natural is bad for your health (tech, gyms, supplements, etc.)*

- *Education and awareness are critical in helping people realize the difference between advertised 'facts' and reality*
- *Compared differences between the quality of food offered in Europe and the US (with the former being substantially better)*
- *Food is medicine in our house*
- *There is 'good' vs. 'bad' food*
- *It is important to not be at either end of the extremes when it comes to diet*
- *Only vitamin D and zinc are helpful supplements*
- *Used to be very focused on nutrition and health, but it made her ultimately unhappy*
- *Health is a combination of emotional/physical/spiritual well-being; all are important*
- *Health is when you can carry out daily tasks/happily live your life unencumbered*
- *Eating healthy generally important, but it's ok to eat unhealthy sometimes because emotional health is important too*
- *Building muscle makes her feel good*
- *Currently, not the healthiest but is happier*

- **Does:** The "Does" quadrant highlights the actions users take. From the research, what does the user physically do? How does the user go about doing it? Here are some examples of what people do about healthy eating behavior (HCI Stanford group, 2018):
  - *Eats out once a week and uses Yelp as a recommendation aid o Sometimes at cheap/fast food places*
  - *Eats red meat once a week*
  - *Buys high-quality groceries (organic veggies, grass-fed beef).*
  - *Doesn't eat gluten (because upset digestion).*

- *"Not a big traveler now, but eats whatever when she does".*
- *"Disagrees with docs."*
- *"Does NOT eat fried food or drink soda"*
- *"Exercises everyday - for at least 30 minutes"*
- *"Makes healthier, homemade variations of food types such as granola*
- *"Cooks meals in bulk, freezes and reheats for meals during the course of the week"*
- *"Eats at home 95% of the time, rarely eats out"*
- *"Uses recipe websites and to search for well-reviewed recipes that are healthy and tasty"*
- *"Has a sweet tooth - enjoys nightly desserts (usually homemade) *contradicting?"*
- *"Enjoys food socially, finds healthy options where she goes"*
- *"Doesn't eat red meat, lots of salmon, environmentally conscious choices"*
- *"Doesn't eat pork because feels sick thereafter"*
- *"Doesn't eat breakfast *contradicting?"*
- *"Kids don't eat sweets, but never told them they couldn't and were super strict"*
- *"Buys organically"*
- *"Packed her kids' lunch for school because bad options there"*
- *"Never fries food at home"*
- *"Avoid unnecessary medication"*
- *"Avoids visiting docs in America at all possible"*
- *"Avoids food with which she has had bad experiences/same attitudes concerning vaccinations - sons follow similar behavior"*

- **Feel:** The "Feels" quadrant recognizes the user's emotional state. Asking questions such as: what worries the user? What does the user get excited about? How does the user feel about the experience?

- Here are some examples of what people think about healthy eating behavior from research by the HCI group at Stanford University:
- *"Strong feelings against non-natural things think they're garbage/trying to kill him"*
- *"Feels paranoid about food/supplement companies and their hidden agendas"*
- *"Feels excited about the link between diet/nutrition and exercise"*
- *"Exercise can always be fun - group/social setting"*
- *"Feels strongly about the routine she sticks to"*
- *"Experimentation in the diet to remedy problems is important"*
- *"Being extreme when it comes to diet (no moderation) is unnatural/unhealthy"*
- *"Having different unfamiliar foods when traveling is not a big deal"*
- *"Exercising as a group is easier"*
- *"Feels bad after drinking"*

In user-centered design, empathy maps are the best used from the very beginning of the design process. Analyzing the empathy map can help designers better understand the enablers and barriers to healthy eating problems.

Interview

There are many internal and external factors affecting the behavior of people such as; psychological, environmental, social, individual, and genetic factors. If designers understand the core aspects of unhealthy eating behavior, they can address the epidemics of diabetes, obesity, and cardiovascular disease. The following questions focus on eating behavior and the information users provide will help the designers understand more about how they might help people develop a better eating lifestyle and prevent the associated diseases.

1. How many meals do you eat a day (breakfast, lunch, dinner, snacks)? Consider every fruit, every yogurt, or a glass of milk, etc., as a single snack. …during the week
2. At which times do you usually eat?
3. Please specify your meals for two specific days of the previous week:
4. How often do you have hot meals?
5. At which times do you have hot meals?
6. Which meals do you usually partake? ☐ breakfast ☐ lunch ☐ dinner ☐ snacks
7. Do you get up at night to eat, or do you eat at night times because of sleeplessness?
8. How much coffee/ tea do you have a day?
9. How many alcoholic drinks do you have a week
10. How often do you eat in a restaurant?
11. In case you prepare your meals at home: do you serve single servings, or do you help yourself continuously until you feel sated?
12. Do you watch out for healthy nutrition? ☐ never ☐ rarely ☐ occasionally ☐ usually
13. . Are you mindful of your sensation of hunger? ☐ never ☐ rarely ☐ occasionally ☐ usually
14. Do you eat when you feel stressed, unhappy, angry or bored? ☐ never ☐ rarely ☐ occasionally
15. What type of diet do you prefer? ☐ Swiss diet ☐ Mediterranean diet ☐ American diet ☐ Asian diet ☐ other _____
16. Where do you use to buy food (you can choose more than one answer) ☐ on markets ☐ in supermarkets ☐ in small shops ☐ in organic food shops ☐ , other
17. What type of food do you preferentially buy (you can choose more than one answer) ☐ pre-

cooked foods ☐ , fresh foods, ☐ frozen foods, ☐ canned foods

18. Describe your physical activity during working hours
19. Did your eating habits during the previous 7 days differ significantly from your last month's habitual routine?
20. Do you take your time to rest and relax? ☐ never ☐ rarely ☐ occasionally ☐ often
21. Have you been avoiding some foods for health reasons?
22. How much of your diet consists of vegetables and non-animal products?
23. Do you know your current BMI (Body Mass Index) index?
24. How often do you eat fruit? (# per day, week, month, year; never)
25. How often do you eat green salad? (# per day, week, month, year; never)

Designers with these kinds of questions can educate and guide people to live healthier and happier lives through true nutrition and a healthy lifestyle and find the best solutions for the current unhealthy eating habits among people. Also, when designers want to derive conclusions from quantitative research or an interview, a summary of quotes could help describe a particular problem or situation.

Affinity Diagram

An Affinity Diagram is a conventional management tool that helps designers and the team organize information from surveys, direct observation, and brainstorming sessions. This method cuts down the data by grouping them in ways that help finds the connections between the groups of information and look for what could affect people’s food choices.

How to create an Affinity Diagram?

Generally, creating an affinity diagram is a team activity with less than seven experts involved. There are simple steps for creating an affinity diagram:

Step one:

Write down all the information received from the surveys, brainstorming, and direct observation about healthy eating behavior among people on separate sticky notes/cards. The information will be different for user groups based on internal and external factors. An online platform such as Miro.com can be used to gather this information together and provide an unlimited area to work with the other team members on board. Cards are placed randomly near each other.

Step two:

Look for local connections between the information items on each card as they are reviewed. Place the related information and ideas near each other and try to create a column for each group. Each team member can do it alone without getting input from another when creating their column.

People have different eating habits and eating behavior according to their lifestyle and so many factors, So the sticky notes could be in their own columns right now, but keep in mind that you need to always keep an eye out for finding similarities between the cards even if they are not in the same group.

Step three:

Each column needs a heading. The heading should explain the similarities and ideas in a group with a single word related to behavior barriers and enablers, for example, social activities, motivational aspects, work and busy hours, time, money, nutrition knowledge, etc. If you find

out there are similarities between 2 columns, you can merge them together.

Step Four:

All the cards/sticky notes are grouped now with their heading. It's time to make it presentable. Write down the problem statement at the top, how we, as designers, can promote healthy eating behavior among people? Bring the team together and start discussing and reviewing the categories. Different colors for each group can help. To hear others' points of view from outside of the team, you can send them the link.

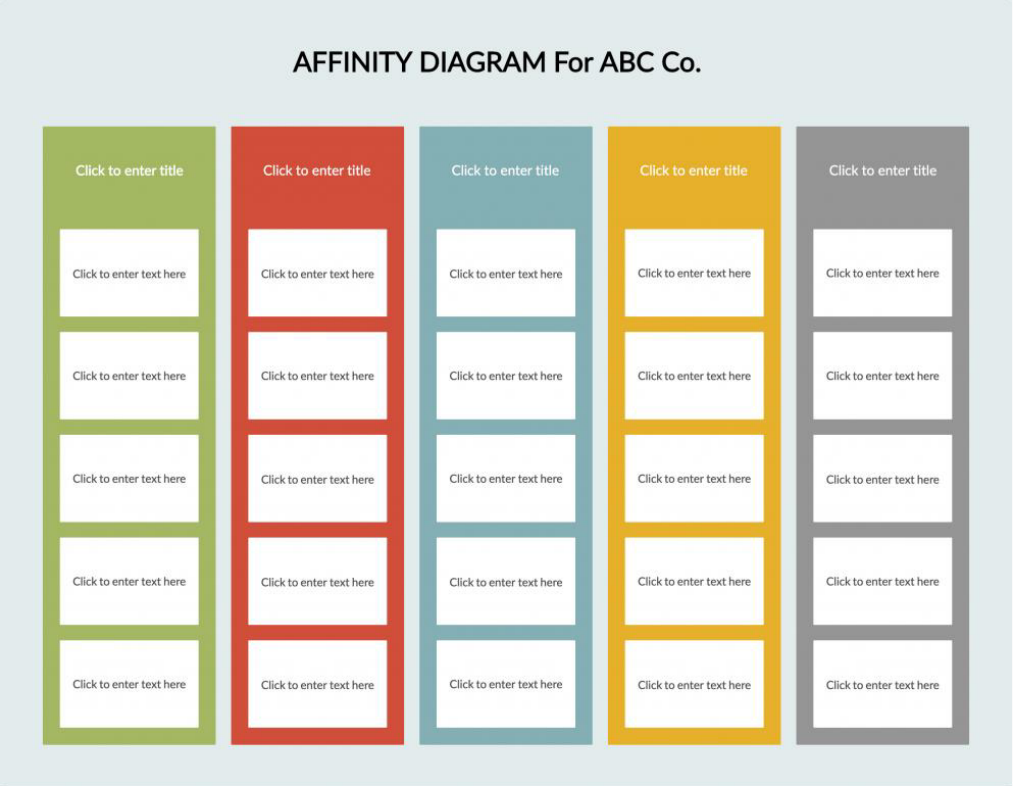


Figure 6 Affinity Diagram template

tps://creately.com/blog/diagrams/what-is-an-affinity-diagram-guide-and-templates/

Journey Map

Designers need a way to develop more empathy and gain new insights. A journey map

could help them focus and consider the user's experience during their behavior journey to achieve and promote healthy eating behavior.

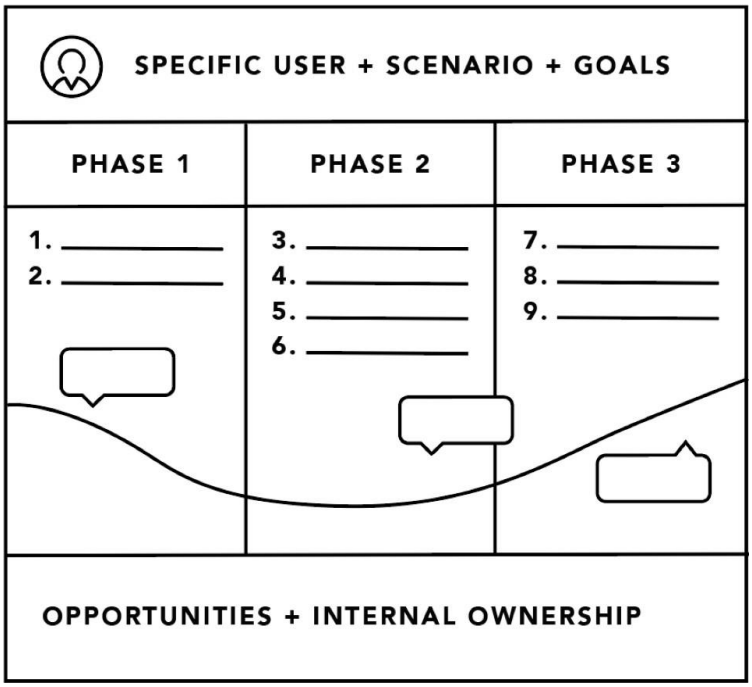


Figure 7 Custome/User Journey map (Gibbons, 2018)

This map is a reference showing the user engaged with the service or product through multiple steps.

The key part of a journey map

- **Player:** The player is the user who is using the product during his journey, which in this case, the user is who wants to have spicific behavior. The entire journey is about what the user experiences in each step. For example, a restaurant might choose either a customer or a staff as a player; each of them would play differently and has a different experience. To get the point of view for both users, the restaurant needs to create two individual maps.

- **Scenario/Story:** The story explains the situation for the user from the beginning to the end. The restaurant user might need to see all the ingredients in the foods to make a better food choice. The user's expectations are finding the information very easy and understandable at first glance.

  The story could be a real story behind an existing product/**s**ervice or something imaginary for those not in the market yet.

- **Journey Steps:** The steps are different for each case study as the story behind each product/service might be different from story to story, and it consists of actions, thoughts, and feelings about healthy eating behavior. Here are some examples:

  1. For online food ordering: the steps can browse, find the food, look for the price, reviews, ingredients, adding to the cart, checkout, make a payment, receive a confirmation email, food delivery.
  2. For selling healthy food online: The steps could be advertising attention for a healthy food meal, build trust, feel special, show ingredients, convince the user to pay and sell.

  Opportunities: In this step, designers ask themselves can improve the user's experience in this journey. Insights from this step help designer and the team enhance their knowledge and find new paths to the best solutions:

The map below shows the whole process for a user journey map:

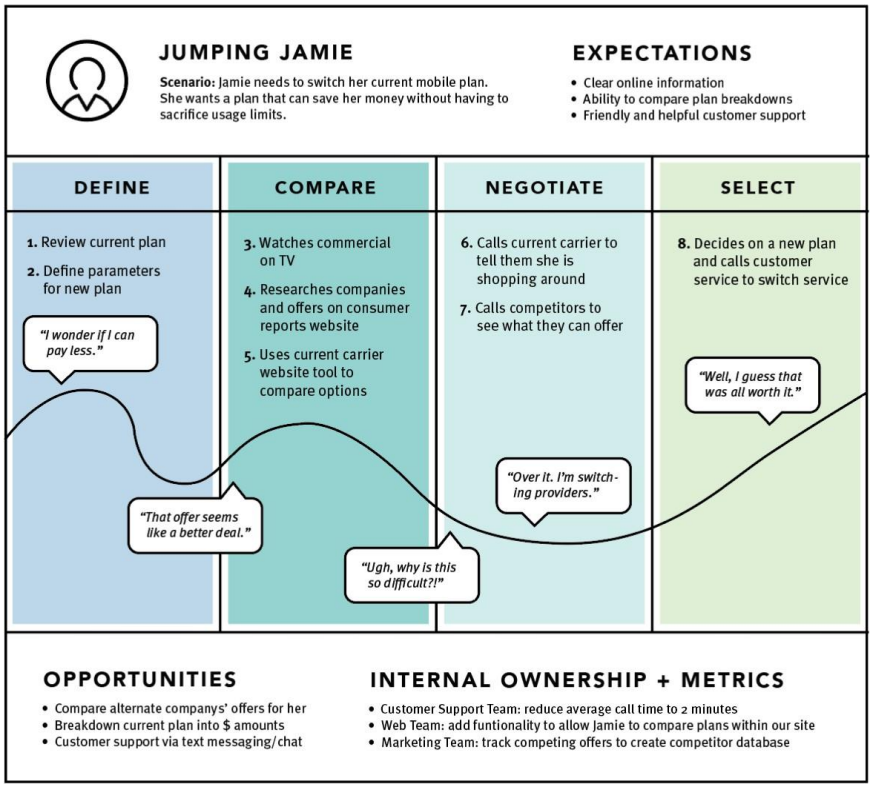


Figure 8 User Journey Map Example (Gibbons, 2018)

Company and Market

(Product Benchmark Analysis)

At the beginning of the design process, benchmarking can help designers have an understanding of the companies and competitors in the current market. An idea can find space to become successful in the market if the designer can find the opportunity in the market place. This tool allows designers to measure their concepts, and compared with other industry products and gives them this opportunity to find their place correctly. If the final product does not meet the standard, the user will see no reason to use the product or service.

There so many technologies available, and each technology works differently and has its own function to promote healthy eating behavior among people. Nevertheless, each theme has been designed to support the user nutrition knowledge, motivation, meal plans, a better situation or more information. The use of them is critical based on the problem the target user has.

The market overview can help the designer understand the restrictions, opportunities, and limitations of healthy eating habits. For designers who look for a new opportunity, this step is a must, and for those who want to be work on an existing product, this step can still help to develop new ideas and insights to define a unique opportunity.

In-depth analysis in benchmarking

It is crucial to understand the features of existing products in more detail to find out how the current features in existing products could make changes in a new product's body and solve the user's problem in other ways.

Product Opportunity Gap

The product opportunity gap is a great method for this step, and it does what it says, and it's a way for designers to measure where they want to be in the market. It creates a picture of how different products and companies are positioned in the market based on the design criteria and user's needs to help them have a better healthy eating lifestyle. There should be a place in the market called a gap that current businesses are not serving. For example, the Instacart food delivery filled a market gap when coronavirus lock-downs happened. People need the best grocery delivery from stores providing organic, healthy, and natural food products. Every

pioneer and successful business has served a gap in the market. The easiest and smartest way to find the market gaps is to ask the user what they are missing about the product or simply to read the reviews. User research and surveys may guide designers in the correct direction and give them the chance to do a better job and be successful in the market.

Another way to find the POG (product opportunity gaps) is to develop a SET analysis.

SET analysis:

SET (Social factors, economic forces, and technological advances) analysis is one of the best ways to find market gaps. Investigating SET factors help to generate many opportunities in a short amount of time, to narrow down a number of ideas to a few of more serious ones, and then to discover any of them at a cursory level enabling the generation of an initial scenario (Cagan & Vogel, 2002).

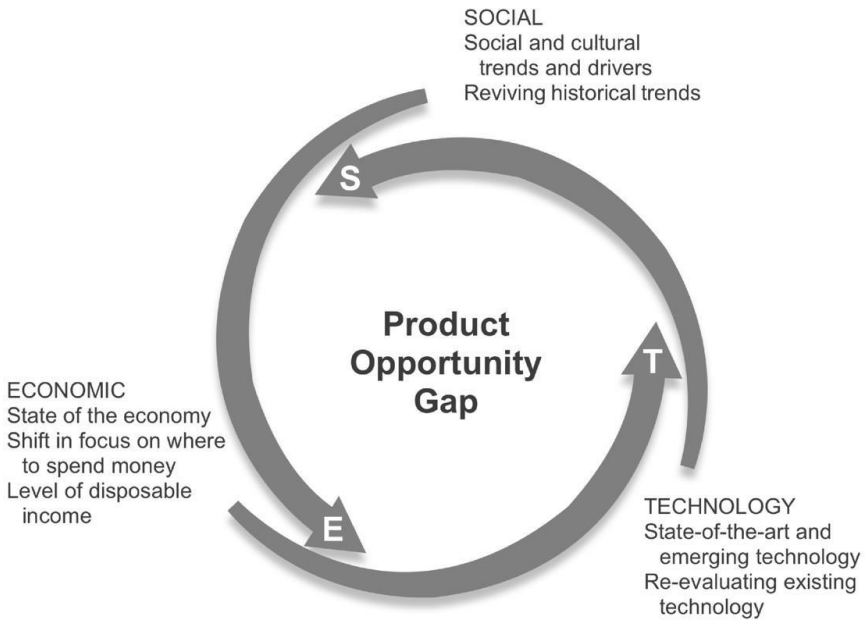


Figure 9 Scanning SET Factors Leads to POGs (Cagan & Vogel, 2002)

- **Social factors include** family and work patterns, health issues, the use of computers and the internet, social environments, successful products in other fields, sports and recreation, sporting events, the entertainment and food industries, film and television, vacation environments, books, and magazines.

- **Economic factors focus on** Excess income that people perceive they have, or that they expect to have, to give them the power of having high-quality food meals. The spending power people believe they have to buy the products and services they believe will promote their healthy eating lifestyle.

- **Technology factors focus on:** Results from new scientific discoveries in healthy eating behavior, government, and university research and the implied capabilities stemming from that research (Cagan & Vogel, 2002).

SET factors help industrial designers and user experience designers to see how their view is different from their users' view, which is essential for the development of a successful product/service.

Analysis of Existing Products

Existing products could give the designers much knowledge and information by looking at how another company's designers attempted to find a solution for people to make reliable food choices. It does not matter what stage of the design process the designers are; it could take place at any time.

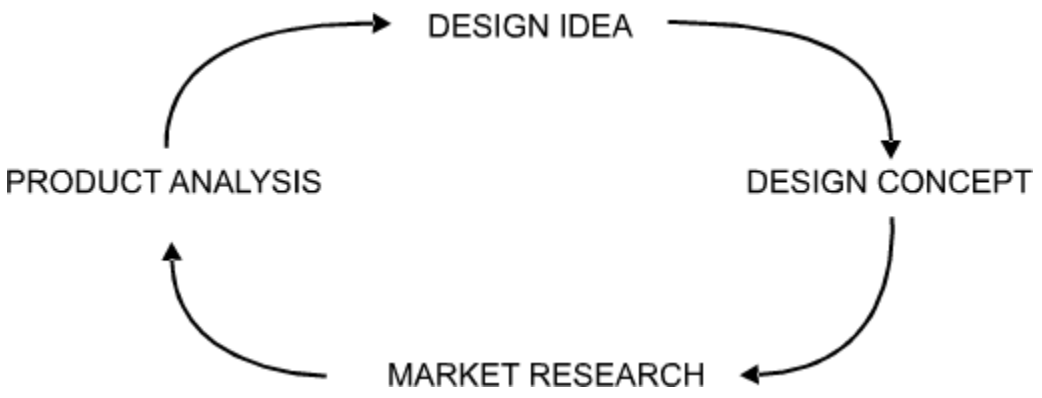


Figure 10 Analysis of Existing Products cycle

There are likely to be many similar products that have already been launched and relate to existing products—developing and redesigning a new idea requires looking back to the past products, analyzing the process, reviewing the appearance, functionality, and features to understand better how to design a new product.

How many products are ideal for analysis:

– An individual product

– Several similar products, then they can be compared with each other.

