MOBILE APPLICATION FOR OBESITY SURVEILLANCE

โปรแกรมประยุกต์บนโทรศัพท์มือถือในการเฝ้าระวังสภาวะโรคอ้วน



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ABSTRACT

The objectives of this research were to construct a mobile application to promote the monitoring of obesity and the correct food consumption according to nutritional principles, to investigate the effects of the weight control program with a focus on behavioral change using the theory of planned behavior as well as physical exercise of the participating overweight or obese students, and to examine the satisfaction with the mobile application of the sample group. The constructed application, adiCET Nutrition, was able to record fundamental data of users, food and nutrition, their health, their exercise and advice on exercise, health and nutrition. User data were analyzed by health and nutrition experts for health risk assessment, nutrient analysis for each meal, the user notification system, and summaries of metabolism from activities and exercise as well as nutrients and energy from consumption with and emphasis on management of eating habits, exercise, nutritional correctness and obesity monitoring.

The study on the effects of the weight control program focused on changing the eating habits of overweight or obese students in the Department of Food Technology and Services, Suan Dusit University, Lampang Compus. The purposive sampling method was used to select 40 students with over standard waist circumference (males>90 cm and females>80 cm), who volunteered and were willing to participate in this study. They were divided into two groups in equal numbers: control and experimental. The control group took part in three activities in the period of three months. The activities included knowledge provision, group discussion, distribution of self-study media, distribution of menus, and group activities with an excursion to Asawin and supermarkets. The assessment was on a change of food and weight control knowledge, variables based on the Theory of Planned Behavior, waist circumference, body weight and body mass index within the experiment period. It was revealed that the scores of the experimental group on food control behavior and intention, awareness on weight control ability, and belief in social norm in food control were higher than those or the control group (P < 0.01). However, it was not statistically significant when compared with the control group. The weight control program with a focus on changing eating habits of the overweight or obese students was able to promote their knowledge, intention, awareness on weight control ability and geed eating habits, enabling them to reduce their waist circumference, body weight and body mass index during the experiment period.

For the satisfaction with the application in terms of its design beauty, advice of nutrition and exercise, system usage and overall utilization of 20 male and female samples on their android-operation device, it was found that their satisfaction was at a good level with the mean of the satisfaction at 4.31

It is recommended that the research results be implemented to change teenagers eating habits and exercise in order to reduce their obesity rate. This mobile application should be used to monitor obesity enabling teenagers to have proper nutrition. The application is also beneficial, easily accessible and technologically modern, and should be used to promote eating habits of teenagers who wish to lose weight safely.

Keywords: Obesity, Mobile Application, Weight Control Program



หัวข้อวิทยานิพนธ์	โปรแกรมประยุกต์บนโทรศัพท์มือถือในการเฝ้าระวังสภาวะโรคอ้วน
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บทคัดย่อ

การวิจัยเรื่อง โปรแกรมประยุกต์บนโทรศัพท์มือถือในการเฝ้าระวังสภาวะโรคอ้วน มี วิธีดำเนินการวิจัยแบ่งตามวัตถุประสงค์ 1. เพื่อพัฒนาโปรแกรมประยุกต์บนโทรศัพท์มือถือ (Mobile Applications) ในการส่งเสริมการเฝ้าระวังสภาวะโรคอ้วนในการบริโภคอาหารให้ถูกต้องตามหลัก ทางโภชนาการ 2. เพื่อศึกษาผลของโปรแกรมควบคุมน้ำหนักที่เน้นเรื่องการปรับเปลี่ยนพฤติกรรมโดย ใช้ทฤษฎีพฤติกรรมตามแผนที่ควบคุมพฤติกรรมทางการบริโภค รวมไปถึงการออกกำลังกายในกลุ่ม นักศึกษาที่มีน้ำหนักเกินหรือเป็นโรคอ้วน และ 3. เพื่อสำรวจความพึงพอใจในการนำโปรแกรม ประยุกต์บนโทรศัพท์มือถือ ในการใช้งานการเฝ้าระวังสภาวะโรคอ้วนกับกลุ่มตัวอย่างจากการ ศึกษาวิจัยได้สร้างแอพพลิเคชั่น adiCET Nutrition สามารถเป็นการบันทึกข้อมูลด้านการออกกำลัง การบันทึกข้อมูลอาหารและโภชนาการ บันทึกข้อมูลด้านสุขภาพ การบันทึกข้อมูลด้านการออกกำลัง กาย คำแนะนำด้านการออกกำลังกาย คำแนะนำด้านสุขภาพและโภชนาการ การวิเคราะห์ข้อมูลผู้ใช้ โดยผู้เชี่ยวชาญด้านสุขภาพและโภชนาการ การประเมินภาวะความเสี่ยงด้านสุขภาพ การวิเคราะห์ สารอาหารในแต่ละมื้ออาหาร ระบบการแจ้งเตือนผู้ใช้งาน สรุปการเผาผลญพลังงานจากกิรกรรม และออกกำลังกาย สรุปปริมาณสารอาหารและพลังงานจากการบริโภค โดยมุ่งไปจัดการด้าน พฤติกรรมการบริโภคและการออกกำลังกาย รวมไปถึงความถูกต้องในด้านโภชนาการและเฝ้าระวัง สภาวะโรคอ้วนต่อไป