What type of products are ideal for analyzing:

- The products that have unique features related to your design
- The Products that are unproductive for the existing problem
- The products that help you understand the unique features and the current market

What type of products need to keep away from:

- The Products that are similar to what you have plan to design. Your design should be exclusive and meet your target group's needs.

- Products that are not able to give you inspiration and ideas
- The products that just "look pleasing." You need to analyze the context first

After selecting the products to compare and analyze, it is time to list the features based on the users need, design criteria, and requirements to evaluate and analyze the existing products

Source of the products: The product a designer needs to meet the design criteria as completely as possible affording the opportunity to find out about the company or the designer. Images from "Google," "Pinterest," and the other related sites need to be avoided. If you find something interesting, it is always better to find the primary source.

Chapter 4 Design Application

Design Process

Literature review helped to better understand freshman college students' needs for better eating behavior when they use dining hall facilities. While eating, students were observed talking to friends at the dining tables to monitor their available foods' decision-making process at the dining hall. In this study, direct observation and contextual inquiry helped observe freshman students' eating behavior at the dining hall and learn more about freshman students' healthy and unhealthy habits during their food choices. Direct observation guided user research to do The Kipling Method (5W1H) at the beginning of the user research journey.

The Kipling Method

Six Honest Serving-men (5W1H)

The goal of this method is to help take different views when defining the problems. Many questions as possible related to the topic were created. These questions represented various aspects of the problem and could define the user's most essential and common issues.

Information Gathering and Problem Solving:

- **What** happened?
- **Who** was involved?
- **When** did it take place?
- **Where** did it take place?
- **Why** did it happen?
- **How** did it happen?

Random questions were developed based on literature review and direct observation at the dining hall.

What

- If the user has the knowledge but does not want to follow?
- If the user needs more information about food?
- If the school does not have any nutrition programs for students?
- If the user is not be motivated enough to make healthy food choices
- If the user wants to eat in a group but stay on a healthy diet?
- If the cost of food for freshman students impacts the amount of food they eat?
- If the unbalanced diet impacts what their bodies need?

When

- Will this service be used?
- Will the user start using the service?

Where

- Will this service be held?

Why

- A healthy lifestyle?
- Students' lifestyle should be approved
- Mental health matters?
- Freshness and happiness are important among college students?
- A healthy diet could affect students' studies?
- Is social improvement related to healthy eating behavior?

Who

- Will you use dining hall facilities?

- Will you need help to improve their healthy eating behavior?
- Will be our target group?
- Will it affect students' food decisions?

How

- Design a system for the dining hall to make it better?
- A designer can help students to eat healthily
- Will a healthy eating lifestyle impact users?
- How will socialism impact food decisions?
- How will motivation be a part of the user's daily meal plans?
- Will a balanced diet impact user's health?
- Will the long-term consequences of bad eating habits in school impact the user's future?
- Will bad eating habits turn into healthy eating habits?
- Will eating with friends impacts the portion of their food and their food choices?
- Will knowledge of healthy eating behavior impacts food choices?

In conclusion, after analyzing these questions based on pre-existing interviews in the existing literature, it was obvious that students use dining hall facilities as a social place! They socialize, eat together, and follow each other's healthy or unhealthy habits during food making decisions. Social activity can affect students' long term food choices and eating behavior after a while.

They also believe in social media as an influencer on their diet. Some follow people to imitate their eating lifestyle. Still, after entering school as a freshman and getting busy, they do not have enough motivation to pursue a healthy lifestyle. As a designer, the question is how we can help students advance a healthy eating lifestyle with so many barriers and enablers on campus in different dining hall facilities.

Empathy Maps

Visualizing user attitudes and behaviors in an empathy map helps designers align on a deep understanding of end-users. The mapping process also reveals any holes in existing user data (Ferreira et al., 2015).

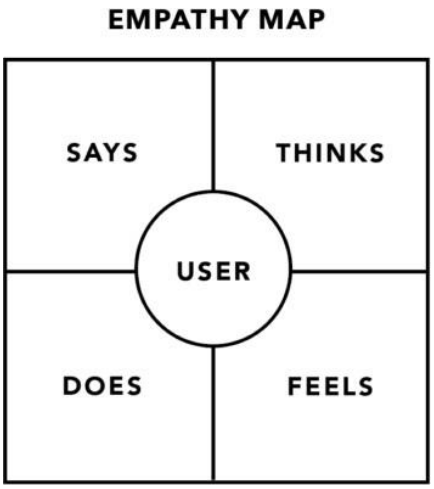


Figure 11 Empathy Map (Gibbons, 2018)

All of the four parts' outcomes came out from analyzing the existing survey and interview, which was mentioned in the literature review (Sogari et al., 2018).

Think: The Thinks quadrant captures what freshman college students are thinking throughout the experience:

- I don’t know what healthy eating means.
- I don’t know how to have a healthy eating lifestyle
- I like hanging out with friends and also different people on campus
- My main focus is doing my research spend so much time on it, so I don’t have enough time to cook and think about what I should eat every day.

- I have enough knowledge about eating healthy, but I am not motivated enough to follow it
- I need more education programs from school about foods
- I have so many bad eating habits, but I don't how t get rid of them

Says: The Says quadrant contains what the user says out loud in an interview or some other usability study. Ideally, it has verbatim and direct quotes from research.

- I cannot control myself to not overeat every time I eat with a group of friends
- I can not control myself to not eat a lot of junk foods
- I have already paid for my food, and something in my head always pushes me to eat more.
- When I go to the dining hall during the rush hours, I cannot get my favorite food, and I have to pick anything very quick to go back to my classes.
- Sometimes I can see myself eating repetitive food for so many days.
- I prefer not to eat in dining hall facilities as it pushes me to keep eating because so many types of food are available and I cannot stop myself.

Does: The **Does** section talks about the users. From the research, what does the user physically do? How does the user go about doing it?

- When I am in a rush, I go and pick the easiest food that I can grab for a second, so most of the time I do not care I have to eat and what my body needs.
- I always prefer to eat with my friends or even with strangers as I hate eating alone
- I hate thinking about what to eat every day
- I do care about nutrition, and I always check what I want to eat

Feel: The **Feels** quadrant is the user's emotional state. We asked ourselves: what worries the user? What does the user get excited about? How does the user feel about the experience?

- I feel so excited when I see my friends at the dining hall
- I love eating with my friends
- I feel exhausted when I want to stay in lines after my classes
- It makes me sad when I see some food are gone
- I am always worried to face a very busy dining hall at noon
- I love eating a variety of pre-paid foods.
- I always feel better about eating at the dining hall instead of going out
- The dining hall kitchen feel like my mom's kitchen as there is always so much food around

In user-centered design, empathy maps are the best used from the very beginning of the design process. Analyzing the empathy map could help to understand the users better.

Based on our empathy map, the beginning of the freshman college journey is pretty straightforward. Many schools require freshman students to sign up for their meal plans during their freshman year. Obviously, at that sensitive time that students are going to live on their own, thinking about the meal plans is one less thing to think about. They go to the dining hall facilities, swipe their card, and eat. Moreover, it gives them more opportunities to make new friends.

Target Users Analysis

Analyzing the different categories of users using dining hall facilities was necessary to

understand the reasons for them to use this service.

Based on the literature review of user studies, the main reasons for students to use the dining hall facilities were:

1. **Convenience:** Eating at the dining hall is much nicer and easier than preparing food at home while under pressure for their studies.
2. **A mandatory option for freshman students:** It is required for freshman students to sign up for their meal plans every semester/year
3. **Lack of Time:** Saving time is crucial for freshman students as they are swamped at the beginning of their school.
4. **Cost effective:** Mostly, it is cheaper than buying ingredients and making food on their own

And also, there were four groups of students that use dining hall facilities:

1. **Users (Group A):** Students who care and are motivated about their health and balanced diet when using dining hall facilities

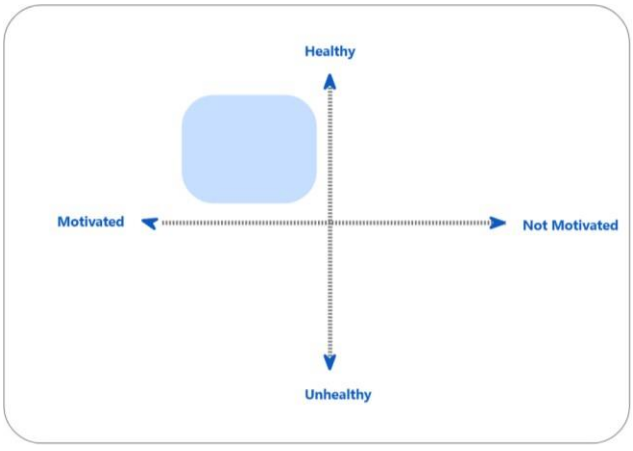


Figure 12 Users (group A)

2. **Users (Group B):** Students who do not care and are not motivated about their health and balanced diet when using dining hall facilities.

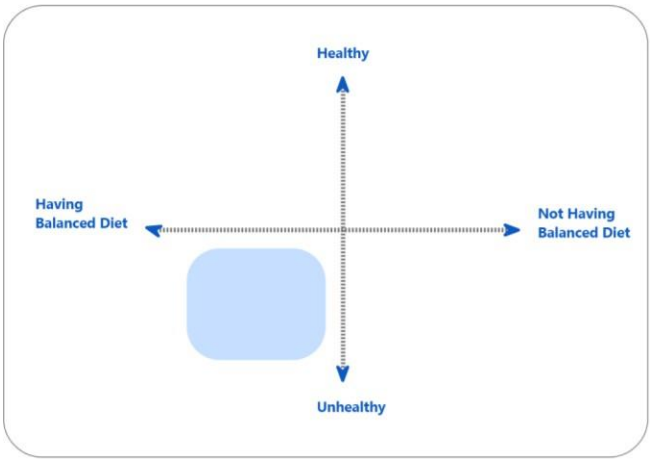


Figure 13 Users (group B)

3. **Users (Group C):** Students who care about their healthy lifestyle and dining hall facilities' social aspect.

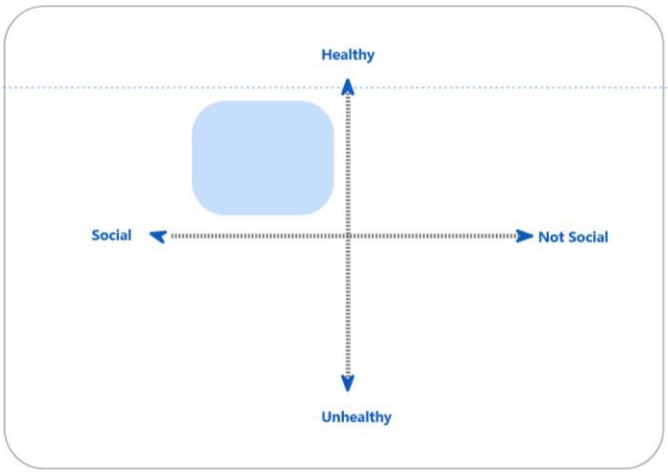


Figure 14 Users (group C)

4. **Users (Group D):** Students who care about their healthy lifestyle but do not have enough knowledge.

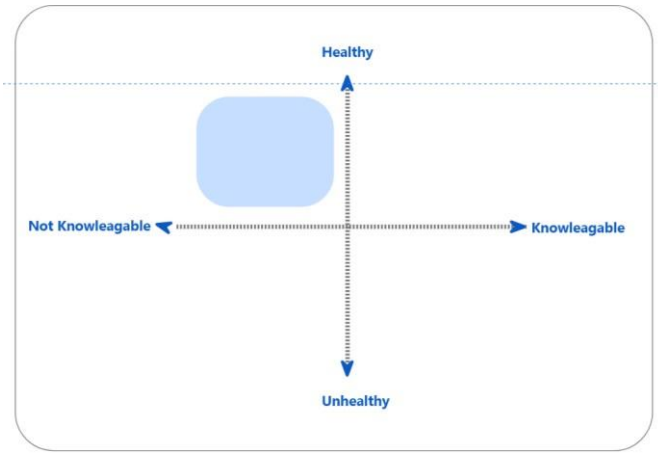


Figure 15 Users (group D)

Biaxial Map

After analyzing different groups of students, two axes of Healthy and social appeared. Most of the students found themselves involved in a group or conversely alone, and they believed that socialism had affected their eating behavior.

Area of opportunity

There are some students who are exceptionally social and want to use the dining hall as a social place but with limited healthy eating behavior due to a lack of motivation and knowledge.

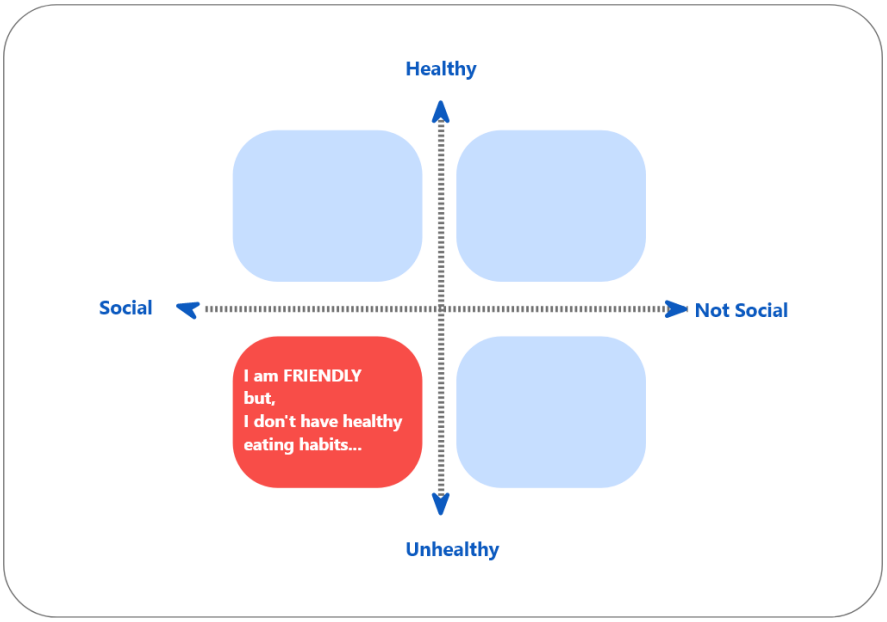


Figure 16 Area of opportunity

Selected Persona

Based on our research findings, a persona is constructed to serve as a cumulative representation of all the common user needs. We explored motivations and pain points through empathy mapping and user journeys to gain a deeper understanding of users.

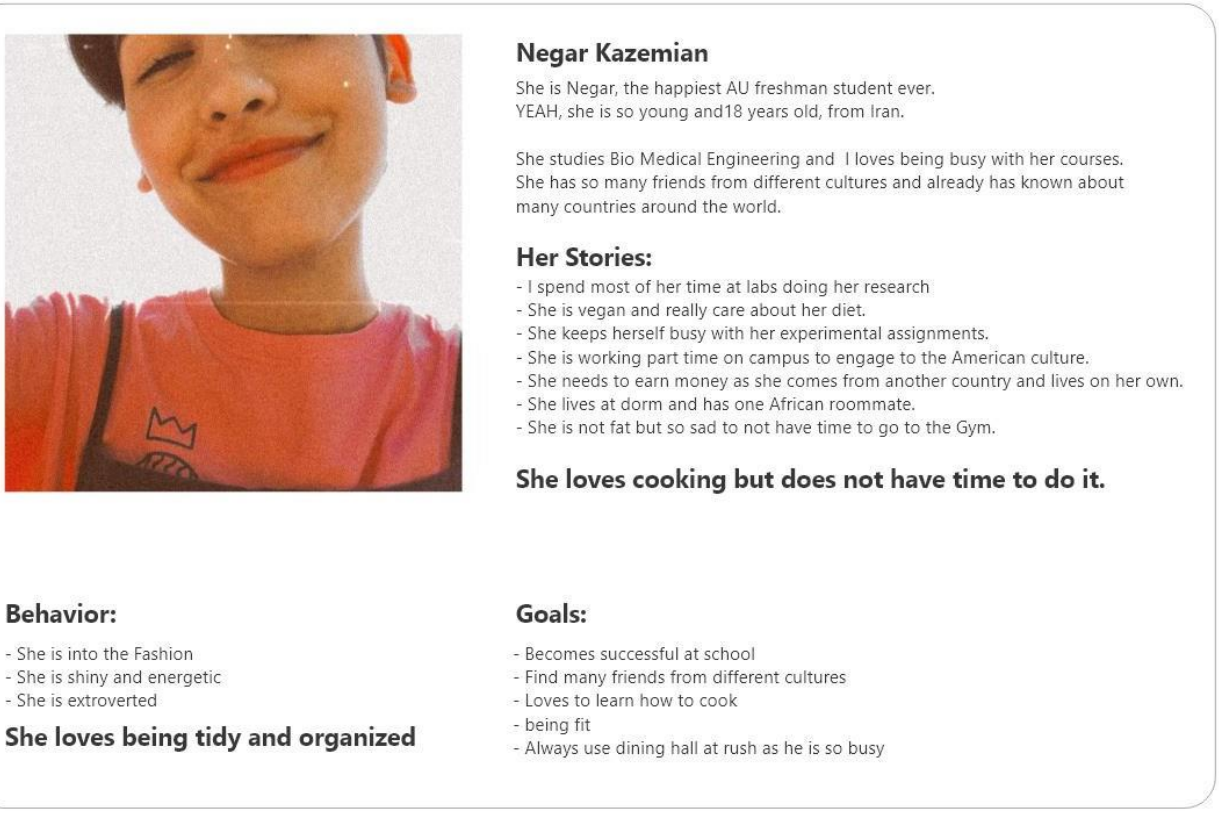


Figure 17 Selected Persona

Existing Interview Quotes

(Sogari et al., 2018)

- *"For me, healthy eating is eating clean. So, lots of fresh veggies and fruits and some sort of protein"*
- *"Things (healthy food) that help fulfill your daily nutrition requirement, even though I obviously don't do that"*
- *"When I was a kid, I definitely thought it was more ... just eating less, ... now I understand that it's more eating the right things, and not necessarily eating less, but just eating different stuff"*

- *"I think about getting a lot of balance"*
- *"before it was all about portion control, eating smaller things, but now, it's focused more on eating healthy things"*
- *"my mom told me when I was a kid, healthy eating is if your plate is colorful, so sometimes when I went through that little phase where I was trying to eat really well at the dining halls I'd be like, carrots, orange, tomatoes, red, I'd get a bowl of blueberries, blue. You'd try to get every color on your plate and that's healthy"*
- *"you have less health problems, for the most part, that are related to your diet. You probably have more energy, honestly, because processed stuff sort of slows you down"*
- *"I think that America has this epidemic, which is obesity. And I know that leads to a whole bunch of complications, especially the demographic that I am. I understand that our life expectancy isn't as high as other demographics, and that's due to obesity, diabetes, heart disease, and stuff like that" (FG2_M20).*
- *"I think healthy is feeling good about yourself, having energy, and not being exhausted all day" (FG2_F18);*
- *"I think healthy goes beyond just food, you have to be mentally healthy and physically healthy"*
- *"I tend to like healthy food, it makes me feel better"*
- *"I think being healthy is both your physical appearance and your mindset . . . exercised and eating food, as well as balancing it out with your mental state"*
- *"I want to be in a good shape, and I think that's what motivates me"*
- *"I'm trying to eat a heavier breakfast so that I snack less throughout the day"*
- *"I have snacks late night, mostly, ifI'm going to snack at all, it's generally junk food"*

- *“I don’t mindlessly snack, but when I do snack, it’s always something healthy like nuts or fruit”*
- *“I try to eat like four to five times a day like smaller meals as opposed to just like breakfast, lunch and dinner”*
- *“I like carbonated drinks, like sugary drinks that I should probably stay away from”*
- *“I think there’s a lot more junk food now than there was then, and it’s also way cheaper than getting healthy food”*
- *“I think junk food is way more accessible than going out to get healthy food”*
- *“Sometimes people just don’t have access to food in their neighborhood”*
- *“I think unhealthy food just tastes better. I don’t know, if a food tastes good to me, I have thoughts of, "Is this unhealthy?" Because I feel like healthy food just doesn’t taste as good”*
- *“I think unhealthier food just tastes better for everybody”*
- *“I really like pasta, like a lot, it’s pretty much what I eat every day. I put hot sauce on everything”*
- *“my parents were also very encouraging of me and my other siblings with doing sports”*
- *“not keeping junk food in the house” was*
- *“I try to get individual packages, so I have portion control”*
- *“the first time I lived outside of the home wasn’t good. I ate out twice a day, every day, which is really unhealthy and really expensive. So now I’m trying to cook more, which is good. I feel like I’m healthier when I’m cooking it myself” (FG1_F21).*
- *I definitely snack too much when I’m stressed”*

- *"I work too much. I don't take the downtime to exercise. I like to snack a lot. I use food to regulate my mood"*
- *"I don't have time to be going to the grocery store to just get fruit and healthy things"*
- *" . . . then sometimes I will eat at random hours during the day, including sometimes I'll have to skip lunch if I just don't have enough time, which I can see the effects, it just makes me really tired, it's not good for working out" (FG4_F19).*
- *"it's very abnormal in America that the fruit and the vegetables are much expensive than the meat because back in China the vegetables and fruits are very cheap, so everyone can have access to that"*
- *"What you eat and who you're around is really influential*
- *"Seeing if someone's eating really unhealthy, you can be like: "I'm going to be the one to eat healthy tonight", or if everyone's eating healthy, you feel more inclined to eat healthily"*
- *"I tend to eat what I can't eat at home, so always unhealthy"*
- *"When I'm eating out "I might as well treat myself" and treat myself for nothing"*
- *"When I lived at home, I would always eat really healthy, so whenever I go out, I tend to eat a lot of junk food*
- *"Usually when I go out with my friends or family, I eat just such trash food. And restaurant food, to begin with, is already so caloric, and then you just add on top of it, let's get appetizers and desserts"*
- *"There is just so much social pressure to eat healthy around other people"*
- *"I think the general rule of thumb, if you see people [friends] that look healthy, that we tend to ask someone, what do you eat? How do you do that?"*

- *"When I'm with my friends in the evening we do tend to eat heavier meals, which make me feel pretty sick the next morning"*
- *"I eat irregularly, like sometimes for dinner I just don't want anything in the dining halls and I'll just eat cookies or the ice cream"*
- *"I probably eat more meat at college, I don't know, just a lot of food"*
- *"Having that sort of unrestricted freedom of being able to choose whatever you want to eat, and also having a meal plan where it's like an "all-you-can-eat" buffet"*
- *And once you're at the dining hall, you have unlimited food, so I feel like I overate a lot in the dining halls.*
- *"it was good to have the dining halls right there so you could kind of eat whenever you wanted to. So it helped me stay healthy and had a good eating pattern for that kind of lifestyle. And then, I think once when I got off campus, it's like harder to keep up with good eating patterns"*
- *"I also sometimes skip lunch when I have a class or studying to do, and a lot of times when I'm studying I also eat junk food, try to keep myself awake"*

Sometimes we hear something during the interview, and they realize that how well that sentence described that particular problem or situation. After going through all the interview quotes it was to to take out some quotes from the pre-existing interview to analyze and to see what we have got.