การศึกษาผลของโปรแกรมควบคุมน้ำหนักที่เน้นเรื่องการปรับเปลี่ยนพฤติกรรมการ รับประทานอาหารในนักศึกษาที่มีน้ำหนักเกินหรือเป็นโรคอ้วน สาขาเทคโนโลยีการประกอบอาหาร และการบริการ มหาวิทยาลัยสวนดุสิต ศูนย์การศึกษานอกที่ตั้ง ลำปาง โดยกลุ่มตัวอย่าง นักศึกษา จำนวน 40 คนที่มีรอบเอวเกินมาตรฐาน (ชาย > 90 ซม. และหญิง > 80 ซม.) สมัครใจและยินดีเข้า ร่วมโครงการวิจัย คัดเลือกแบบเฉพาะเจาะจง (Purposive sampling) โดยแบ่งเป็น กลุ่มควบคุม 20 คน และกลุ่มทดลอง 20 คน โดยกลุ่มทดลองเข้าร่วมกิจกรรม 3 ครั้ง ในระยะเวลา 3 เดือน กิจกรรม ประกอบด้วย การให้ความรู้ การอภิปรายกลุ่ม การแจกสื่อเพื่อการเรียนรู้ด้วยตนเอง การแจกรายการ อาหาร และกิจกรรมกลุ่มโดยการจัดทัวร์ตลาดอัศวินและ ซูเปอร์มาร์เก็ตผลลัพธ์ที่ประเมิน คือ การ เปลี่ยนแปลงของความรู้เรื่องอาหารกับการควบคุมน้ำหนัก ตัวแปรตามทฤษฎีพฤติกรรมตามแผน (Theory of Planned Behavior; TPB) ความยาวรอบเอว น้ำหนักตัว และดัชนีมวลกาย โดยในเวลา 3 เดือน กลุ่มที่เข้าร่วมโปรแกรมควบคุมน้ำหนัก (กลุ่มทดลอง) มีคะแนนพฤติกรรมการควบคุมอาหาร ้ความตั้งใจในการควบคุมอาหาร การรับรู้ความสามารถในการควบคุมน้ำหนัก และความเชื่อในบรรทัด ฐานของสังคมในการควบคุมอาหารมากกว่ากลุ่มควบคุม (p < 0.01) แต่ไม่พบความแตกต่างอย่างมี นัยสำคัญทางสถิติเมื่อเปรียบเทียบกับกลุ่มควบคุม โดยโปรแกรมควบคุมน้ำหนักที่เน้นเรื่องการ ปรับเปลี่ยนพฤติกรรมการรับประทานอาหารในนักศึกษาที่มีน้ำหนักเกิน หรือเป็นโรคอ้วนสามารถ ส่งเสริม ความรู้ ความตั้งใจ การรับรู้ความสามารถในการควบคุมน้ำหนัก และพฤติกรรมที่ดีในการ ควบคุมอาหาร ทำให้ความยาวรอบเอว น้ำหนักตัว และดัชนีมวลกายลดลงได้ภายใน 3 เดือน

สำหรับการศึกษาความพึงพอใจของผู้ใช้แอพพลิเคชั่น adiCET Nutrition ที่มีต่อความ สวยงามในด้านการออกแบบ ด้านข้อมูลแนะนำด้านโภชนาการและการออกกำลังกาย ด้านการใช้งาน ระบบ และความพึงพอใจโดยรวมของการใช้งานแอพพลิเคชั่น โดยกลุ่มตัวอย่างสำหรับงานวิจัยครั้งนี้ ซึ่งใช้อุปกรณ์มือถือแอนดรอย์ในชีวิตประจำวันทั้งเพศชายและเพศหญิงจำนวน 20 คน พบว่ามีความ พึงพอใจต่อการใช้งานแอพพลิเคชั่นสำหรับด้านต่าง ๆ อยู่ในระดับดี ส่งผลให้ความพึงพอใจต่อการใช้ งานโดยรวมของแอพพลิเคชั่นมีค่าเฉลี่ยเท่ากับ 4.31 ซึ่งอยู่ในระดับดี

ดังนั้นการศึกษาวิจัยในครั้งนี้จึงควรนำรูปแบบการปรับเปลี่ยนพฤติกรรมด้านโภชนาการ และการออกกำลังกายเพื่อลดภาวะอ้วนในกลุ่มวัยรุ่น โดยใช้โปรแกรมประยุกต์บนโทรศัพท์มือถือใน การเฝ้าระวังสภาวะโรคอ้วน ทำให้มีภาวะโภชนาการเหมาะสมกับวัยและเป็นประโยชน์ในการเข้าถึง ได้อย่างรวดเร็วและทันสมัยตามเทคโนโลยีในปัจจุบัน ซึ่งสามารถนำโปรแกรมประยุกต์ไปใช้ส่งเสริม การบริโภคอาหารกับกลุ่มวัยรุ่นที่ต้องการลดน้ำหนักอย่างปลอดภัย

คำสำคัญ: โรคอ้วน, โปรแกรมประยุกต์บนโทรศัพท์มือถือ, โปรแกรมควบคุมน้ำหนัก



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Benefit from this study would be dedicated to my parents, my wife and the authors of the book and articles used for this study until this investigation was successful and could become an example for those interested in studying this field.

RAJABHA

Atthapong Chumkiew

TABLE OF CONTENTS

	Page
ABSTRACT (ENGLISH)	ii
ABSTRACT (THAI)	iv
ACKNOWLEDGEMENTS	vii
TABLE OF CONTENTS	viii
LIST OF TABLES	xi
LIST OF FIGURES	xiii
CHAPTER	
1 INTRODUCTION	1
Background and significance of the study	1
Objectives of the research	10
Benefits of the research	11
Scope of the research	11
Definition of Terms	12
Research Framework	14
2 LITERATURE REVIEW	15
Problems related to consumption of Thai teenagers	15
Excess weight and obesity	23
Causes of promoting factors and effects of excess weight	
and obesity	27

TABLE OF CONTENTS (CONTINUED)

.

Page

Factors that affect excess weight and obesity	28
Effects of excess weight	30
Losing weight in the benchmark	38
Principles of exercise for health	53
Theory of Planned Behavior: TPB	56
Important trends of 5 IT in the information age (Five IT Megatrends) 64
IT Infrastructure and Emerging Technologies	74
Mobile Application	109
Research related to mobile medical applications	124
RESEARCH METHODOLOGY	137
A system design to construct the mobile application to promote	
the monitoring of obesity	137
The study of the effects of weight control programs focused	
on changing eating habits of overweight or obese	
students	179
Survey on the satisfaction with the implementation of the mobile	
application for obesity monitoring among the samples	190

3

TABLE OF CONTENTS (CONTINUED)

	Page
4 RESULTS	194
Results of the development of the mobile application in	
promoting obesity surveillance in food consumption	
according to nutritional principles	194
Results of weight control programs that focused on changing eat	ing
habits in overweight or obese students	218
Survey of satisfaction in implementing the mobile application for	or
obesity surveillance of the samples	231
5 CONCLUSION DISCUSSION AND RECOMMENDATION	234
Conclusion	242
Discussion	237
Recommendation from the study results	244
$ z \leq z $	
171	
RALADUA	
ABAL	

TABLE OF CONTENTS (CONTINUED)

Pag	e
	-

55151710	
REFERENCES	246
APPENDICES	261
Appendix A Application adiCET Nutrition	262
Appendix B Activity record for weight loss	271
Appendix C TPB diet questionnaire	274
Appendix D Knowledge and weight control questionnaire before - after	1
accessing to the Obesity Condition Monitoring Program	279
Appendix E User satisfaction questionnaire for applications	
adiCET Nutrition	280
Appendix F Documents for Protection of Participants in	
the Research Program	281
Appendix G Research document certification from Ethics Committee	
University	288
CURRICULUM VITAE	290
AJABHA	