Figure 18 Interview quotes

Convergent interviewing

In this step after taking out the interview auotes, key areas of the the opportunities and interesting insights were found here. The initial design criteria were created and the set of repetitive and important problems are narrowed down.

Knowledge:

Lack of knowledge about nutritional values

Lack of knowledge about healthy eating behavior

Lack of knowledge about the long-term consequences of bad eating habits

*"I want to eat healthily but I do not know how***!**

I think I have the knowledge but cannot use it

I need some nutritionist helping me with my diet

I don't know what is necessary for my body

There is no nutritional information at dining halls

Social Aspect:

Affects their eating behavior

Causes overeating

They forget their diet

Mostly ends up with junk food

I overeat when I go to the dining hall with my friends

I hate eating alone but eating with friends affects my diet

When I hang out, I eat whatever they eat

If my friends eat healthily I eat healthy if they don't, I follow them

We mostly eat junk food when we are together

Food accessibility:

Availability of foods

There is no control over eating food

So many healthy/unhealthy choices

I have paid for the food and I want to eat whatever I want

I can not stop eating in dining halls

I want to try most of the foods

I have to eat what they offer when I am in a rush

I find myself eating the same days for days

I don't know how to help my body with eating necessary foods

Motivation

Looking for motivation to stay healthy and get rid of unhealthy eating habits

I have paid for the food and I want to eat whatever I want

I don't know how to stay motivated for my diet

I am super busy with school and have no time to motivate myself to stay fit

My friends motivate me to stay healthy

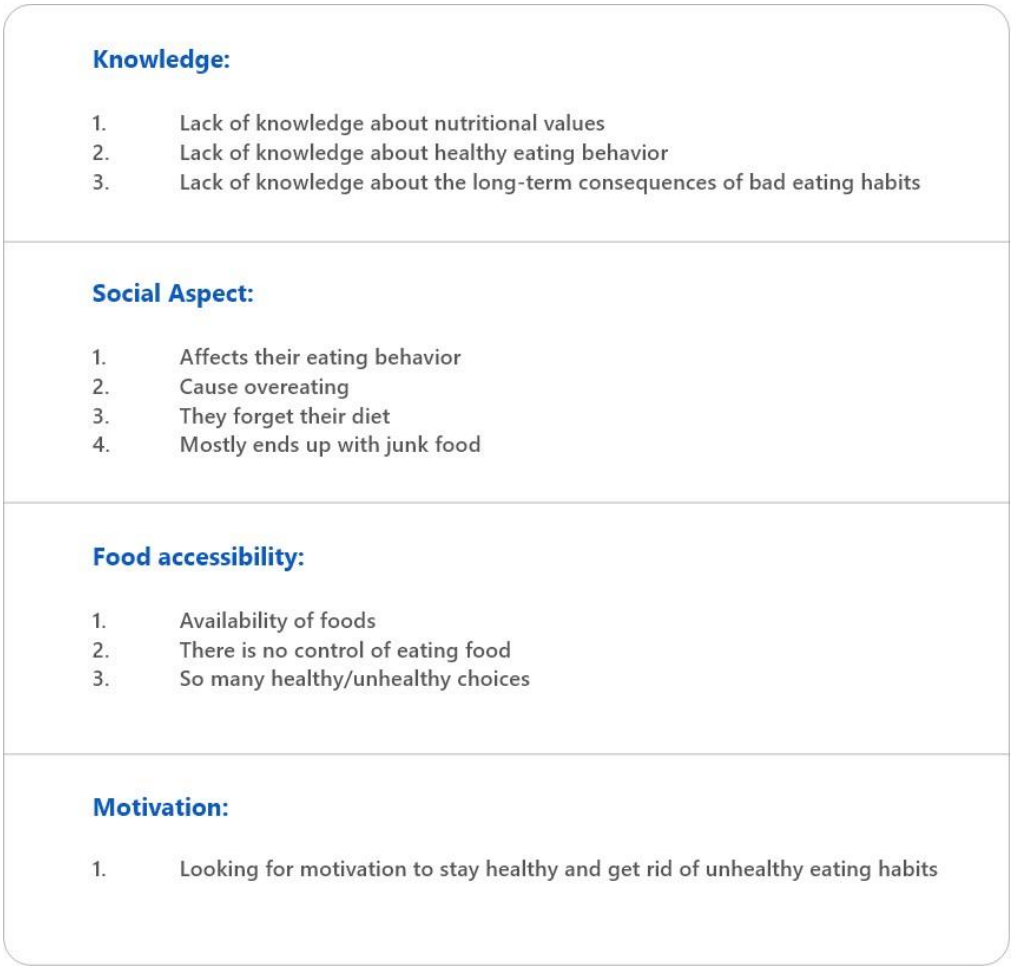


Figure 19 Converging interviews table

Affinity Diagram

The affinity diagram tool helped to organize the outcome from the literature review and pre-existing interviews. This diagram was organized based on the primary design criteria in a few different categories.

Figure 20 Affinity diagram

Before starting to group the information, sometimes it is helpful to state the problem with a question. For example, the question for grouping these sticky notes was:

"why most of the freshman college students do not have a healthy eating behavior."

It is vital that before grouping, designers understand the aim of the session. From the user research, multiple impacts emerged, including media, stress, lack of a balanced diet, lack of knowledge, rush hours, lack of motivation, personal diets, and eating with friends.

Figure 21 Emerged affinity diagram

Conclusion

Fascinating insight started to emerge from here, basically revolving around how interviewees perceive the meaning of the healthy diet and the critical reasons for the user to use dining hall facilities and how they allow them to eat healthily. Some highlights indicate that the most common problems happen when dining hall facilities are so busy and crowded. Students are not patient enough to search around and try various food staying in long lines. Rush hours prevent students from having a balanced diet every day in school, which causes repetitive food. In this case, they prefer to grab their food on the go and abstain from staying in a line to have a particular food.

Journey Map

Designers need a way to develop more empathy and gain new insights. A journey map could help them look narrow and consider the user's experience journey. This journey map starts from the decision-making about selecting one of the dining hall facilities and leaving the dining hall.

As a designer, we need to ask ourselves how could we be more innovative and creative and turn the frustrations (red spots) into something extraordinary that could bring satisfaction to the user. Noticeably, the painful moments mostly happen for those who go to the dining hall with their friends or join them in there and affect each other's food decisions. Finally, they find themselves overeating and following their friends' food choices.

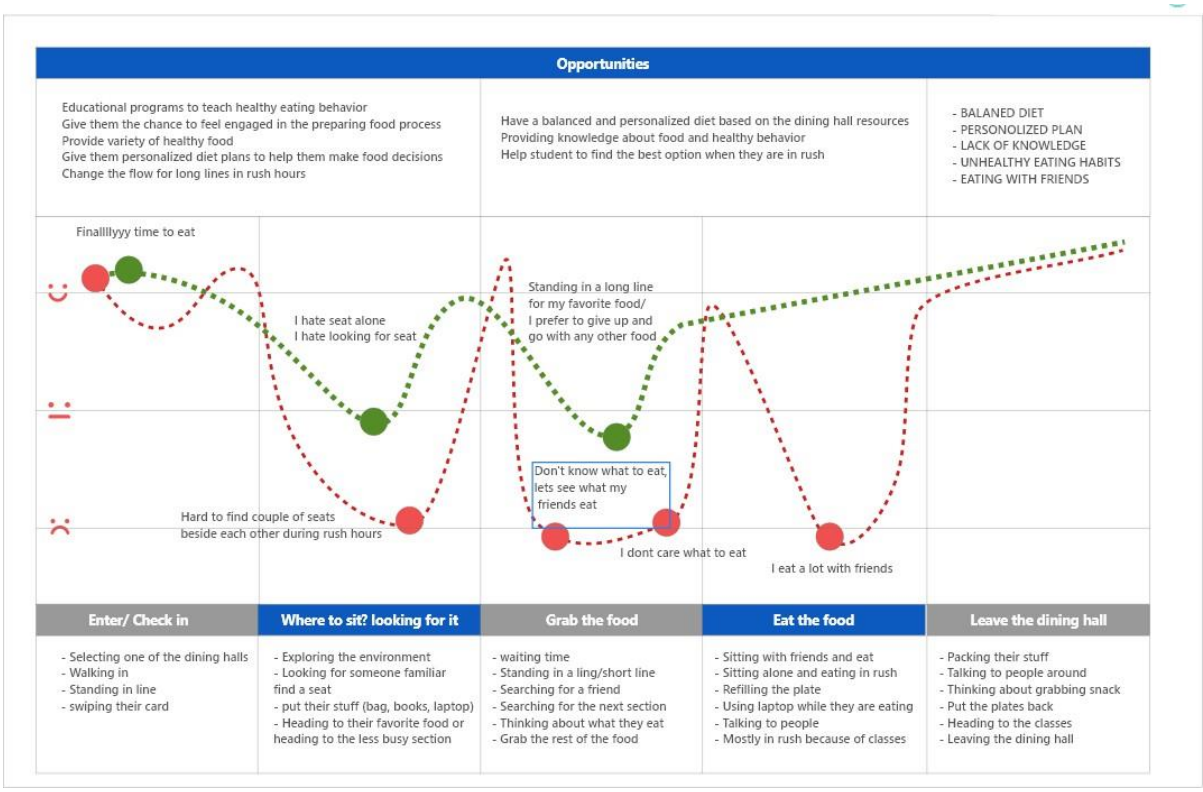


Figure 22 Journey Map

Product Benchmark Analysis

Product benchmark analysis helps designers to identify opportunities for improvement. New products, new technologies, new solutions are being used among successful companies and businesses to develop their strategy, compete with their competitors, and satisfy their users. Designing better and smarter products needs a good overview and research about the other companies to get familiar with their insights and how they choose to be the top brand in the market. Technologies and businesses are key aspects of product development and help designers to realize where their ideas are in the current market. In this study, it was also important to consider physical products and digital products while allowing students to have healthy eating behavior and stay healthy.

Product number one (Food Devider)

Figure 23 Product number one (Food Devider)

- Nutrition Content: NONE
- Tech: Smart tag (LED Ring Indicator) - Power Life: 12 to 18 months)
- Interaction: Smartphone, Alexa, Hub, Smart Speakers, Google Home
- Goal Statement: Fresh food, Reduce food waste
- Semantic:

  Glassy, Dark Grey, Colorful tag, Light in (Green, Yellow, Red)

  Material: ABS, TPU, Triton, Silicon, EA Free, BPS, BPA, Stainless Steel, UP gel

  Container Material: BPA-free durable Triton plastic
- Features: Main: Freshness Reminder. Secondary: Recipe Search, Waterproof
- Medical Features: NONE
- Function: Storage

Product Number Two (My Plate)

Figure 24 Product Number Two(My Plate)

- Nutrition Content: Track macronutrients (protein, carb, fat) and micronutrients (fiber, sugar, sodium), accurately and easily
- Tech: advanced photo recognition and AI technology
- Interaction: SmartPlate's iOS and Android app, wearable devices
- Goal Statement: Your Personal Nutritionist, nutrition tracking device, analyze health data and diet report, Set custom health goals, allows us to analyze and adjust meals accurately, efficiently, and quickly.
- Semantic:
- Fit to the users' personality
- Features: Main: Identity, weigh, and analyze everything you eat, Set custom health goals, allows to analyze and adjust meals accurately, easily, and quickly. Marked with: weight accuracy, nutrition accuracy, and efficiency
- reverse chronic disease, Blood Grouses, Diabetes
- Function: Plate, Weight, Analyser

Product Number Three (food Allergy Detectors)

Figure 25 Product Number Three (food allergy detectors)

- Nutrition Content: food allergy detectors.
- Tech: Test patch: new food-testing technology (Detector). Material: “Sentinel Wrap”
- Interaction: Smart Phones.
- Goal Statement: food allergy detectors. You are cooking your own healthy meals.
- Semantic: Green Light, Dark Grey, White
- Features: can detect gluten and traces of peanuts in food. Replace the traditional “best before” date on food and drinks.
- Users can record restaurant foods, packaged foods, and others. Every time the user test and share their result, they help others make healthier dining decisions.
- Medical Features: can detect gluten and traces of peanuts in food. Contribute their test results to inform the entire gluten-free or peanut-free community. They can monitor the contents for harmful pathogens such as E. coli and Salmonella.
- Function: Plate: Detector

Product Number Four (Food Analyzer)

Figure 26 Product Number Four (Food Analyzer)

- Nutrition Content: See the nutritional values of dairy, meat, fruit, and vegetables. WHAT"S IN FOOD? Scan food and beverages and get results based on true macro-nutrient information.
- Tech: molecular sensing capabilities, SCiO puts a lab in your own hands = micro-spectrometer (Includes an SCiO sensor).
- How works: that absorbs light reflected from an object, breaks it down into a spectrum and analyzes it to determine the object’s chemical makeup.
- Data: results are instantly uploaded to the cloud where data is aggregated for both real-time monitoring and long term analytics.
- The Changhong H2 has an embedded SCiO sensor that can analyze the properties of foods, medications, body metrics, and more.
- Interaction: Smart Phones, with SCiO embedded kitchen appliances

- Goal Statement: See the nutritional values of dairy, meat, fruit, and vegetables. Track body fat percentage. Select the sweetest, most nutrient-rich fruit.
- Semantic: White light, Dark Grey
- Features: Personal wellness: Scan and track body, composition, heart rate, and oxygen percentage to stay on track with your fitness regime.
- Skincare: Analyze and protect skin with a revolutionary lab-grade analyzer.
- The revolutionary SCiO Sensor, the powerful backend cloud.
- Empower users to reveal information never accessible before - properties of foods, medications, body metrics, and more
- Medical Features: Counterfeit detection: Disrupt the counterfeiters. Test, analyze, and identify, counterfeit drugs and currency anywhere.
- Function: Plate: Detector

Product Number Five (sniff)

Figure 27Product Number Five (sniff)

- Nutrition Content: NONE
- Tech: uses sensors to determine, simply “sniff” it with the FOOD sniffer handheld device
- FOODsniffer sensor gathers data and transmits it to the mobile/tablet app.
- FOODsniffer app measures gas levels, analyze results, and tell the user: The level of freshness of the food they are tasting, Whether it is safe to eat or should be discarded
- Interaction: smartphone or tablet
- Goal Statement: determines the freshness of raw meat, poultry, and fish tell if the food is fresh, hazardous to the user’s health, or has been left unrefrigerated for too long. (Spoiled or starting to spoil)
- Semantic: White, Green, Black, and Purple.
- Features: Detect fresh meat. FOODsniffer is simple to use – just need to slide it in, and the results will come to your smartphone or tablet via the FOODsniffer app in seconds
- Medical Features: NONE
- Function: Detector with Sensor

Product Number Six (Smart forks)

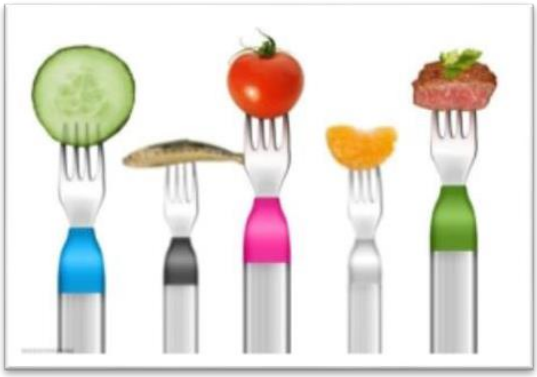


Figure 28Product Number Six (Smart forks)

- Nutrition Content: NONE
- Tech: Capacitive detection
- Microcontroller: ARM® Cortex®-M0 Processor. Four patents cover this technology. The measure of hand-to-mouth movement. Capacitive detection. Specific mechanical cooperation between the electronic key and fork Interaction between apps and data platform
- Interaction: Smart Phones, Laptops
- Goal Statement: Helps users to monitor and track their eating habits. Determine the freshness of raw meat, poultry, and fish tell if the food is fresh, hazardous to the users' health, or left unrefrigerated for too long. (Spoiled or starting to spoil)
- Semantic: Material: 2 plastic shell components. One vibrating feedback + 2 LEDs. Lithium Polymer Battery + 3.7 V
- Features: It also alerts users with the help of indicator lights and gentle vibrations when eating too fast.

- The HAPIfork also measures: How long it took to eat your meal, the amount of "fork servings" taken per minute. Intervals between "fork servings". Track their progress and score points in
- the HAPI.com challenge. Share their HAPI Moments online with friends. More friends...
- More fun!
- Eat at the right time, Eat at the right place: not too fast, Follow a coaching program
- Share with the community.
- Medical Features: NONE
- Function: Fork and detector

Product Number Seven (Fitness tracker)

Figure 29Product Number Seven (Fitness tracker)

- Nutrition Content: NONE
- Interaction: IOS Smartphones
- Goal Statement: Helps users to monitor and track their eating habits. Determine the freshness of raw meat, poultry, and fish tell if the food is fresh, hazardous to the users'

health, or left unrefrigerated for too long. (spoiled or starting to spoil)

- Semantic: Grey
- Features: monitor fitness levels and at the same time, also teach users how to relax and manage their stress.
- Medical: heart rates, respiratory rates, blood oxygen levels
- Function: Monitor Device, a fitness tracker. Check heart rates, respiratory rates, blood oxygen levels. Earn badges and points when you consistently monitor your fitness and wellness to keep you motivated. Indicates the fitness levels in 30 seconds.

Product Number Eight (Personal Diabetes Care Device)

Figure 30 Product Number Eight(Personal Diabetes Care Device)

- Nutrition Content: NONE
- Tech: glucometer (glucose meter), Lancing Device. It needs a small drop of blood - only 0.3 µl required. No cables, no batteries, no hassles. Built-in emergency hypo alert with GPS location for peace of mind

- Interaction: Smart Phones, Laptops
- Goal Statement: Checking blood sugar level and also tell the user how much insulin is required.
- Personal Diabetes Care
- Semantic: Orange, White, Black
- Features: Share real-time information and personalized reports with caregivers and family members. Consult with their specialist to help the users maximize their Dario experience
- Share stories, photos, and videos with the Dario community.
- A smart pocket-sized device, Highly accurate and fast measurements, Get results in less than 6 seconds and automatically records their blood glucose measurements and provides an analysis of their condition.
- Medical Features: It will then tell you your blood sugar level and tell you how much insulin is required based on the food information you entered into the app.
- Function: Personal Diabetes Care Device

Analyzing market research data
and identify opportunities for improvement

Compare the existing products with different aspects based on the user's need:

- Nutritional contents
- Personal content
- Social content
- Medical aspect

	product / Features								
Nutrution	Nutrition /Food Scanner/Sensor		✓	✓	✓	✓			
	Nutrition Analyzer		✓	✓	✓				
Personal Content	Motivation		✓				✓	✓	✓
	Personalization	✓	✓	✓	✓	✓	✓	✓	✓
	Reminder	✓	✓	✓	✓		✓	✓	✓
	Diet Recommendation								
	Personal Contexts	✓	✓	✓	✓	✓	✓	✓	✓
Social Content	Public Context		✓	✓			✓		
	Sharing - Enabled	✓	✓				✓		
	Social Monitoring - Enabled						✓		
	Visual Communication	✓				✓	✓	✓	✓
	Interaction - App	✓	✓	✓	✓	✓	✓	✓	✓
	Interaction - Wearable Devices							✓	
Medical	Medical Features			✓	✓			✓	✓

Table 6 Analyzing market research data

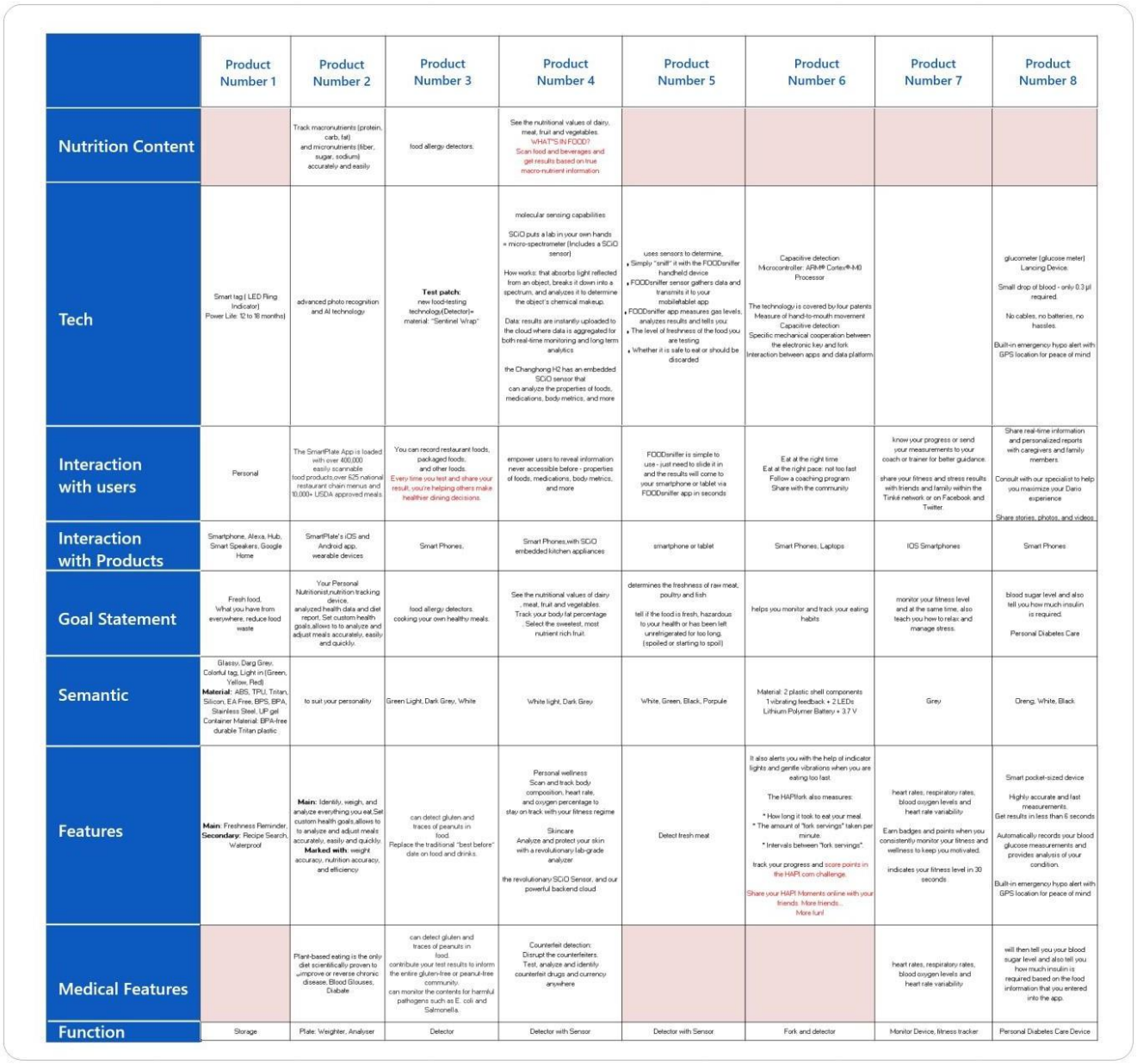
As it is obvious that the mentioned products had the least attention to the items below:

- Motivational aspect
- Diet recommendations
- Sharing-enabled
- Social Aspect
- Pleasing interaction

In-depth analysis in benchmarking

It is crucial to understand the features of existing products in more detail to determine how the current products' current features could make changes in a new product's body and solve the user's problem. In *table 7* every product was analyzed along with other products to find

out how they stand out in the market and how they cover users need in the market.