LIST OF TABLES

Table	5915771100	
2.1	Body mass index (BMI) according to World Health Organization	
	criteria and the intersection of Asian populations	24
2.2	Nutritional value of various food groups	45
2.3	Examples of the amount of food to eat in each meal in order to	
	lose weight	46
2.4	Menu sample for weight loss	48
2.5	Differences between HTML and XML	105
2.6	Details of application categories	117
2.7	Comparisons of applications related to nutrition internationally	131
2.8	Comparisons of applications related to nutrition domestically	134
3.1	Description of Use Case Login	145
3.2	Description of Use Case Registration	147
3.3	Description of Use Case Cal Burn Today	149
3.4	Descriptions of Use Case Weight Loss Today	151
3.5	Descriptions of Use Case Cal Today Total	153
3.6	Description of Use Case Recommend Workout	156
3.7	Description of Use Case BMI Calculate	158
3.8	Description of Use Case Show Food Cal and Activity	160
3.9	Description of Use Case Add Activity	162

LIST OF TABLES (CONTINUED)

		-
Table	JELI II JID	
3.10	Description of the Use Case Search Food	164
3.11	Description of Use Case Edit Data	166
3.12	Description of Use Case Delete Data	168
4.1	Membership information	196
4.2	Food information	197
4.3	Food selection information	198
4.4	Member/user details	199
4.5	Recommended activity information	200
4.6	Data on activity detail	201
4.7	Data on suggested activities	202
4.8	Health data of users	203
4.9	Details of the application structure	208
4.10	Results of weight measurement, height measurement,	
	waist circumference and BMI calculation before and	
	after participating in the obesity monitoring program	219
4.11	Score results from the knowledge questionnaire on knowledge	
	and weight control before and after participating	
	the obesity surveillance program	222

LIST OF TABLES (CONTINUED)

Page

Table	
4.12 Effects of weight control program on food knowledge and	
variables based on the TPB scores in the control	
group (N = 20) and experimental group (N = 20) \dots	223
4.13 Correlation coefficients according to the theoretical framework	
and the plan before participating the Obesity	
Monitoring Program	233
4.14 Correlation coefficients according to the theoretical framework	
and the plan after participating in the Obesity	
Monitoring Program	236
4.15 Results of users' satisfaction with the adiCET Nutrition application	231
EN ENS	
RALINIA	
AJABHE	

LIST OF FIGURES

Figure	a fisili Jin	
1.1	Research Framework	14
2.1	Average body mass index (Kg / sq. m) in the Thai population aged 15	
	years and over by age group and gender	26
2.2	The average waist circumference (cm) of the Thai population aged 15	
	years and over by age group and gender	27
2.3	Theory of Planned Behavior	60
2.4	Important trends of 5 IT affecting changes in organization and society	65
2.5	A quarterly statistics showing the number of active Facebook users, quarterly, from 2008-2018	67
2.6	The concept of the Internet of Things and the things that can be connected automatically	68
2.7	Data and applications access to cloud computing by a variety	
	of devices	70
2.8	Cloud Computing Platform	71
2.9	Connections between organizations and IT infrastructure and business	
	capabilities	76
2.10	The evolution of the IT infrastructure in each era	78
2.11	N-Tiered network architecture	82
2.12	The ecosystem of IT infrastructure	84

LIST OF FIGURES (CONTINUED)

		0
Figure	JEIJIU.	
2.13	The blade server in the rack and the inside the blade server	86
2.14	The most common PC applications running under the Windows	
	platforms	88
2.15	Operating system platforms from various manufacturers on mobile	
	devices	89
2.16	Quantum processor	96
2.17	Nanotubes	97
2.18	Modern processors using multi-core technology with low	
	energy consumption	98
2.19	Key features of Autonomic Computing	100
2.20	HTML code examples with the results running through a browser	
	Program	103
2.21	Popular brands of operating systems on mobile phones	111
2.22	Various operating systems on mobile phones	115
2.23	Examples of applications on smart phones	116
2.24	Android application components	120
2.25	Application components	124
3.1	Design and programming with computer language	138