	Product Number 1	Product Number 2	Product Number 3	Product Number 4	Product Number 5	Product Number 6	Product Number 7	Product Number 8
Nutrition Content		Track macronutrients (protein, carb, fat) and micronutrients (fiber, sugar, sodium) accurately and easily	food allergy detectors;	See the nutritional values of dairy, meat, fruit and vegetables. WHAT'S IN FOOD? Scan food and beverages and get results based on true macro-nutrient information				
Tech	Smart tag (LED Ring Indicator) Power Life: 12 to 18 months)	advanced photo recognition and AI technology	**Test patch:** new food-testing technology(Detector)+ material: "Sentinel Wrap"	molecular sensing capabilities SCiO puts a lab in your own hands = micro-spectrometer (Includes a SCiO sensor) How works: that absorbs light reflected from an object, breaks it down into a spectrum, and analyzes it to determine the object's chemical makeup. Data: results are instantly uploaded to the cloud where data is aggregated for both real-time monitoring and long term analytics the Changhong H2 has an embedded SCiO sensor that can analyze the properties of foods, medications, body metrics, and more	uses sensors to determine, • Simply "sniff" it with the FOODsniffer handheld device • FOODsniffer sensor gathers data and transmits it to your mobile/tablet app • FOODsniffer app measures gas levels, analyzes results and tells you: • The level of freshness of the food you are testing • Whether it is safe to eat or should be discarded	Capacitive detection Microcontroller: ARM® Cortex®-M0 Processor The technology is covered by four patents Measure of hand-to-mouth movement Capacitive detection Specific mechanical cooperation between the electronic key and fork Interaction between apps and data platform		glucometer (glucose meter) Lancing Device. Small drop of blood - only 0.3 µl required. No cables, no batteries, no hassles. Built-in emergency hypo alert with GPS location for peace of mind
Interaction with users	Personal	The SmartPlate App is loaded with over 400,000 easily scannable food products,over 625 national restaurant chain menus and 10,000+ USDA approved meals	You can record restaurant foods, packaged foods, and other foods. Every time you test and share your result, you're helping others make healthier dining decisions.	empower users to reveal information never accessible before - properties of foods, medications, body metrics, and more	FOODsniffer is simple to use - just need to slide it in and the results will come to your smartphone or tablet via FOODsniffer app in seconds	Eat at the right time Eat at the right pace: not too fast Follow a coaching program Share with the community	know your progress or send your measurements to your coach or trainer for better guidance. share your fitness and stress results with friends and family within the Tinkê network or on Facebook and Twitter.	Share real-time information and personalized reports with caregivers and family members. Consult with our specialist to help you maximize your Dario experience Share stories, photos, and videos
Interaction with Products	Smartphone, Alexa, Hub, Smart Speakers, Google Home	SmartPlate's iOS and Android app, wearable devices	Smart Phones,	Smart Phones,with SCiO embedded kitchen appliances	smartphone or tablet	Smart Phones, Laptops	IOS Smartphones	Smart Phones
Goal Statement	Fresh food, What you have from everywhere, reduce food waste	Your Personal Nutritionist,nutrition tracking device, analyzed health data and diet report, Set custom health goals,allows to to analyze and adjust meals accurately, easily and quickly.	food allergy detectors. cooking your own healthy meals.	See the nutritional values of dairy , meat, fruit and vegetables. Track your body fat percentage Select the sweetest, most nutrient rich fruit.	determines the freshness of raw meat, poultry and fish tell if the food is fresh, hazardous to your health or has been left unrefrigerated for too long. (spoiled or starting to spoil)	helps you monitor and track your eating habits	monitor your fitness level and at the same time, also teach you how to relax and manage stress.	blood sugar level and also tell you how much insulin is required. Personal Diabetes Care
Semantic	Glassy, Darg Grey, Colorful tag, Light in (Green, Yellow, Red) **Material:** ABS, TPU, Tritan, Silicon, EA Free, BPS, BPA, Stainless Steel, UP gel Container Material: BPA-free durable Tritan plastic	to suit your personality	Green Light, Dark Grey, White	White light, Dark Grey	White, Green, Black, Porpule	Material: 2 plastic shell components 1 vibrating feedback + 2 LEDs Lithium Polymer Battery + 3.7 V	Grey	Oreng, White, Black
Features	**Main**: Freshness Reminder, **Secondary**: Recipe Search, Waterproof	**Main**: Identify, weigh, and analyze everything you eat,Set custom health goals,allows to to analyze and adjust meals accurately, easily and quickly. **Marked with**: weight accuracy, nutrition accuracy, and efficiency	can detect gluten and traces of peanuts in food. Replace the traditional "best before" date on food and drinks.	Personal wellness Scan and track body composition, heart rate, and oxygen percentage to stay on track with your fitness regime Skincare Analyze and protect your skin with a revolutionary lab-grade analyzer. the revolutionary SCiO Sensor, and our powerful backend cloud.	Detect fresh meat	It also alerts you with the help of indicator lights and gentle vibrations when you are eating too fast. The HAPIfork also measures: * How long it took to eat your meal. * The amount of "fork servings" taken per minute. * Intervals between "fork servings". track your progress and score points in the HAPI.com challenge. Share your HAPI Moments online with your friends. More friends... More fun!	heart rates, respiratory rates, blood oxygen levels and heart rate variability Earn badges and points when you consistently monitor your fitness and wellness to keep you motivated. indicates your fitness level in 30 seconds	Smart pocket-sized device Highly accurate and fast measurements. Get results in less than 6 seconds Automatically records your blood glucose measurements and provides analysis of your condition. Built-in emergency hypo alert with GPS location for peace of mind
Medical Features		Plant-based eating is the only diet scientifically proven to improve or reverse chronic disease, Blood Glouses, Diabate	can detect gluten and traces of peanuts in food. contribute your test results to inform the entire gluten-free or peanut-free community. can monitor the contents for harmful pathogens such as E. coli and Salmonella.	Counterfeit detection: Disrupt the counterfeiters. Test, analyze and identify counterfeit drugs and currency anywhere			heart rates, respiratory rates, blood oxygen levels and heart rate variability	will then tell you your blood sugar level and also tell you how much insulin is required based on the food information that you entered into the app.
Function	Storage	Plate: Weighter, Analyser	Detector	Detector with Sensor	Detector with Sensor	Fork and detector	Monitor Device, fitness tracker	Personal Diabetes Care Device

Table 7 In-depth analysis in benchmarking

Analyzing existing on-campus services for dining hall facilities

The case studies were randomly selected among US universities to see what they have done for college students to help them stay healthy when dining hall facilities.

	University / Dining hall features	Syracuse University	Auburn University	University Of California	Ohio State University	University Of Central Florida	University Of Maryland	UCLA
Nutrition	Nutrition /Food Scanner/Sensor							
	Nutrition Analyzer							
Personal Content	Motivation				✓			✓
	Personalization							
	Reminder							
	Diet Recommendation							
	Balanced eating (Variety of food)							
Social Content	Public Consultant	✓	✓	✓	✓	✓	✓	✓
	Sharing Diet - Enabled							
	Social Monitoring - Enabled							
	Visual Communication	✓	✓	✓	✓	✓	✓	✓
	Interaction - App	✓	✓	✓	✓	✓	✓	✓
	Interaction - Wearable Devices							
Medical	Medical Consultant	✓	✓	✓	✓	✓	✓	✓

Table 8 Analyzing existing on-campus services for dining hall facilities

As it is obvious that the mentioned universities had the least attention to the items below:

- Motivational analysis
- Motivation
- Personalization
- Diet recommendation
- Balanced diet recommendation
- Sharing diet-enabled
- Social Aspect

The only aspects that they had were:

- Dining hall application (Which do not cover users' needs)
- Public consultant

Benchmarking and Analyzing of existing Mobile Apps

Besides analyzing current real products in the market, looking through the high-rated diet and nutrition apps was the best opportunity to figure out how they compete and how they meet their users' needs. Finding out about their pros, cons, insights and bold features helped to find the opportunity gaps among available options in the market.

Application Number One: Diet Planner

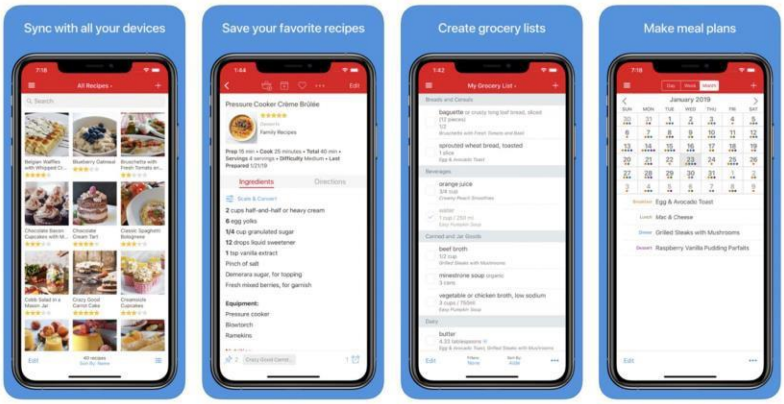


Figure 31 Diet Planner

Pros:

- Able to find out see what made him sick and what didn't, so it has the ability to know the user's body!
- The user can access everything relates to your health, not only diet.

Cons:

- Not able to show the progress

- It needs payments for more details

Insights:

- Making a connection with users with the concerns
- Personalizing the user's profile, and connect all the users with health centers and state gyms.

Application Number Two: YAZIO

Figure 32 YAZIO application

Pros:

- joining the Keto community
- finding people around with the same concern
- Online menus, allowing users to calculate intake calories for each meal

Cons:

It needs payments for more details

Insights:

Graphically visualize how many calorie users take

showing How much time they should work out to burn a specific amount of calories

Application Number Three: Lose it

Figure 33 Lose it Application

Pros:

- Extra feature for diabetes
- Co-operating with industry leaders – like Whole Foods Market
- Being able to connect with different healthy chain markets

Cons:

- Users eating on- the- go can also visit one of many healthy food chains, like chipotle,
- Being able to Snap a photo of the food to get nutritional facts

Insights:

- all data from the health center regarding the user's health and her/his limitation should transfer to their profile.

Application Number Four: My Plate Calorie Tracker

Figure 34 My Plate Calorie Tracker

Pros:

- Provides instant ratings and analysis on whether or not a food is a good fit for Keto
- provide different diet

  personalize with different user

Cons:

- A visual feature to inform the user by eating specific meal how many hours you should work out

  tracking of her/his calorie intake and nutrition

Insights:

- Provide the daily information for inspiration from their peers that have the same situation.

Application Number Five: Fooducate

Figure 35 Fooducate Application

Pros:

- Have a store for product to help you achieve your
- Fun beside knowledge
- Offer the stores around that have a good deal according to her/his diet.

Cons:

- There is the option the user can check the whole list of the professional instructor but cannot ask personal questions
- add more info about nutrient profiles of the food (just premium)
- Offer daily challenge

Insights:

- Meet a doctor or a dietitian.
- provide demos from the chef or nutritionist

Insights from analyzing existing mobile applications

Ideas and thoughts which came out after benchmarking existing mobile apps:

- All we need is providing the service for AU students which can personalize their healthy lifestyle information and connect this information, like the dining hall with the health center and state gym.
- There are many applications out there, but we need our application specifically for Auburn University to provide everything related to students' health.
- There is a lot of information online from bloggers and people who claim to know a lot about nutrition, but a lot of what they share is not science-based and is more about selling something or maybe following a trend.
- Like a state gym that uses students as a coach, we should use nutritionist students as mentors or instructors.
- Have a feature to know the chefs and their recipes.
- There is a need for better visualizations for better understanding for students.
- Use the nutritionist graduate or Ph.D. students to help students to have an ideal plan routine.
- Value those specific chefs who have some healthy recipes. Comment and star them
- Provide different plan according to different body style and needs by supervising the nutritionist and coaches

Mobile applications are ubiquitous right now in the market. Students are likely to have a phone with them and smart devices enhance the functionality in different areas of their lives. So there are a number of mobile applications that address the issue of balancing diet alone, but in

order to enhance and help the students at Auburn University to eat healthily, there are some opportunity gaps that convinced me to focus on this area. Few insights start to emerge of this which there aren't application-specific, which connected different levels and layers of a healthy lifestyle. They are not personalized based on each user, and they are not sharing enabled which connect users to motivate them being healthy.

Product Opportunity Gap

The product opportunity gap is a great method and it does what it says and it's a way for designers to measure where they want to be in the market. It creates a picture of how different products and companies are positioned in the market based on our design criteria and user's need.

The designed criteria derive the product opportunity gap axes to knowledge and balanced diet and motivation.

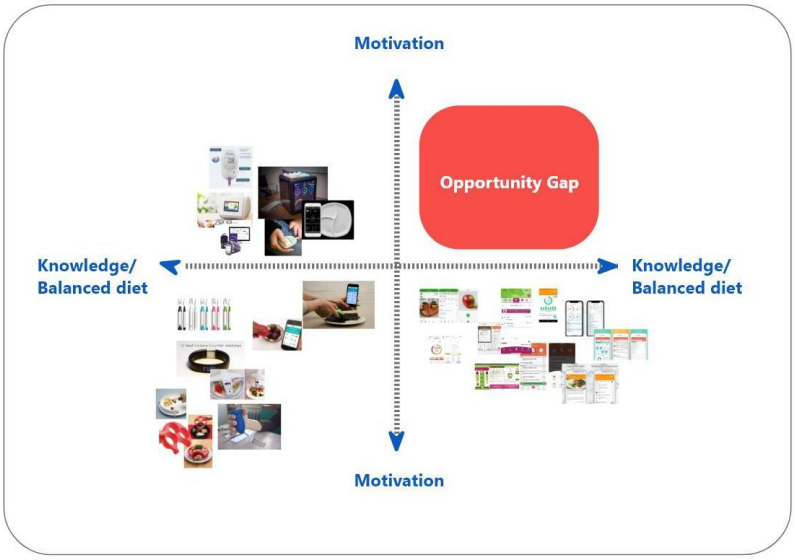


Figure 36 Product Opportunity Gap

By this chart, I tried to find out where I might be doing well and we might not be. As it is obvious, there was an opportunity gap in the red area. There is a lack of products that provide enough knowledge, create personalized balanced meal plans, and at the same time, motivates the user to stay and on healthy eating behavior.

Insights from market Analysis

Market research and analysis helped determine how other companies and businesses try to help people, especially freshman students, stay healthy and give them enough motivation to stay on the right track. Market analysis can actually reduce the risk of failure, and designers can use others' experience to make their design outstanding in the market.

Market analysis summary

Based on the market analysis and available resources, there are a lack of:

Role models among users to follow

Personal diet plans

Balanced diet plans

Visually pleasing nutrition content

Enough nutrition knowledge

Communication and sharing experience

Motivation to make healthy food decision and stay on the right path

Based on the user research analysis, users need to:

Import nutritional information about their food simply

Enjoy healthy eating behavior

Have awareness of Information about available food

Save time in the data operation

Personalize their diet plans to reduce time on every decision they make about their food

Manage their diet

Find motivation to stay on the right track

Feel good about their food decision-making process and eating food

Simplify the information

The figure below was derived from market research analysis and combined with what college students need for a healthy eating lifestyle.

Figure 37 Gap opportunities from market research

From findings to the design criteria

The transition from the literature review to the design criteria:

Healthy eating behavior:

Eating balanced and try to put a variety of food in daily food plans.

Get all the nutrition body needs through a healthy diet.

Eating healthy snacks like fruits and vegetables.

Inside and outside barrier to healthy food decisions:

Healthy and unhealthy eating habits Stress.

Lack of time management skills.

Healthy eating pre-knowledge.

Convenience.

Taste of food.

Family healthy/unhealthy eating habits.

Insights:

Create strong interaction between students with social media Engage social aspects of the dining hall with individual factors.

Try to change the user's eating behavior.

Personalize nutritional educations and advice from nutritionists Finding about the user.

Eating behavior:

Changing in eating behavior after entering school

Unhealthy eating habits

Overeating with friends

Following friends for food decision making

Willing to eat with friends or in a group rather than eating alone

Restrictions:

Unhealthy eating behavior

Following their friends and affecting by each other

Lack of knowledge about their body needs and nutritional content

Lack of eating behavior management

Variety of food in dining hall facilities

Insights

Help students to make better decisions about their daily food-related plans. Help them to stay on a healthy path and not follow others' bad eating habits. Teach them cooking quick and simple recipes.

Help them to manage their daily meal plans and balance their diet based on their body. Give them advice on their grocery shopping to eating more healthy snacks and ingredients.

Help them to make healthy food decisions even during the rush hours. Give them opportunities to learn about foods/ingredients and their bodies.

Findings from Market research (Tech & Business)

There are no diet-based social media platforms.

There are no role models for people for those who want to follow successful people. There is no personalization for individuals about their foods.

People can not share their experiences or their plans with people. There is no nutritional content based on their personal information

Insights

Making the user feel good about their food

Personalizing users meal plans and helping them live with healthy eating habits Suggesting meal plans based on their environment, facilities, and available foods around. Simplifying every process for the user as they are busy with so many things

According to the literature review, user study, and market analysis, the core aspects of design criteria are challenges in rush hours, lack of knowledge, lack of motivation, the social aspect of dining hall facilities, and food cost.

Figure 38 The core aspects of design criteria

These were the pillars that make up the bulk of design insights and ideas necessary for my final ideas. After considering the user's need and the environment (dining hall facilities), these

three items became key aspects of this product:

1. **Balanced diet** (Personalization, information, a limitation for eating some unhealthy foods)
2. **Motivation** (Award, pitches, role models, competition, challenges)
3. **Social Side** (Connect with friends, find role models, share their experience, social media

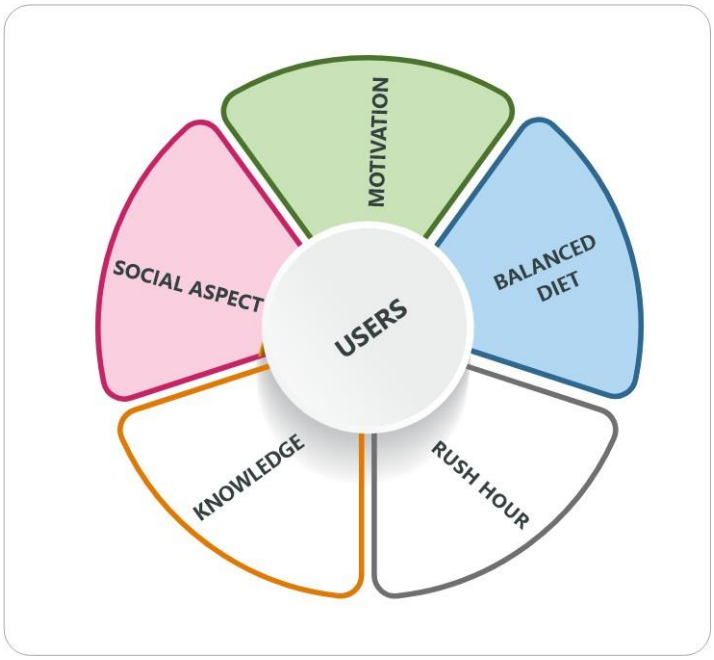


Figure 39 Actionable design criteria

Turning opportunity gaps in the final design ideas

1. **Motivation:** As a designer, we need to design a product/service to help students learn more about a healthy eating lifestyle and motivate them to stay on the right path.
2. **Balanced diet:** As a designer, we need to design a product/service to help them have a balanced diet that is personalized for each of them based on the available foods at dining

hall facilities on campus.

3. **Social aspect:** As a designer, we need to design a product/service to help students communicate with each other, stay healthy together, and find their role models.

Ideation

So, now that the goals of the product are defined, it is time to move to concept generations to see how we can help freshman students to have a healthy eating behavior on campus.

Low-Fidelity

The information from the literature review was used and converted to a low-fidelity (lo-fi) prototype. The main reason for the sketches is to compare and edit different ideas and concepts. The low fidelity phase consists of the final ideas based on the design criteria to cover key aspects design criteria and select the final candidates.

Design criteria

Motivation (number one)

Motivation: We needed to design a product/service to help students learn more about a healthy eating lifestyle and motivate them to stay on the right path.