LIST OF FIGURES (CONTINUED)

		0	
Figure			
3.2	The process of adiCET Nutrition application according to the obesity		
	management system	142	
	3.3 Use Case Diagram	144	
3.4	Login procedure	146	
3.5	Membership application process	148	
3.6	Steps to get information on the daily burned calorie	150	
3.7	Daily weight loss	152	
3.8	Steps to get information on daily remaining calories	154	
3.9	Steps to get information on remaining calories that can be consumed	155	
3.10	Steps to browse for the recommended exercise information	157	
3.11	Steps to calculate the body mass index	159	
3.12	Calories of all activities	161	
3.13	Steps of adding information	163	
3.14	Calories of all foods	165	
3.15	Steps to edit the data	167	
3.16	Steps to delete the data	169	
3.17	Application structure	170	
3.18	Entity Relationship Diagram of the application	171	

LIST OF FIGURES (CONTINUED)

Figure			
4.1	Application structure	205	
4.2	Application diagram for planning and monitoring weight loss	207	
4.3	Basic body mass index information page	209	
2	4.4 Menu on the Home pages	210	
4.5	Membership registration page	211	
4.6	The body mass index data page	212	
4.7	Health record page	213	
4.8	Meal record page	214	
4.9	Activity menu page	215	
4.10	Summary page of used energy	216	
4.11	Recommended food and activities page	217	
	AJABHA		

CHAPTER 1

Introduction

Background and significance of the study

Current eating habits have drastically changed from the past due to an influx of western foods, changing the way we used to eat. This is particularly so among teenagers and working people who have turned to fast food due to a limited eating time. There are a large numbers of disadvantages in eating fast food. For instance, Thai teenagers tend to eat more ready-made snacks and drink more caffeinated beverages on a daily basis. Large amounts of preservatives and monosodium glutamate have been added to these snacks and beverages, which could have adverse health effects in the long term. Surveys have revealed that those eating foods with complete nutrients of the five food group and having fruit as their snack have a better health than those eating fast food and ready-made and commercial snacks. Some of the eating habit problem of Thai teenagers are that they become more picky or eat whatever they like or popular food or eat whenever they wish to without taking food nutrients into consideration. These improper eating habits could lead to nutrients-related ailment, such as, malnutrition, obesity, hypertension, high blood sugar, or hyperlipidemia. For overweight or obese teenagers, they are also at risk of other diseases in the future, such as, heart disease, hypertension, ulcer, malnutrition or diabetes (Ministry of Public Health. Department of Health, 2000).

Moreover, Thai teenagers and youths nowadays are focusing more on external physical appearances and are not satisfied with their figures. Their general perception about their weights is that they are fat or overweight, whereas their body mass index which indicates whether or not an individual on overweight is at a suitable level. This perception is derived implicitly from advertisements that have focused on external physical appearances, skinniness and the presentation of external beauty rather than internal beauty. Overweight or fatness has socially been defined as an undesirable aspect of teenagers. Therefore, they have tried to lose their weight in the hope that they could become thin and socially acceptable (Sojayya & Sornkert, 2005). Weight loss method used by teenagers vary according to individual circumstances. The method that have adverse negative effects on them include using medication, food supplements and weight-reducing coffee (Feepakphroh, 2010). These methods would make the body systems dysfunctional, affect their growth and fertility, and may lead to death in severe cases.

Overweight and obesity are important risk factors for chronic noncommunicable diseases, especially, diabetes, high blood pressure, high blood cholesterol, cardiovascular system diseases, and cancer. In addition, from the research of the Thai Burden of Disease and Risk Factors Working Group (2006), it was found that obesity is, associated with insulin resistance, and cardiovascular disease, It also results in decreasing disability-adjusted life years, From the occurrence of chronic diseases affecting the quality of life, and economic losses, due to increasing health costs, and loss of disability-adjusted life year from disability and premature death in 2004, obesity (body mass index ≥ 25 kilograms / square meter) was a risk factor for the loss of disability-adjusted life year (DALYs), ranked 2nd in Thai women, and 6th in Thai men. And from the 4th Thai People's Health Survey in 2009, the prevalence of obesity was increasing, from 40.7 percent to 41.8 percent in women and, from 28.4 percent to 32.9 percent in men, and Obesity increased as well, from 45.0 percent to 51.3 percent in women, and in men from 18.6 percent to 26.0 percent in men in 2014 (Rongmuang, 2018). The 2014 Thai health Report in 2014 stated that obesity was considered the cause for illness and the premature death from chronic non-communicable diseases (NCDs), such as, diabetes, high blood pressure, liver disease, cancer, gallbladder disease, depression, dyspnea and sleep apnea, and osteoarthritis. Obese people had 2-3 times more chance of these diseases than normal people. In 2014, it was found that the cost of medical treatment for this group of patients was as high as 5,584 million baht or 1.5 percent of the national health expenditure. The losses were 6,558 million baht from lack of work, from hospital admission 694 million baht and the cost of opportunity loss, from premature death of 5,864 million baht. The total costs caused by obesity were 12,142 million baht (Pitayatienanan, 2014). It could be see in that obesity affected health and increased health costs. To reduce such problems, modifying health behaviors in order to prevent obesity was important, and in changing health behaviors should integrate a variety of theories, in order to make effective and sustainable behavior changes.