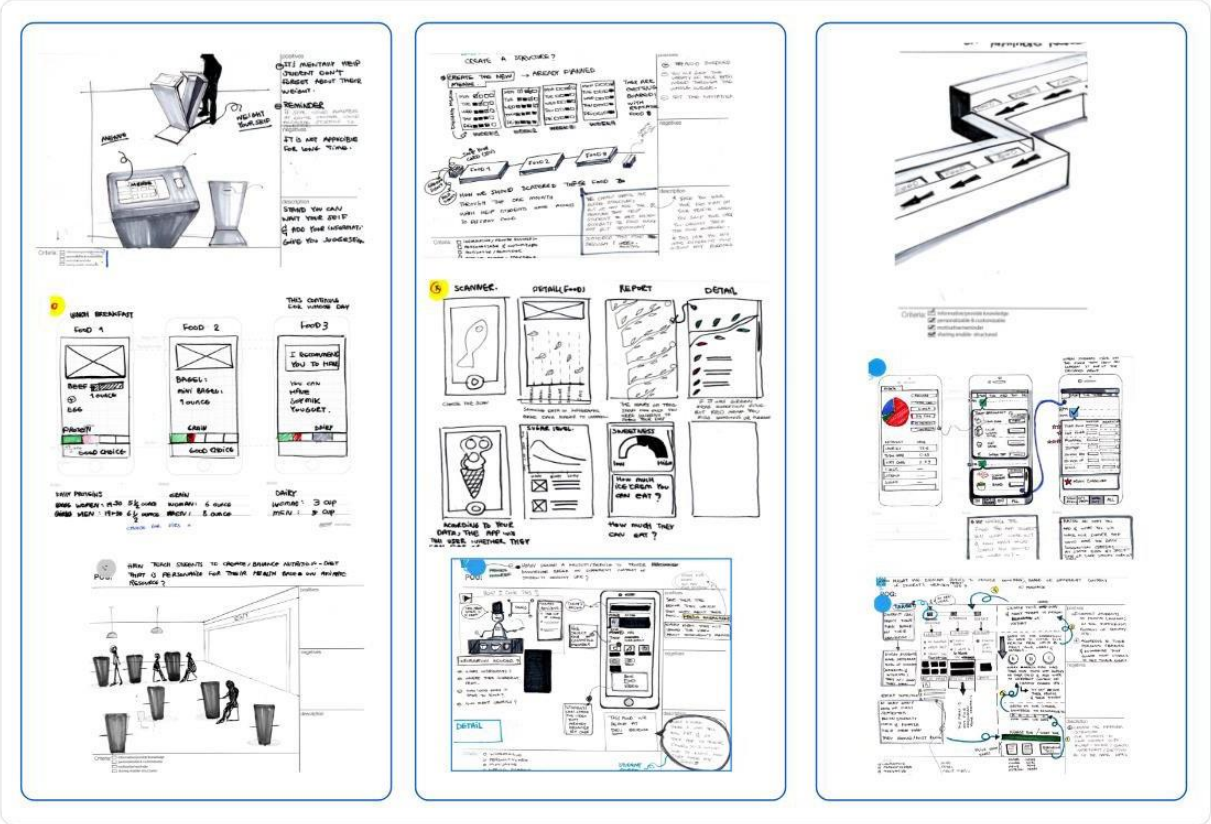


Figure 40 Ideation (Part 1)

Design criteria

Balanced Diet (number two):

We needed to design a product/service to help the user have a balanced diet that is personalized individually, based on the available foods at dining hall facilities on campus and their preferences.

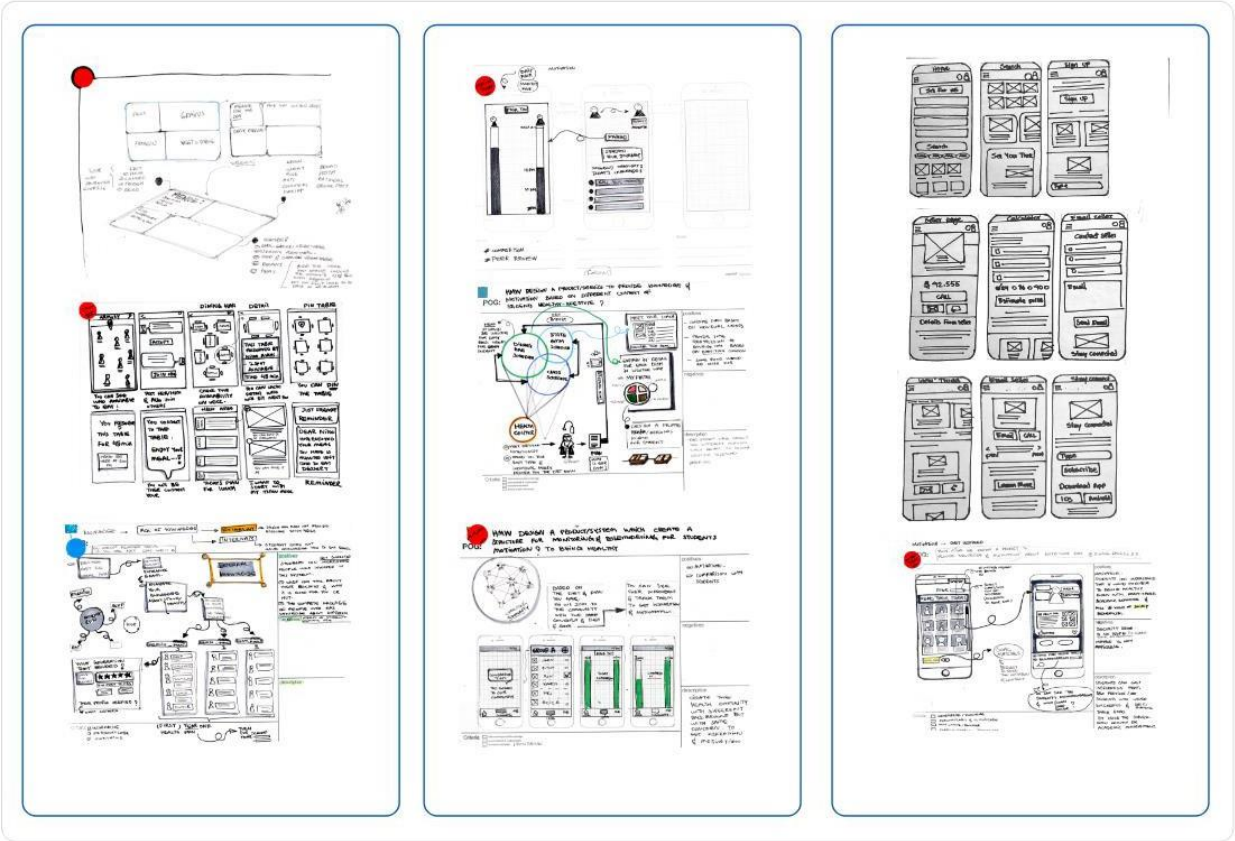


Figure 41 Ideation (Part 2)

Design criteria

Social Aspect (number three)

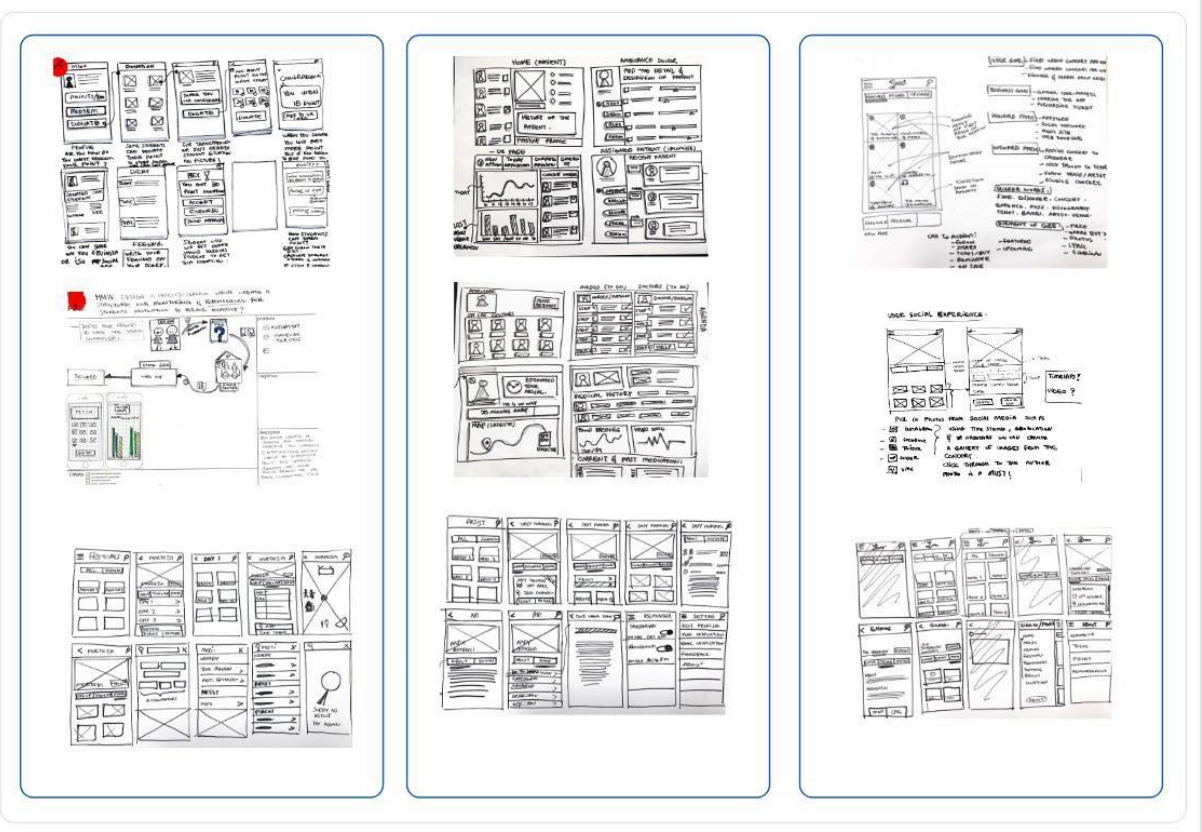


Figure 42 Ideation (Part 3)

Ranking Ideas

Designers often end up with many ideas, and some will be more creative than others. User research and literature review help them not continue the design process with all design ideas. One of the effective ways is to get all of the ideas in one place like an excel spreadsheet. Listing each idea with enough details and information allows review and comparison of them all together. Once all the ideas are gathered together, it is time to rank them. In general, designers rank the ideas based on the user's needs, and instead of ranking ideas against each other each idea is independency scored from 1 to 10.

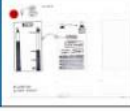
	DESIGN CRITERIA/ IDEAS	KNOWLEDGABLE	BALANCED DIET	PERSONALIZATION	MOTIVATIVE	ROLE MODELE / SHARING ENABLED	TOTAL	COMMENTS
HAPPINESS		0	5	5	5	2	17	RANKED SECOND
EXCITED		4	4	4	3	0	15	
JOLLY		5	5	4	4	4	22	RANKED FIRST
INVITING		4	5	5	0	0	14	
EAGER		1	0	0	5	5	11	
HANG OUT		0	3	3	5	5	16	RANKED THIRD
APPETIZING		2	2	0	5	5	14	
CARING		5	0	0	1	3	9	

Table 9 Ranking Ideas

After ranking ideas, there is one more step that could help designers evaluate each of the ideas based on the design criteria. The individual design criteria aspects are:

1. Role modeling
2. Motivation
3. Knowledge

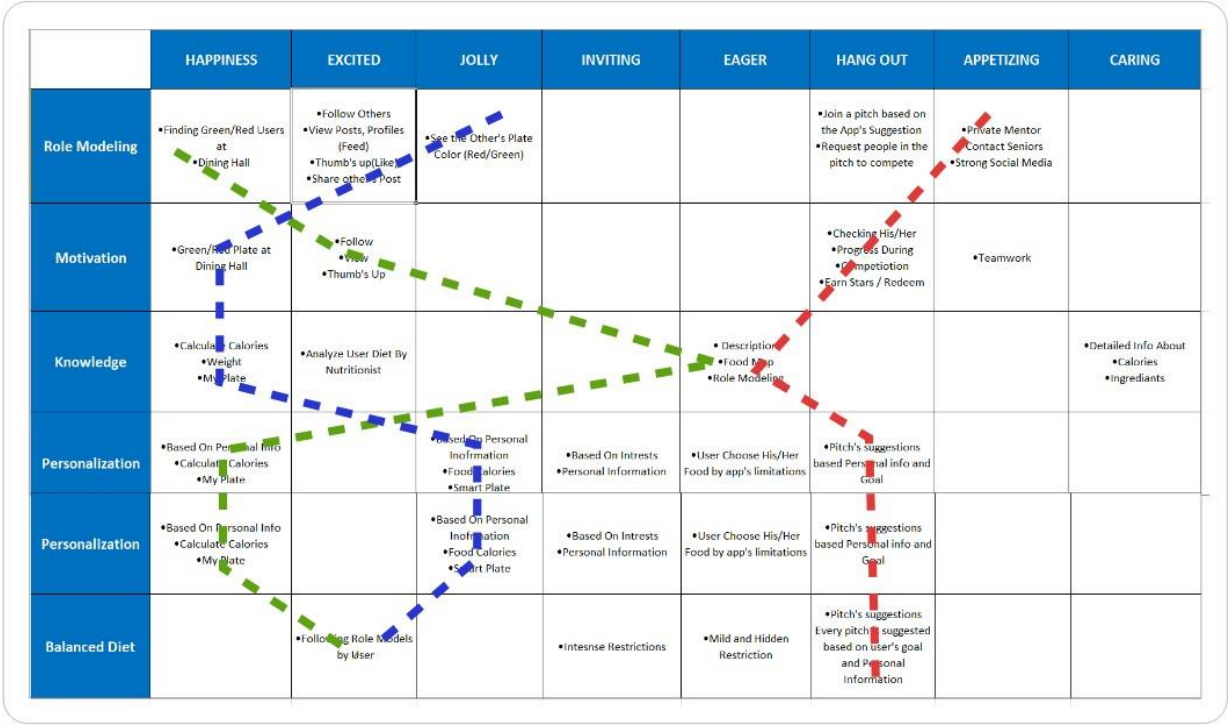
4. Personalization
5. Balanced diet
6. Motivation

	HAPPINESS	EXCITED	JOLLY	INVITING	EAGER	HANG OUT	APPETIZING	CARING
Role Modeling	•Finding Green/Red Users at •Dining Hall	•Follow Others •View Posts, Profiles (Feed) •Thumb's up(Like) •Share other's Post	•See the Other's Plate Color (Red/Green)			•Join a pitch based on the App's Suggestion •Request people in the pitch to compete	•Private Mentor •Contact Seniors •Strong Social Media	
Motivation	•Green/Red Plate at Dining Hall	•Follow •View •Thumb's Up				•Checking His/Her •Progress During •Competiotion •Earn Stars / Redeem	•Teamwork	
Knowledge	•Calculate Calories •Weight •My Plate	•Analyze User Diet By Nutritionist			• Description •Food Map •Role Modeling			•Detailed Info About •Calories •Ingrediants
Personalization	•Based On Personal Info •Calculate Calories •My Plate		•Based On Personal Inofrmation •Food Calories •Smart Plate	•Based On Intrests •Personal Information	•User Choose His/Her Food by app's limitations	•Pitch's suggestions based Personal info and Goal		
Personalization	•Based On Personal Info •Calculate Calories •My Plate		•Based On Personal Inofrmation •Food Calories •Smart Plate	•Based On Intrests •Personal Information	•User Choose His/Her Food by app's limitations	•Pitch's suggestions based Personal info and Goal		
Balanced Diet		•Following Role Models by User		•Intesnse Restrictions	•Mild and Hidden Restriction	•Pitch's suggestions Every pitch is suggested based on user's goal and Personal Information		

Table 10 Ideas evaluation based on the design criteria

Matching the ideas based on the design criteria

Each idea has its own features, but there are elements that they did not cover. This chart helped combine all the best features from different ideas and ended up with three ideas: the combination of all the design ideas.



	HAPPINESS	EXCITED	JOLLY	INVITING	EAGER	HANG OUT	APPETIZING	CARING
Role Modeling	•Finding Green/Red Users at •Dining Hall	•Follow Others •View Posts, Profiles (Feed) •Thumb's up(Like) •Share other's Post	•See the Other's Plate Color (Red/Green)			•Join a pitch based on the App's Suggestion •Request people in the pitch to compete	•Private Mentor •Contact Seniors •Strong Social Media	
Motivation	•Green/Red Plate at Dining Hall	•Follow •View •Thumb's Up				•Checking His/Her •Progress During •Competiotion •Earn Stars / Redeem	•Teamwork	
Knowledge	•Calculate Calories •Weight •My Plate	•Analyze User Diet By Nutritionist			• Description •Food Map •Role Modeling			•Detailed Info About •Calories •Ingrediants
Personalization	•Based On Personal Info •Calculate Calories •My Plate		•Based On Personal Inofrmation •Food Calories •Smart Plate	•Based On Intrests •Personal Information	•User Choose His/Her Food by app's limitations	•Pitch's suggestions based Personal info and Goal		
Personalization	•Based On Personal Info •Calculate Calories •My Plate		•Based On Personal Inofrmation •Food Calories •Smart Plate	•Based On Intrests •Personal Information	•User Choose His/Her Food by app's limitations	•Pitch's suggestions based Personal info and Goal		
Balanced Diet		•Following Role Models by User		•Intesnse Restrictions	•Mild and Hidden Restriction	•Pitch's suggestions Every pitch is suggested based on user's goal and Personal Information		

Table 11 Matching the ideas and features

PMI (Plus, Minus, Interesting)

The PMI technique was used to improve the design thinking. This technique helps designers to fine the Plus Points, Minus Points, and Interesting points before forming the final idea. All final candidates were named spectrally enable better recognition in the table.

	PLUS	MINES	INTRESTING
HAPPINESS	•Screen shows you how much you were successful in your diet based on colors on the screen. •The colors on your screen encourage you and others to compete with each others. •Psycologicaly could affect you control your diet cause you can see other's plate with their colors. •They can carry it and stand whereever they what. •Help them save their time to find an open sit •It is a smart plate that can visually help you to how much you can eat based on your diet. •Smart carry on that can help you which road you should go to pick you food.	•It takes a lot of room • Cost a lot for dining hall •Socializing - Disabled •NOT knowlegable	•It's like a game •play the game, keep yourself healthy •earn points and redeem.
EXCITED	•It can connect to your smart phone •It provides you diet plan based on your personal information •Limit you, Notify you to stop you not being healthy Inform you by the color on the plate's screen(Red= stop taking that food (over weight) / Green = you are good to go) •Share your plan and succeed with others, recieve encouragement and comments, follow your friends ... •Weight you food •Nutrition Analyzer •Avoid student to not over eating •Smart screen to calculate the caleries (Food detector) •Blalenced their diet by the calories,perotein, carbs, .. •Alart you if you are eating wrong and even miss a part of your diet	•Cost	•Colorizing •Personalization •Socializing •Sharing •Motivation •food weighter •nutrition analyzer in seconds •Be your nutritunist •It awares of what you eat, so no need to enter what you eat and the calories you got after your meal
JOLLY	•It takes the user to a fun and motivational plan. This journey is devided to 3 semesters (Fall, Spring, Summer). •Every challenge/journey is categorized in daily, monthly or whole semester challenge which is selected by the user in advanced but they can make a change or stop during the journey (it is flexible).•This plan is designed by dietition and nutritionist based on the science. By following this diet you will get you daily ballenced-nutritiong based on your personal ifromation (sex, Body, weight, ...)	•No sharing information and improvement with others •It wont motivate based on the competition and other's progress. •You are alone in this plan. •You can not evaluate yourself with graphs and others. •NO Social media	•Color / Visualization

Table 12 PMI table (part 1)

	PLUS	MINES	INTRESTING
JOLLY	♦It takes the user to a fun and motivational plan. This journey is devided to 3 semesters (Fall, Spring, Summer). ♦Every challenge(journey is categorized in daily, monthly or whole semester challenge which is selected by the user in advanced but they can make a change or stop during the journey (it is flexible).♦This plan is designed by dietition and nutritionist based on the science. By following this diet you will get you daily ballenced-nutritiong based on your personal ifromation (sex, Body, weight, ...)	♦No sharing information and improvement with others ♦It wont motivate based on the competition and other's progress. ♦You are alone in this plan. ♦You can not evaluate yourself with graphs and others. ♦NO Social media	♦Color / Visualization
INVITING	♦Check the menu for the 2 weeks in advanced and see the entire ingredients. ♦There are 2 ways you can choose food during 2 weeks. 1. you can go ahead and select your food so athomaticaly the app stop you select some food based on what you have selected with their amount of nutrition. 2. let the app find give you the best plan for the 2 weeks based on yur personal information and your taste. ♦The application give the infrmation to find your upcoming meal in the right location (save time for looking the food's place) ♦Student can plan what they want to eat for 2 weeks the sysytem does not allow you to choose one food over and over so there is no repeatation, it means you will recive your nutritional balance through the whole week (like Protein, carb, vitamins ...) ♦Psycologicaly you will be free to think about what you wnat to eat every day(you have diffenert options in each mael. ♦Based on your first and main food it will calculate what you have had and what you will have to eat to fill your my plate rule.	♦Can not follow your friends and your roll models ♦you have to be alone in your diet (No outside motivation) ♦No Socializing ♦NO motivation through the competions or with people	♦repeatitive food ♦Strong knowledge about nutrition ♦Variety in your diet ♦Makes you not to get bored of
EAGER	•Joing to different community based on your concern. Challenge yourself weekly, daily or monthly. •Request and ask you friends to join the pitch and compete with you. •Check on your pairs progress •Motivate you through the team and with people request the senior and jonour student that already have successful background in the pitches. •More pitches, more points then you can redeem them for different goals.	•NO personalization •Not knowledgable about nutrition	•Challenge with professionals and see yourself in the future •finding people with the same concern to compete with you

Table 13 PMI table (part 2)

	PLUS	MINES	INTRESTING
HANG OUT	•Students can follow each others, put comments and like or dislike their activities to helo each other find the best suggestions. •Expert people can analyze student post and let them know if they are doing a good job or not, even they can suggest a better choice •Create the profile for students, chefs, nutritionists in one platform. •Expert people in nutrition can follow succeessful people and introduce them to the other through the app •Share their personal choice based on availabe resorce at dining hall and snap it and share it through the feed page to recieve comments and get recommendations. •Good motivation to recieve more thumbs up. •Became a role model through the app by being followed and viewed	•No personalization on diets	•Strong socializing •Bcome famuse bloger and job poster •Receive comment on your daily routin about food
APPETIZING	•App recommends you some group based on what you enterde about your concerns •Each group has its own mentor to be managed, its own diet plan and recommendation for you exercise. •members can ask their questions to mentors and the others •all available teams compete with eachothers with theirs members. So as a team member you have the responsibility to do your best to make your team successful as a reward for each team, they recieve some awards like, free food, free consultant, discount in the next semester meal plan.	•No descriptin about what you get from each meal specificley •No personalization, so you all in a team have one meal plan and diet. It is general for all team members •you need to keep you balane by yourself if you want your team be succeessful. So you need to keep an eye on your diet by your own knowledge.	•Strong socializing •Bcome famuse bloger and job poster •Receive comment on your daily routin about food
CARING	•plans provide best knowledge about what the plan is going to BE , about the nutrtions... •Detailed Profile for students to know their mentor, dietionist, nutritionist	•No plan to personilze the students knowledge •No monitoring about how student balance their meals •No socializing •No motivation	NONE

Table 14 PMI table (part 3)

Use of the PMI technique helps to structure our thinking so that before the final idea is committed, the team can explore the upside, the downsides, and the interesting points of each concept. Finally, when I wanted to form the final idea, more balanced decisions about the features are proposed.

Ideation (Round Two)

Idea number one

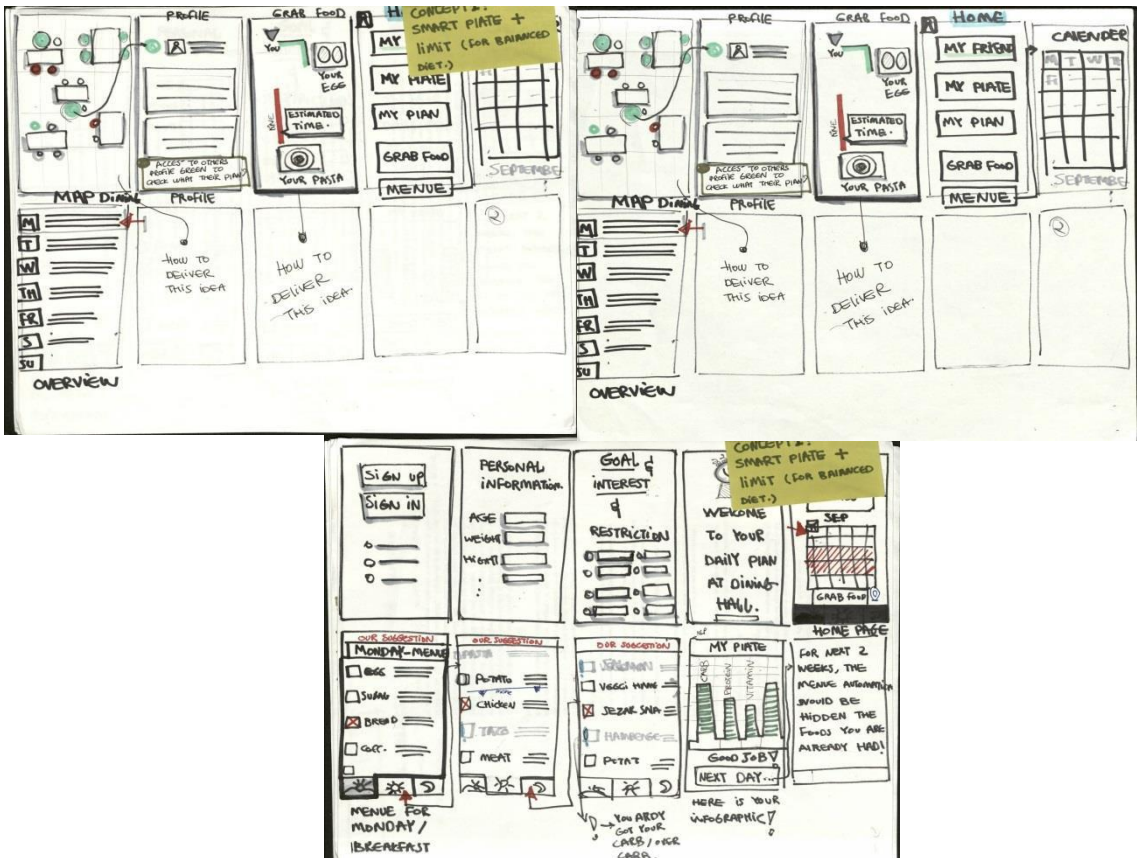


Figure 42 Idea number one

Features

- Auto Filtering (Balanced diet-personalization)
- Recommendations (knowledge-personalization)
- Separating users in red and green users (psychology-Motivation)
- Finding food locations
- Finding friends (Social Aspect)

Explaining the features of this design proposal

- **Auto filtering**:

On the homepage, there is a part for breakfast, lunch, and dinner. When students choose their meal plans for each, the app will hide some other meals on the menu for the day, respectively, and automatically if they already used some.

For example, since the user has already got enough carb from his breakfast meal plan, selecting carb for the rest of the day will be disabled or hidden, and the users can no longer have carb in her/his plan on that day.

- **Red and Green users:**

This application divides all users into two different groups, red and green. These colors will appear on their profile and show their status. If the users regularly follow a healthy diet, the profile turns green; if not, their profile becomes red. Leveraging the psychological aspect of color that reveals the students' performance with colors to affect their decision at the moment and show them the way they eat every day. Being red or green can make them proud or alert to what they are doing to their body with their healthy or unhealthy meal plans.

- **App recommendations:**

There can be different types of users and some of them are might be "bossy" and "lazy" based the interviews.

Lazy students:

Users can let the app suggest to them what to eat for the daily plan based on the personal information that they entered into their profile at the beginning. This feature could help them

stay healthy and save time at the same time. On every page (breakfast, lunch, dinner) users have multiple recommendations based on the user's personal info, allowing them to select appropriate food immediately among the suggestions. All the users need is to follow the application and fill their plans.

Bossy students:

On the other hand, this idea allows users to manage their meals plan entirely manually.

- **Social aspect:**

Students can add their friends and see their status and food plans simultaneously on their profiles.

- **Grab my food:**

A section named "map" graphically shows the dining hall map so they can find their food location and check the waiting time for each line to estimate how much time they need to stand in a line**.**

Conclusion

Although idea number one meets all the criteria, it does not cover the **"Balanced diet"** option, which is one of the primary criteria. To solve this problem, idea number one was combined with one of the other concepts to borrow a balanced diet feature. These questions were created to be answered at the final idea.

- How is this feature implemented in the "number one" idea?
- How restrictions and balanced diets could be added to the "number one" idea?
- What is the reason behind idea number one?

Idea Number Two

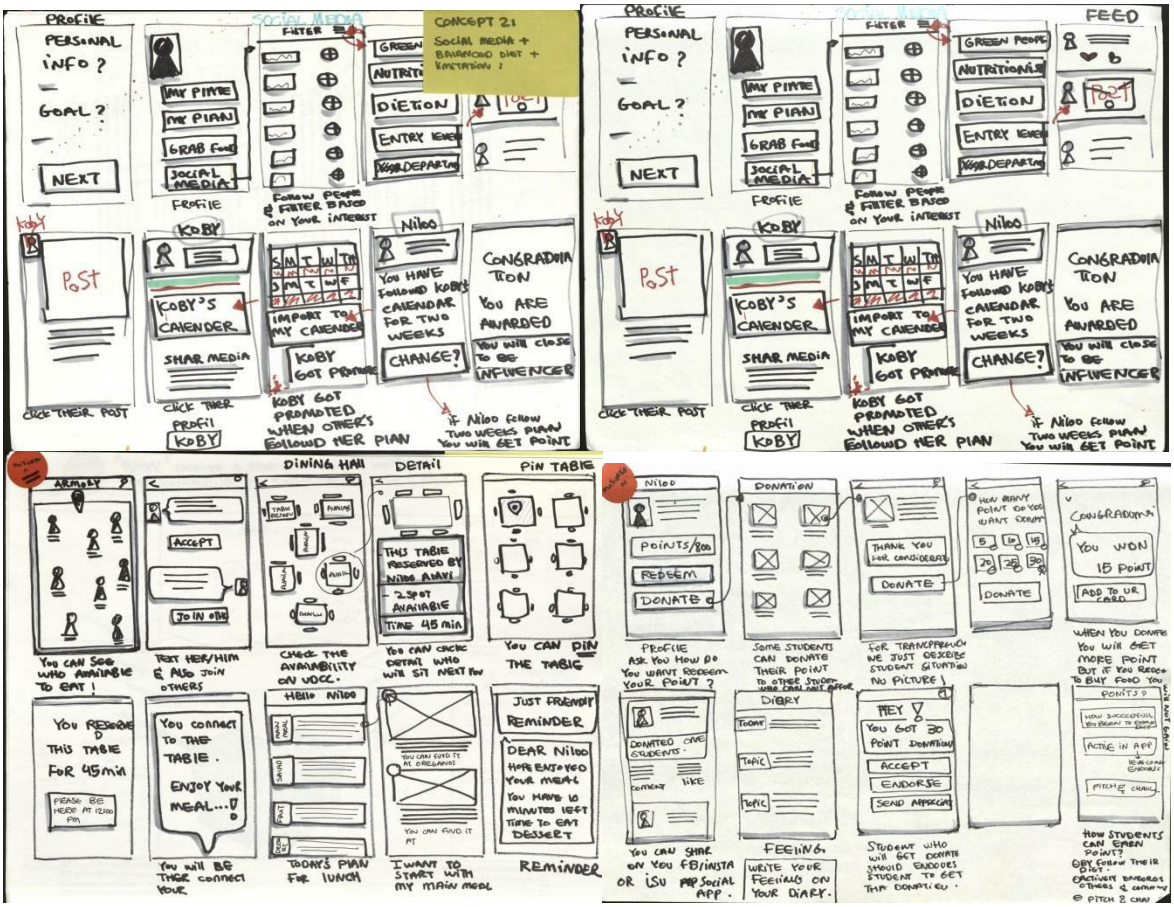


Figure 43 Idea Number Two

Features

- Finding green people (Social aspect)
- Finding healthy plans (Social Aspect – Personalization)
- Award-Winning based (Motivation)
- Thumbs up button (Motivation)

In this idea, users can go and check the other students' diet plans. For example, They can check people's status, and at the same time, they can find out how they arrange their meal plans and how they stay healthy.

Explaining features:

- **Following people:**

  On this app, people can follow each other and even follow somebody's plan. So based on this, the app suggests some green users to follow. If they are matched by their personal goals, physical activities, internets, and all of the basic primary information they had been asked during the sign-up process such as Age, sex, goal, weight, etc., they will help each other to grow.

- **Thumbs up:**

  The other students can like each post. More likes recognize you as a successful student compares to the others. Points will be added to their profile if they get different numbers of likes for each post.

- **Finding healthy plans:** Following similar people gives the users this opportunity to follow others' plans as well. So those lazy users who do not want to arrange their plan by themselves will not be affected and still can eat healthy by just applying their plans to their own profiles.

- **Award-winning based application:**

  If more and more people follow someone, the student will receive points. Being a green user for a specific period and having more followers can increase the chance of earning more points. People with the highest point became a member in the role model category and can get more bones.

How we considered a balanced diet in this idea:

Since this is a social media app, we were not able to suggest any balanced diet feature for every student, but based on the psychology science and imitation facts, as long as students follow and imitate the right (green) and successful people, they will be kept on the healthy side.

Idea Number Three

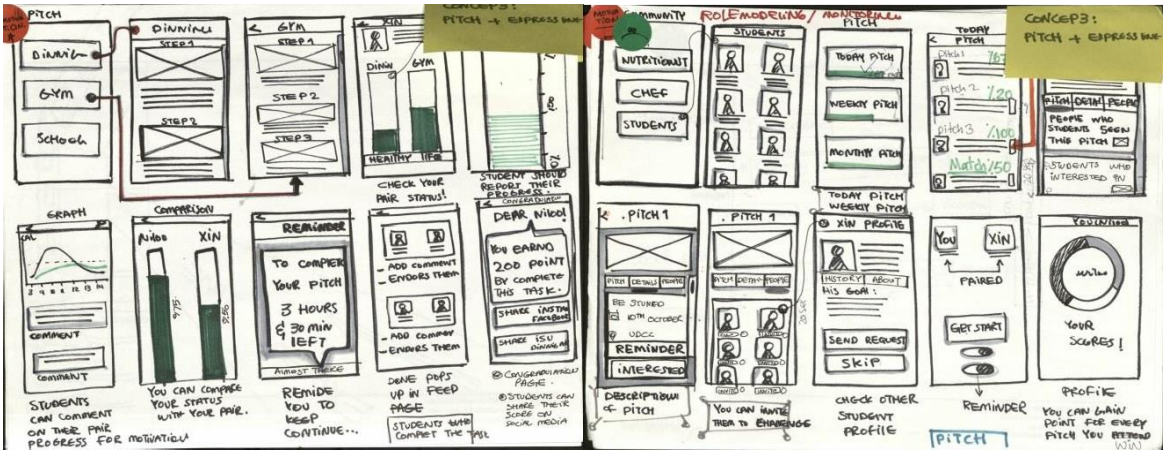


Figure 44 Idea Number Three

Features

- Pitches (Motivation-Social Aspect)
- Finding meal plans (Motivation-Social Aspect)

The application has different pitches provided by nutritionists and deletionists (based on science). Pitched are defined to be daily, weekly, and monthly. Students will decide to join a suggested pitch every two weeks based on their preferences on their profile.

How does it work?

Pitch categories have different percentages that show how matched they are with the user's preferences and goals like %30, %50, or %90. Since the user decides to join a pitch, the competition starts and they need to fight as a team to win the game!

In every pitch, competitors have access to the other's profile to see what their meal plans are and follow the way they eat healthily.

Final Idea: My Bites

User Experience:

This section walks the reader through a successful system for dining hall facilities. It demonstrates how freshman students can follow a healthy eating habit/behavior while using dining halls during their first school year.

User Flow

After collecting all the data and information from the user through research, we were able to make a user flow diagram that displays the complete path a user should take to get his food every day at dining halls.

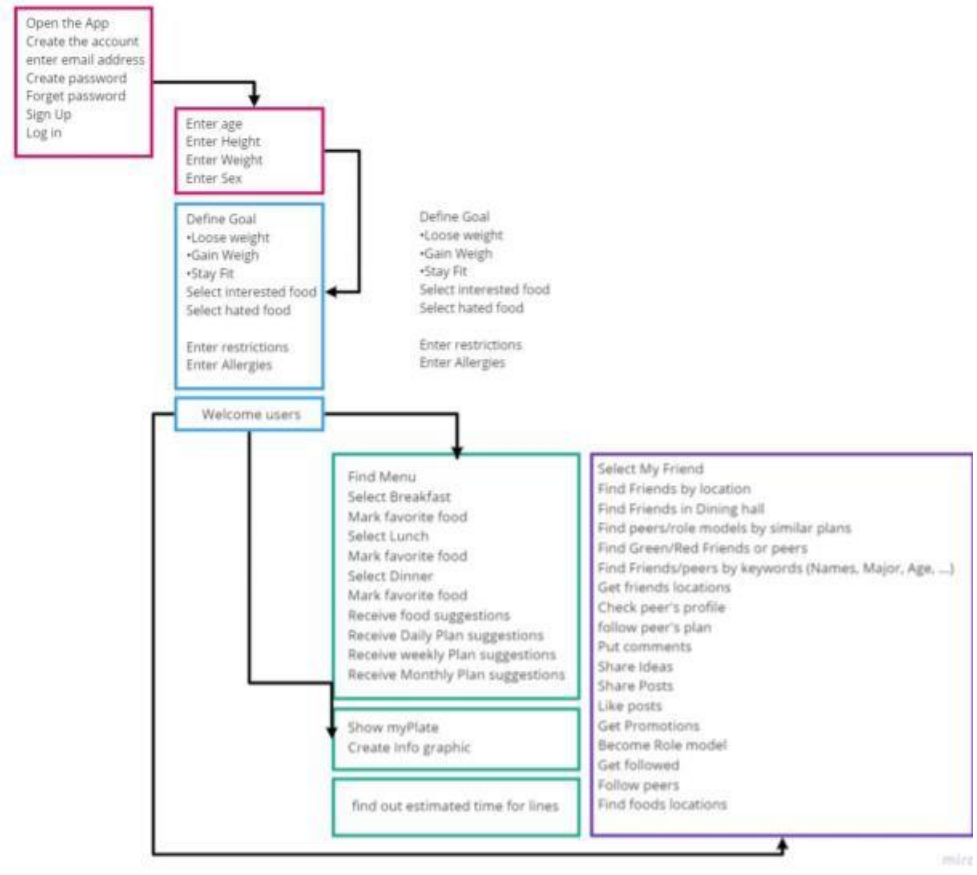


Table 15 User Flow

Introducing AU BITES

AU BITES application is for freshman students, which focuses on Balanced diet, nutritional knowledge, and motivational aspects and aims to help them have a healthy eating lifestyle. It gives the user the option to have their best meal plans every day based on their preferences during their busy school days. It also provides a community space to connect them to their friends, nutritionists, and other experts to pursue their healthy eating lifestyle on campus.

Design Criteria at a glance

At first, we focused on User Experience and tried to create a solution based on user needs and design criteria(Figure 47). we collected the user needs and frustration through the user persona. After considering the user's need and the environment (dining hall facilities), these three became critical aspects of this product (AU BITES application):

1. **Balanced diet** (Personalization, information, a limitation for eating some unhealthy foods)
2. **Motivation** (Award, pitches, role models, competition, challenges)
3. **Social Side** (Connect with friends, find role models, share their experience, social media

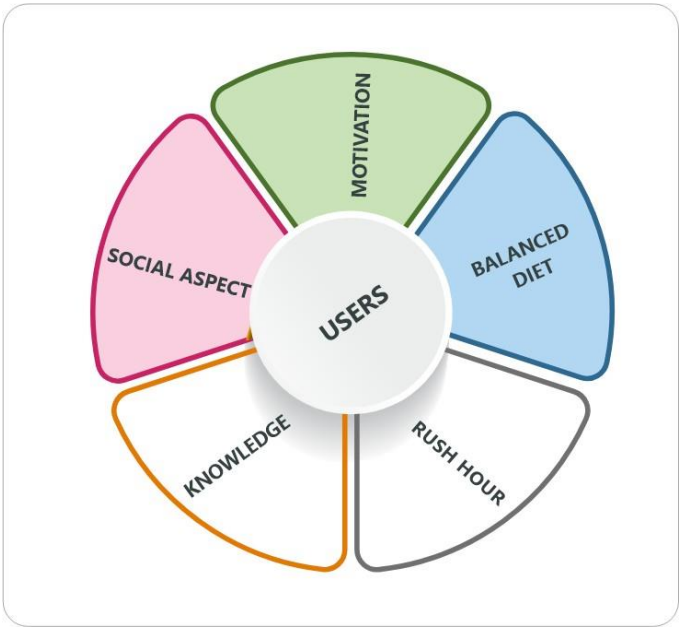


Figure 45 Actionable design criteria

There is no better interpretation of the saying of the quote, "Health is wealth." A scenario could be when entering dining hall facilities and food options are available, knowing that an individual has some allergies or may watching out for some ingredients exceptions. Moreover, knowing how harmful a poor diet is, but you don't know what the best meal plan for you is. What if students have an app that can suggest daily meal plans based on personal preferences and what thier body really needs? Sounds good, right?

Here is another scenario; you have a specific food in mind for a couple of days; you find yourself eating that food for days in a row just because you are busy with school; you just want to grab your food and go. So you are missing some essential nutrition by making wrong food decisions. What if you have an app that helps you with your daily food choices based on what you like and what your body needs?

The design of the UX and UI grew from the finding in the user research. The user research was analyzed for commonalities. We found commonalities of when:

- The user wants to select a food
- The user has nutrition knowledge but does not care
- The user has nutrition knowledge but does not have enough motivation to follow it
- The user can not balance his diet based on nutritions
- The user does not have enough motivation to have/follow a healthy eating behavior
- His/her friends affect his eating behavior

AU BITES will take care of many scenarios that could happen to many freshman students at dining hall facilities every day and affect their healthy eating behavior.

Key features of the AU BITES

There are four main features in AU BITES application based on our design criteria (Figure 48):

- **Daily food suggestions:**

Suggests meal plans based on users' set meal preferences, Medical conditions, main goals, recent food choices, physical activity, body type, etc. Users can also choose to plan their meals by themselves.

- **Individual Balanced meal plans:**

Suggests meal plans based on essential factors for a balanced diet (MyPlate): carbs, protein, fat, fiber, vitamins, minerals, and water.

- **Social environment:**

getting motivations, Gaining knowledge, making friends, getting rewards

Low-Fidelity Wireframes

. We were starting with hand-drawn low-fidelity wireframes for main screens. It helped to visualize the basic structure of the interface. Then we converted them into high-fidelity wireframes digitally.

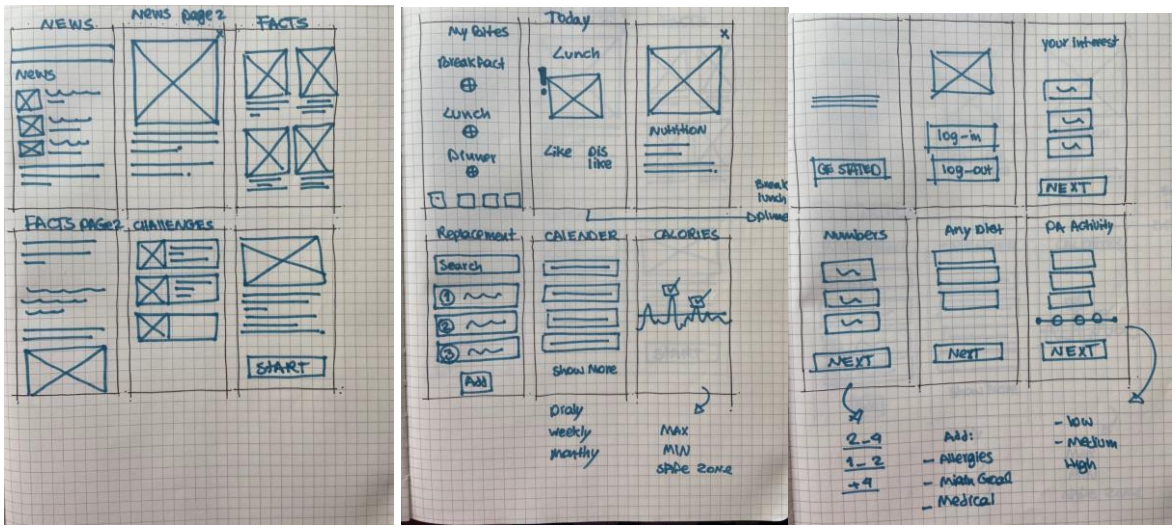


Figure 46 Low-Fidelity Wirefra

High-Fidelity Wireframes

After design research, creating design criteria, and low fidelity wireframes, it was time to generate high fidelity wireframes and bring the solutions to the real world. (Figure 47).

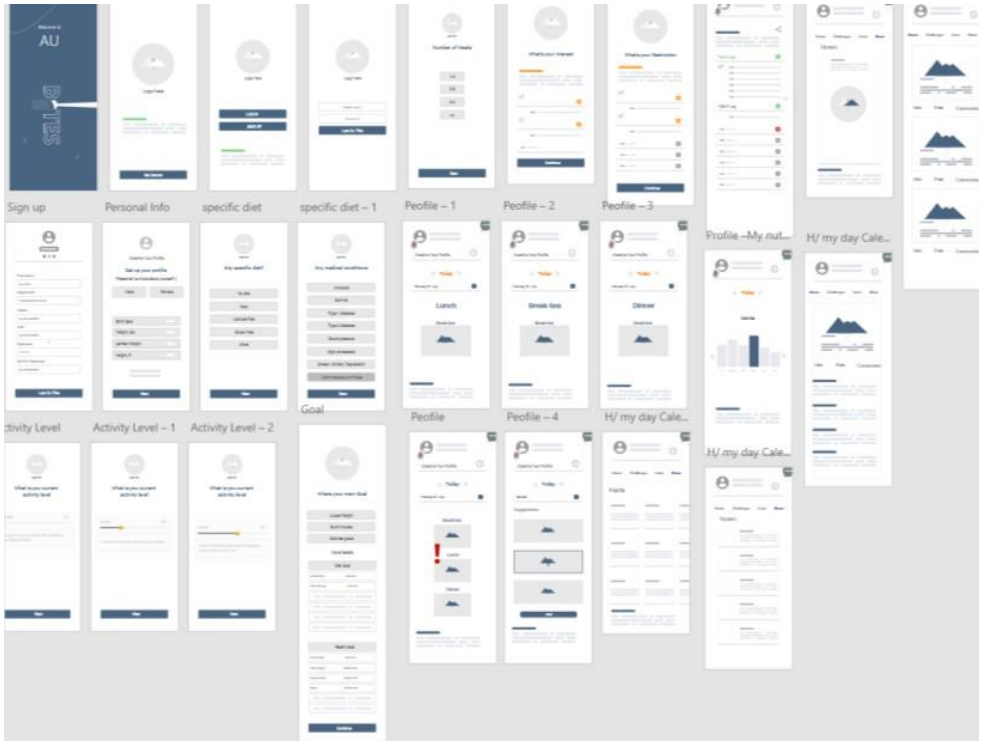


Figure 47 Overview of all wireframes

We can focus on perfecting the features and the user flow with wireframes without being distracted by colors and icons.

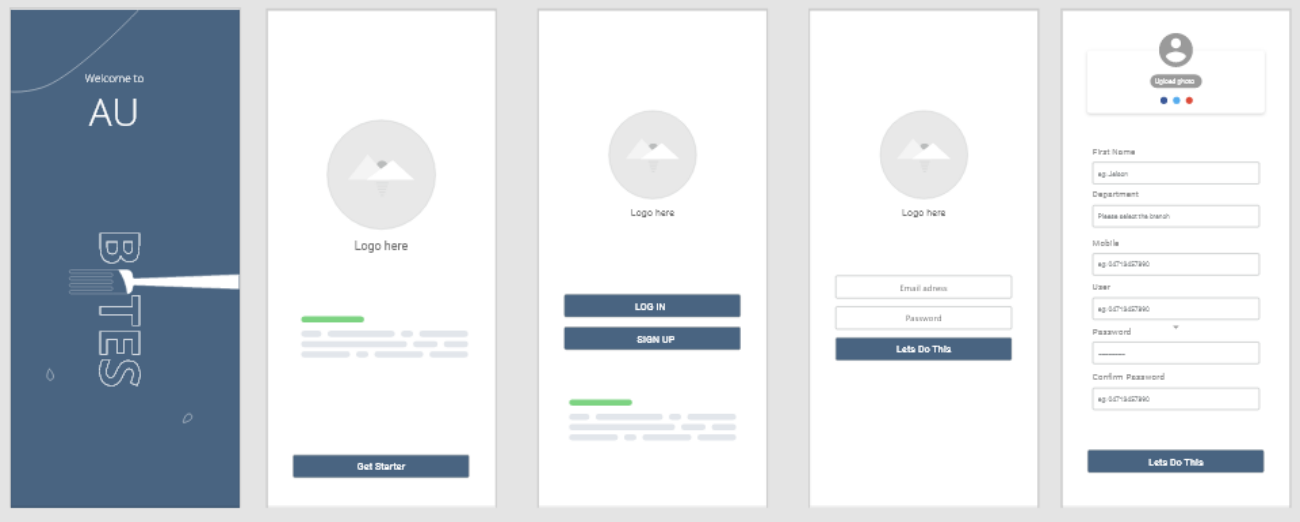


Figure 48 Welcome/Sign in/ Sign up

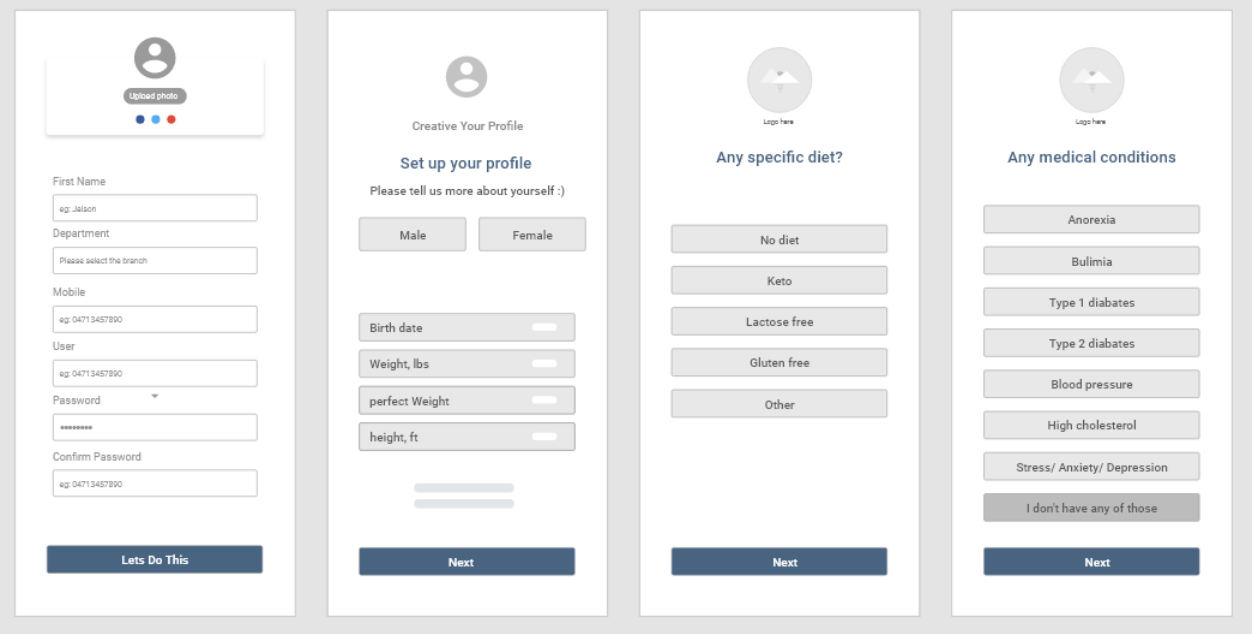


Figure 49 Personal information/ Specific diets/ Medical conditions

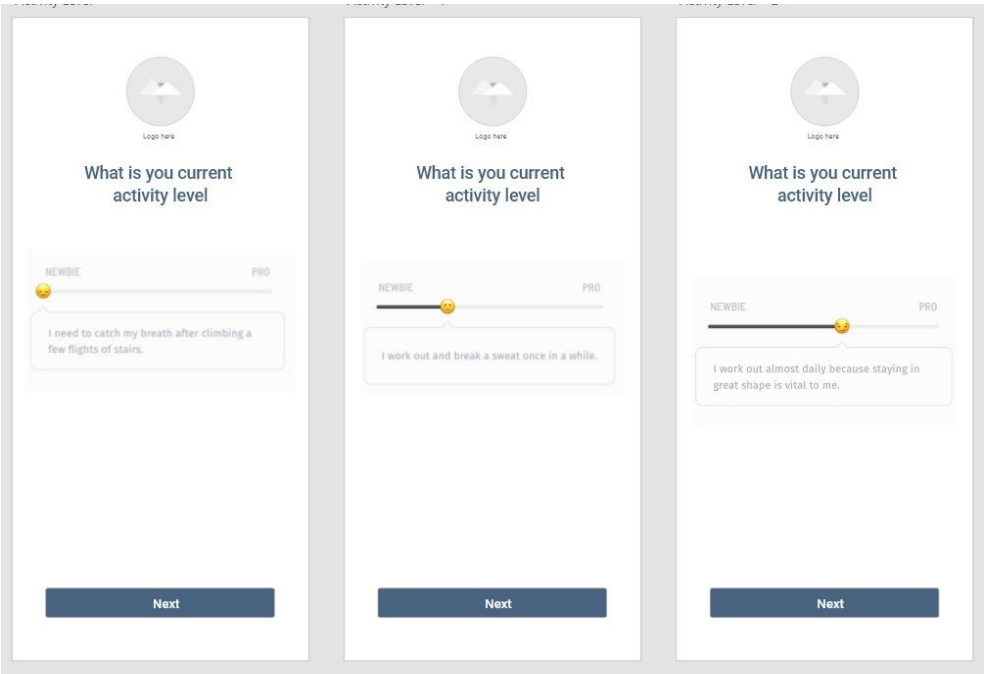


Figure 50 Activity levels

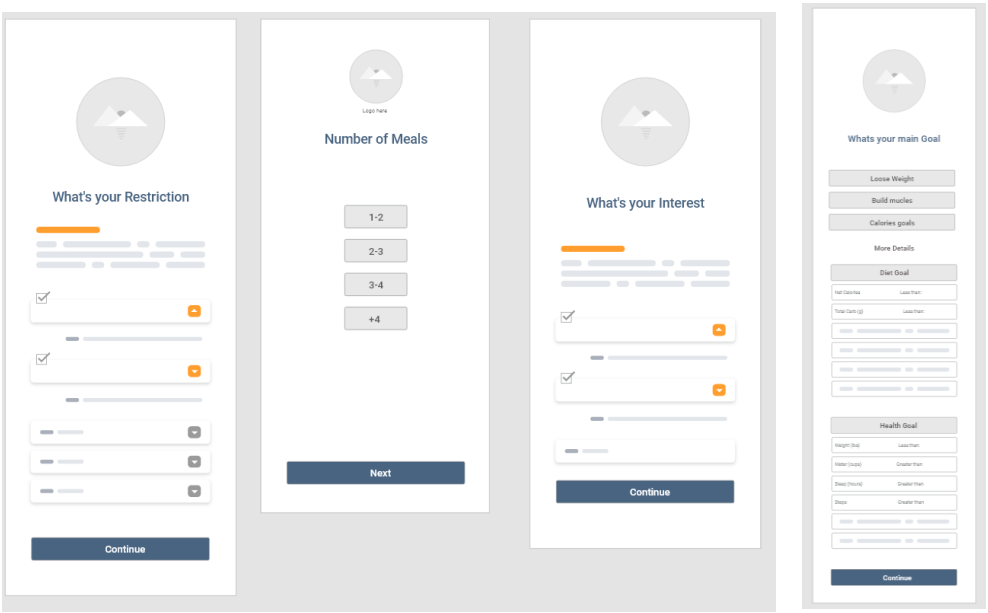


Figure 51 Restrictions/ Number of diets/ Area of interest

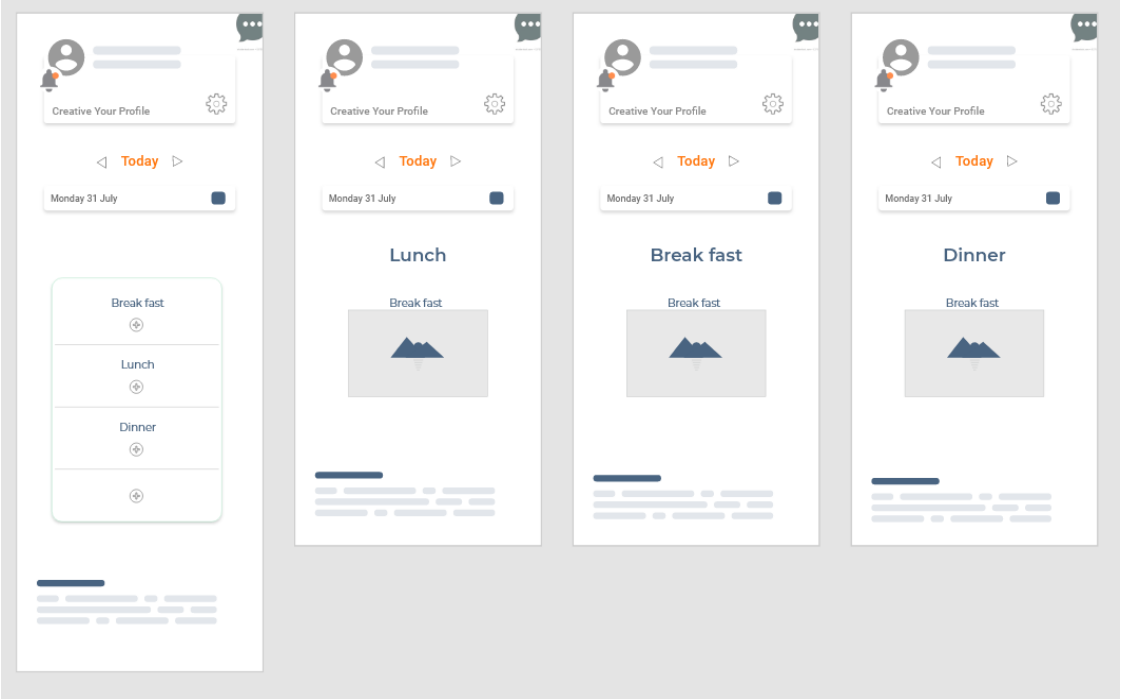


Figure 52 Creating meal plans

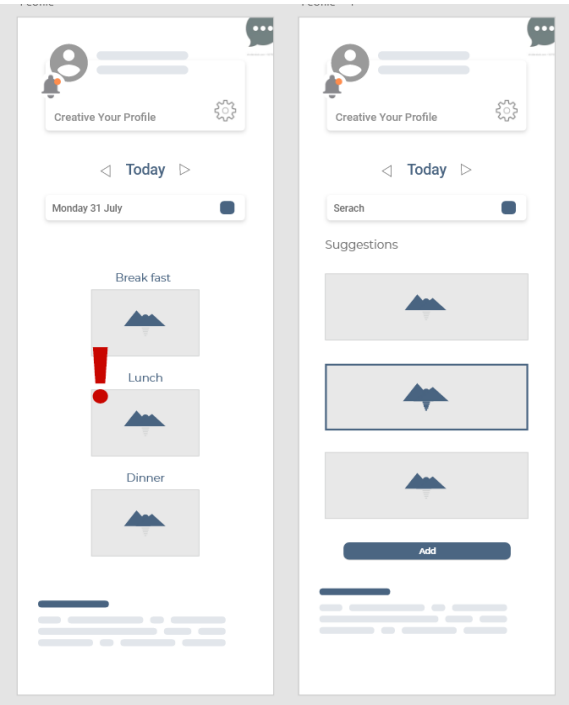


Figure 53 Balancing diets

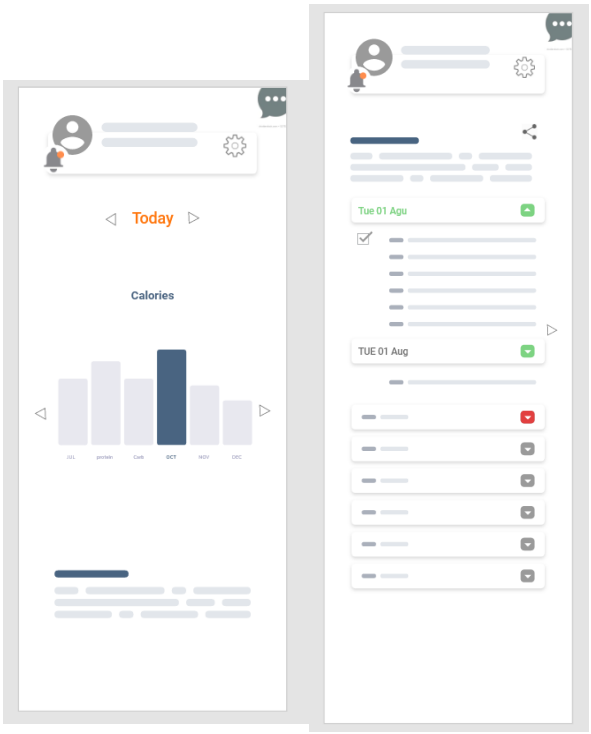


Figure 54 Calories intake/ Calendar

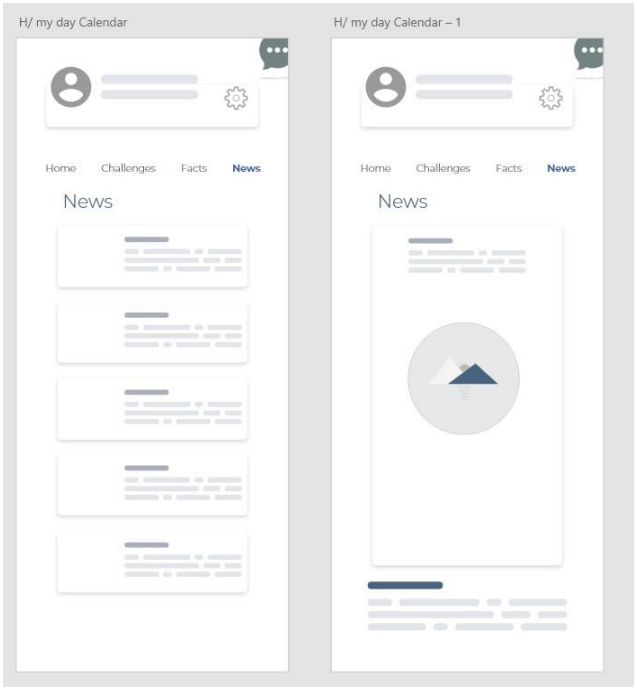


Figure 55 News/

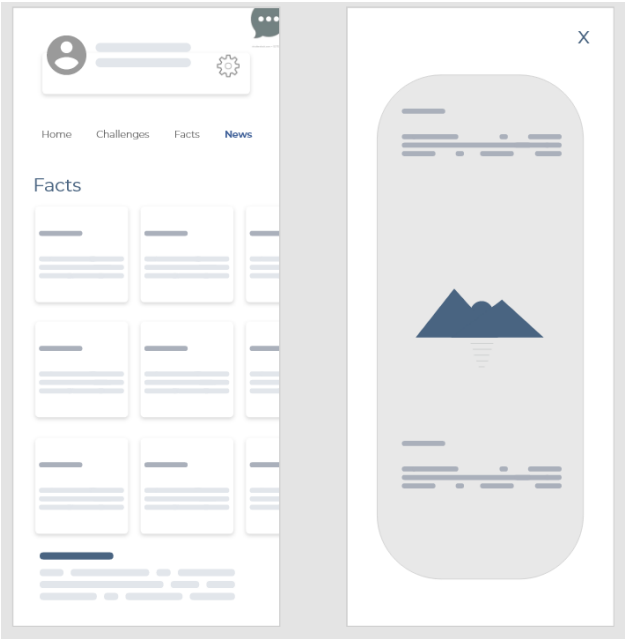


Figure 56 Facts

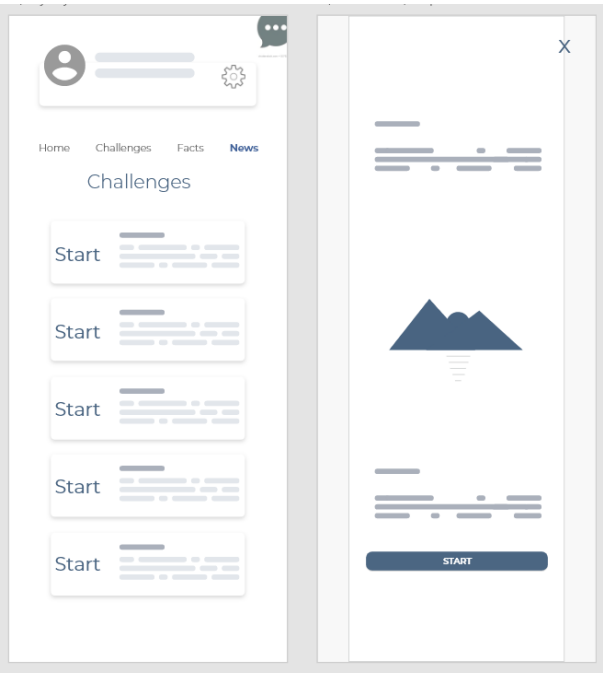


Figure 57 Challenges

Conversion low-fidelity design into high visual design

After going through all the above steps, now it's time for the UI design section. After completion of the wireframes, we start our work to create high visual designs. We tried to follow all the basics UI principles to craft a beautiful user interface that is both smooth and scalable.

Figure 58AU logo

Color Pallet

Figure 59Color Palette

Fonts Typography

Figure 60 Fonts Typography

Onboarding process

When the user first opens the app, he should fill out the onboarding process. (See Figure - -) asking for personal information, preferences, eating habits, allergies, etc.

- Welcome
- Sign Up
- Sign In

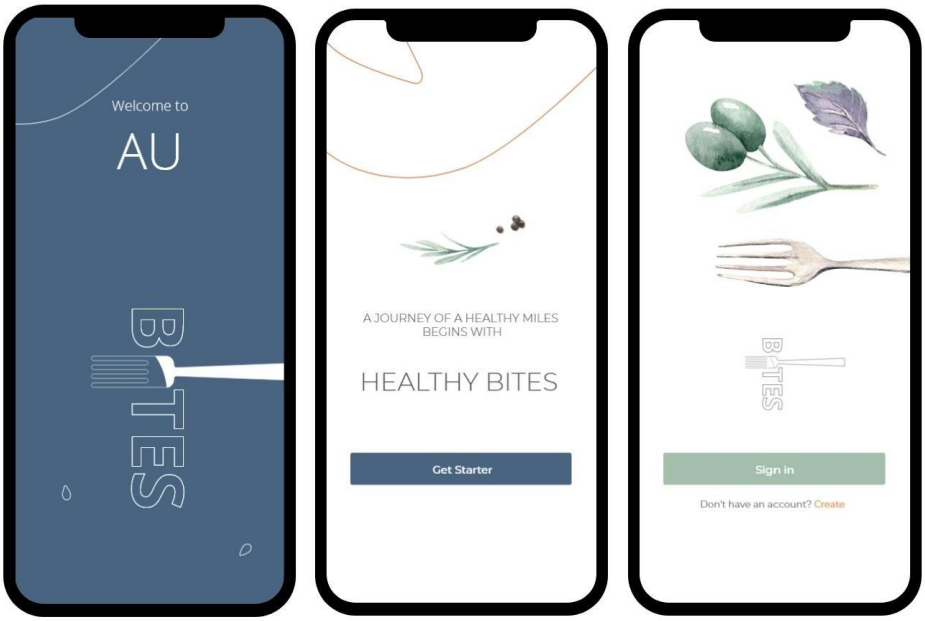


Figure 61 Welcome/ Sign Up/Sign In

The onboarding process will help AU BITES to assist the user with his/her balanced meal plans every day.

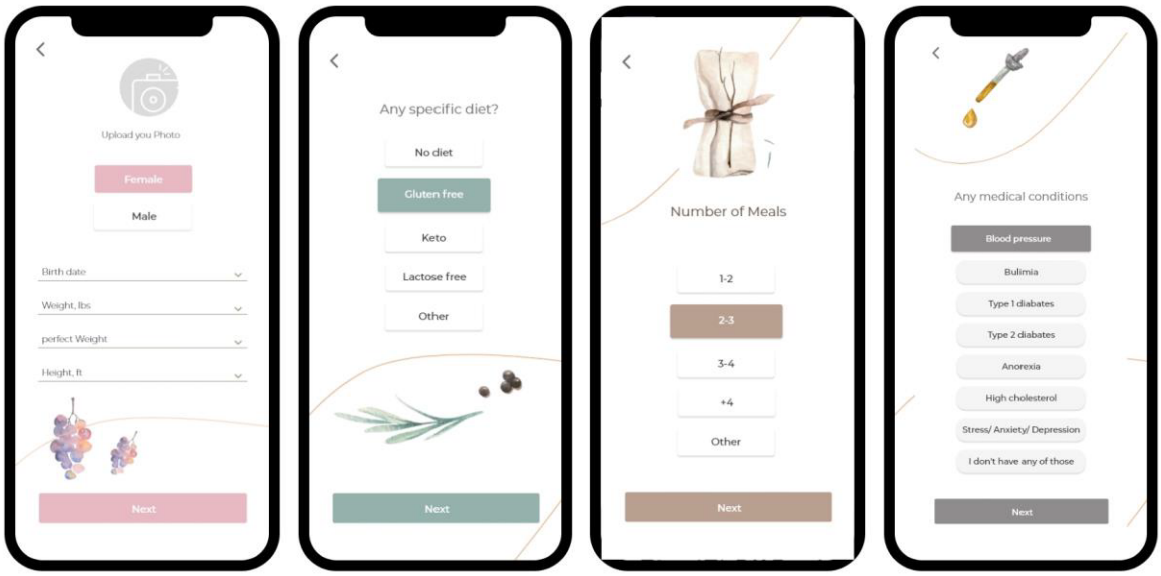


Figure 62 Onboarding screens1

It asks users questions about:

- What is his/her Gender?
- Does she/he have any special diet?
- How many meals he/she usually eat during a day?
- Does she/he have any medical conditions?

This step helps AU BITES understand users' needs better and be good assistant in the future.

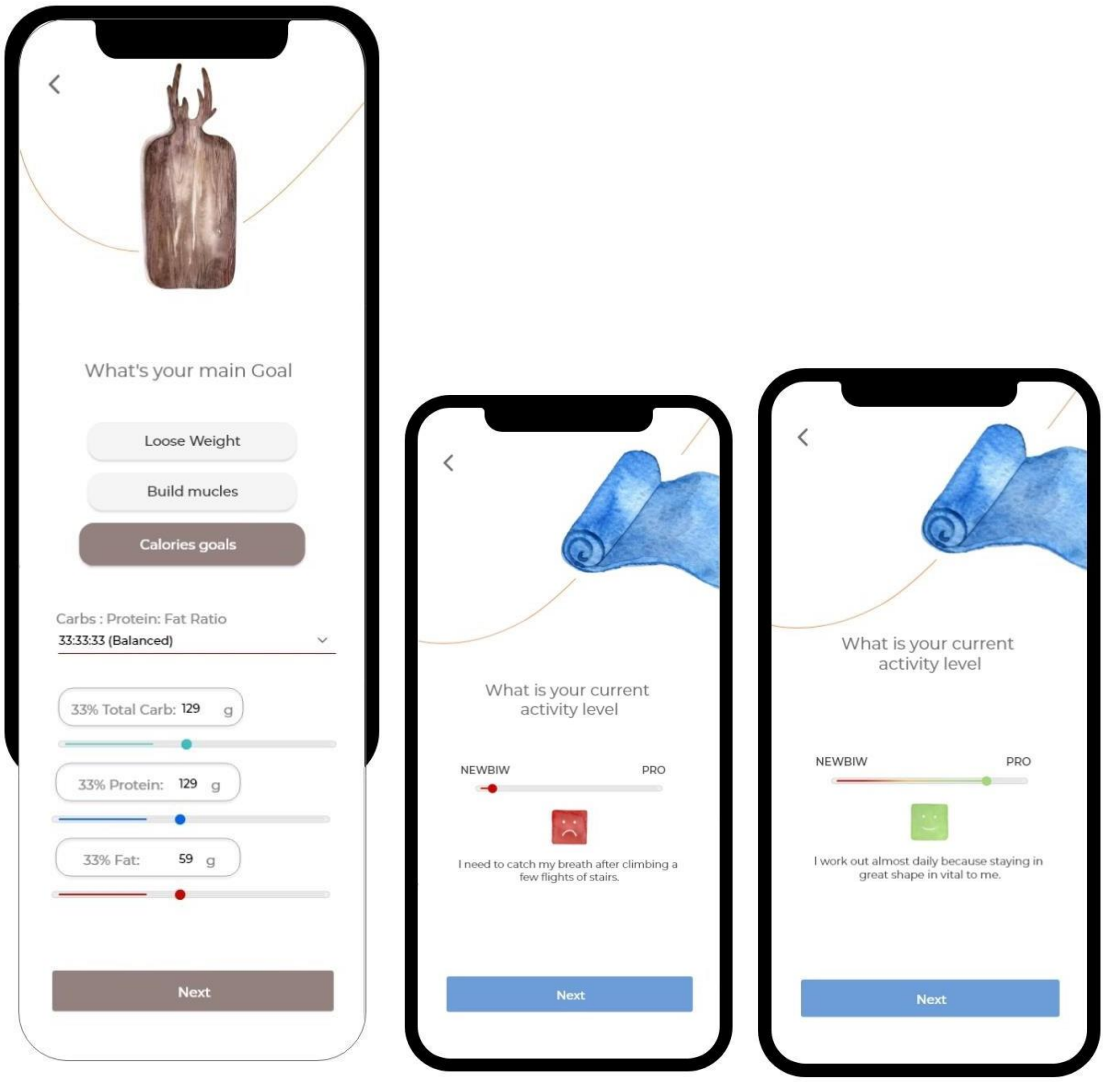


Figure 63 main goal/ physical activity

Main goals: It helps AU Bites to find out if the user wants to lose weight, gain weight or stay fit during his/her food choices.

Physical activity: User with different level of physical activity needs other diet plans. Food provides energy, so it's essential to make sure the user gets the proper amounts of nutritions during the day.

Profile

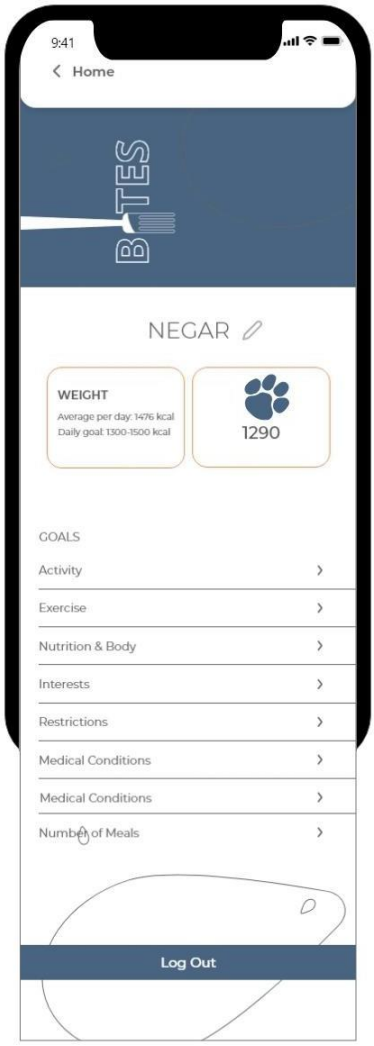


Figure 64 profile page

All of the onboarding information can be edited and handheld in the profile section. For example, if the user wants to change his/her primary goal from losing weight to gaining weight, he/she can do it from here. The weight and awards (PAWS, we will find out more about later) sections are bold here at the top for the reminder and easy access.

AU BITES Menu

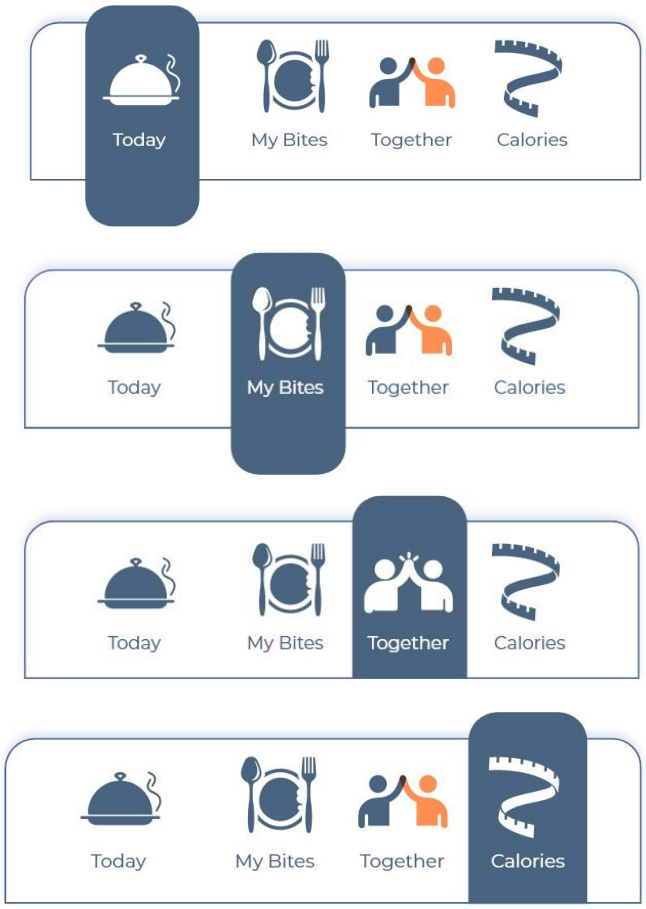


Figure 65 Au Bites Menu

My Bites (Menu)

Selecting Food: For every meal plan, the user can like/dislike the AU BITES suggestions; for example, If the user like the suggested breakfast offer, he/she will access to the next meal offer; if she/he dislikes the offer, the system will offer a new food option. This part of the application covers the “Balanced diet” aspect in our design criteria. Every AU BITES offer is based on the user history food choices and personal information; it helps the user balance water her/his diet in carbs, protein, fat, fiber, vitamins, minerals and eat healthy.

Figure 66 Design criteria (Focus on Balanced diet)

Figure 67 My everyday Bites

Unhealthy behavior:

If the user selects a wrong food choice, which is not a good match with her/his diet, a giant red exclamation mark appears on the screen. Clicking on the exclamation mark takes the user to a page to replace the food with a better option. The user can search for her/his favorite food or select one of the offers to replace the food and balance her/his meal plans. This part of the application covers the “Balanced diet” aspect in our design criteria

Figure 68 Design criteria (Focus on Balanced diet)

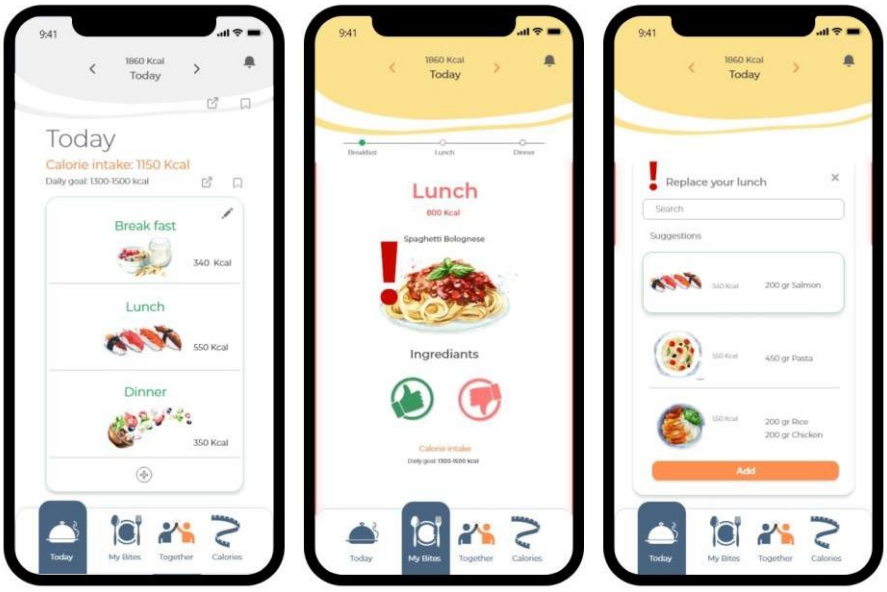


Figure 69 exclamation mark

Tracking Calories (Menu)

Tracking calorie intake is essential. In AU bites, the information is not complicated for the user; it just shows the most necessary data on the screen. Greenline shows the safe zone for a good amount of daily calorie intake. For more information about the red areas users should tap on the red spots. This part of the application covers the “Balanced diet” in our design criteria

Figure 70 Design criteria (Focus on Balanced diet)

Figure 71 Tracking Calories

Together (Menu)

Together is a social environment in AU BITES for freshman students to get advantages of being together. It has been well documented that social media affects eating patterns, but it does not directly correlate with mass media exposure (Bachner-Melaman & Tavor, n.d.). The role of social media in our every moment can not be denied, and the way it affects our cultural behavior, Scoialization, eating behavior, etc. has changed considerably(Bachner-Melaman & Tavor, n.d.).

Figure 72 Design criteria (focusing on Social aspects and motivation)

AU BITES helps freshman students stay in touch with an online platform that is trying to motivate them to learn more about healthy eating behavior with the help of nutritionists, experts, and their friends and have healthy eating behavior. This part of the application covers our design criteria' “Motivation” and “Social” aspects.

Together/ Home

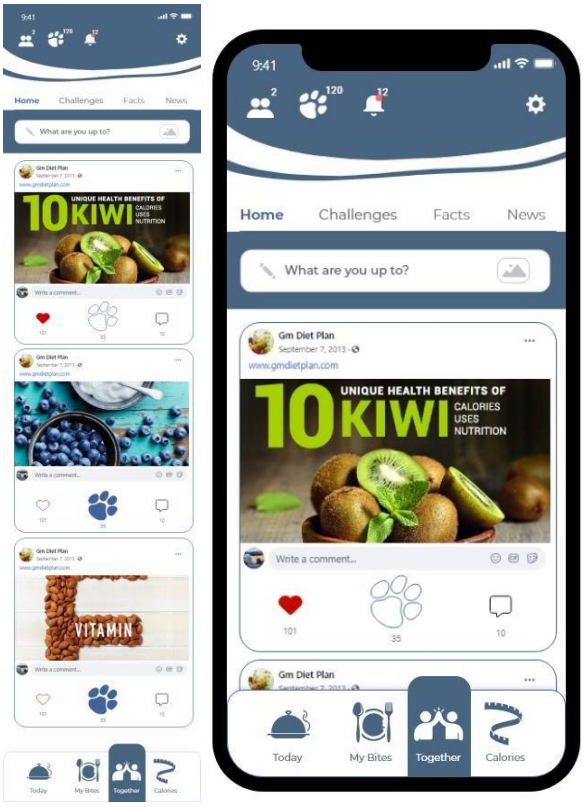


Figure 73 Together/ Home

Users can post nutritional or motivational content on social media, and they will meet people like them, all working toward their individual goals.

How "together" can help?

Users can:

- Get their daily dose of inspirations on the AU BITES community
- Find friends
- Get motivated through challenges and earning PAWS (Figure 77)
- Gain knowledge from nutritionist, friends posts, and joining different challenges (Figure 78)

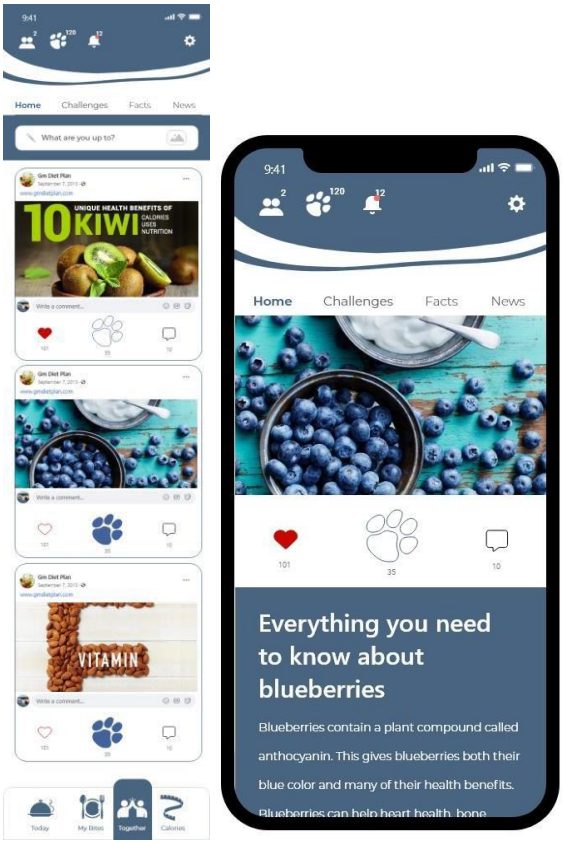


Figure 74 nutritional posts

What are the PAWS?

Every user could earn PAWS (inspired by Auburn tigers). The PAWS benefits are more than getting just likes and comments on their posts (Figure 77).

Figure 75get motivated by earning paws

How PAWS motivate students to share valuable content with others and help the community to stay healthy?

PAWS consider as a reward; it is like money for the user; they have to find a way to earn it, try to find a way to spend it, and try not to lose it.

How can the user earn PAWS?

- Eat healthy every day of using the dining hall
- Eat healthy two weeks in a row
- Posting sth valuable on the community and get PAWS

How might users lose them?·

- Overeating (not caring about a balanced diet and calory intake)
- Ignoring errors in their diets (Exclamation marks)

What PAWS are for?

- Donation to (students in need on-campus for their next meal plan)
- Adding to their credit line for paying upcoming meal plan
- Redeeming their PAWS with products(selected shops on campus)

Healthy Eating Challenges

Users can pursue their goals much easier if they are in a battle with people who are fighting for the same goal. In this step, it's time to hold each others' hands and get the support and motivation we need to reach our goals.

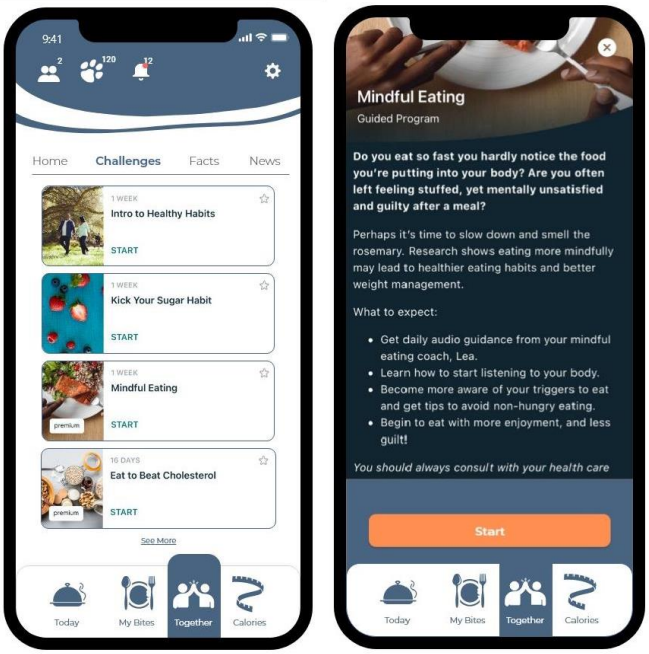


Figure 76 Join Healthy Eating Challenge

Nutritional Facts

Figure 77 Nutrition Facts

Nutrition News

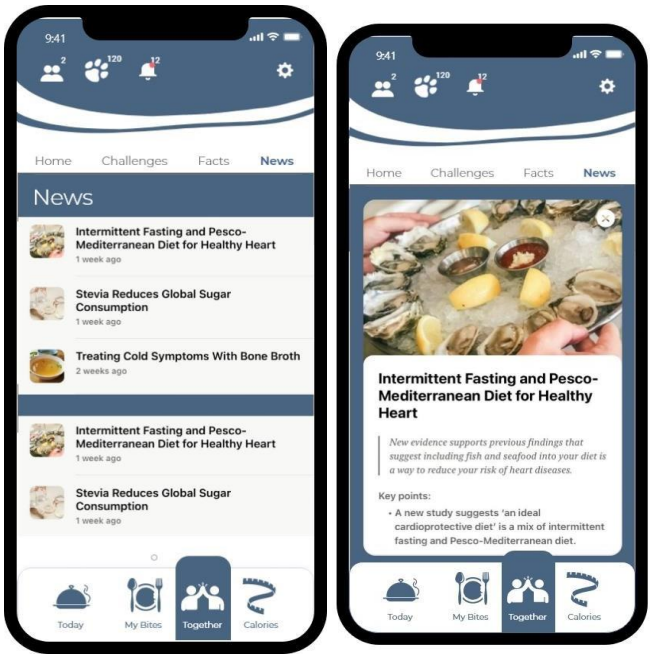


Figure 78 Nutrition News

Chapter 5: Conclusion

Study accomplishment

This approach was created to demonstrate how a service could benefit all freshman college students. This thesis outlines the kind of information freshman students need during their food decision-making process, mainly when they use dining hall facilities. This study explains that freshman students need personalized meal plans based on their body type, their dietary behaviors, and available food resources. This study also demonstrates that students consider dining hall facilities a social place to make friends and hang out with others regardless of their friends' bad habits that could affect their eating behavior. It is also shown that freshman students need the motivation to stay on a healthy eating lifestyle nevertheless, most of them know about the consequences of bad eating behaviors.

Recommendation for future study

The relationship between having healthy eating behavior and being a freshman student can be discussed further to find more reasonable connections. There are so many barriers and enablers that could affect freshman students and their food decision-making process.

Due to the timeline and on-campus limitation, this study could not do any user testing at dining hall facilities among the freshman students. If a future study could find a way to run a user testing of the application created by this study’s guidelines and recommendations, the result will be beneficial.

As the need for a healthy eating lifestyle among college students grows, there will be more research methods and studies that will be provided by designers, nutritionists, psychologists, etc;

therefore, there is a potential to have complementary research to this study for upcoming research methods and guidelines.

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