Nutrition and weight loss are important factors associated with obesity because the main cause of obesity is getting more energy than the body's needs, especially fatty foods. (Nitithongyong, 2006). Overweight or obese individuals have often experienced in trying to lose their weight through various means, such as fasting, eating low-fat foods repeatedly, taking pills or exercise. These methods are often ineffective in the long term, they could lead to anorexia and fatigue. When returning to eat again, they

3

tend to eat more food (Khomin, 2006). Therefore, understanding the amount of calories that is appropriate for weight loss and the type of diet appropriate to lose weight is important. For the number of calories that are appropriate for weight loss, the key to food intake is to get sufficient nutrients and energy that the body needs, resulting in the body not receiving food beyond what is needed, to pass on overweight, to achieve a sufficient of pre-menopausal women, body weight and normal activities. People who did not work hard should receive 30 kcal of energy per body weight. 1 Kg per day. Women should receive 1,600 kcal per day and men should receive 2,000 kcal per day, less than 1,200 kcal per day, because it would be negative effects on the body's work, affecting reduced the energy metabolism system (Kitworapat, 2006). For those who are involved in heavy labor, 40 kcal of energy per kilogram of body weight is needed, and if almost no labor is needed, 20 kcal of energy per kilogram of body weight is needed, Food consumption must have complete and sufficient nutrients, with 20-30 % of fat, 15 percent of protein and 55-60 percent of carbohydrate, To consider losing weight, the following are suggested. Recording various eating and environmental conditions in order to consider why eating so much, what encouraged you to eat and the correct exercise. 2) Self-control, by using the control principle of uncontrollable behavior, such as eating alone could control the amount of food. 3) Eating properly with the main control of food that does not make you fat.4) Improving the mindset, and setting goals for weight loss. 5) Finding your own relationship with others to adjust your diet, with friends, relatives, and families support, and 6) avoiding the process or behavior that would cause weight gain when weight loss could be achieved. From a study of the College of Sports Medicine, the United States of America (Otto & Jakicic, 2004), it was summarized that losing weight required significant behavior training for weight

4

loss, by commenting that diet or focusing only on food to lose weight, often ineffective in the long term, but it by oneself had to be done in parallel with behavioral changes, by being habitual in everyday life.

For monitoring and monitoring of self-eating for those who want to lose weight, it is necessary to successfully change the behavior for weight loss, which might be in the form of daily food item records conducted a study to analyze weight loss by controlling food alone in a period of 15 weeks, It was found that 10.7 kilograms of weight were lost A comparison of weight loss with low-fat diet and low carbohydrate diet by Meckling, (2004), found that eating low-fat foods had a positive effect on waist circumference reduction, and low carbohydrate diet had a positive effect on the body mass index. Lepnanon (2005) conducted a study by applying the theory of health belief patterns, together with self-efficacy theory by changing behavior of dietary intake of elementary school students. The program focused a variety of knowledge-related activities, such as, lectures, cooking skills training, The results of the study showed that the experimental group had more knowledge, but could not recognize the risks and severity caused by complications of obesity, but found that perceived performance of self-control in food and eating behavior after participating in the program was better. It could be said that the program had strategic advantages, which focused on taking notes on food, making the participants aware of the amount of food they ate, and the excess that was limited to the quantity. Using emotional handling to control eating behavior showed that the experimental group had better eating behavior and more exercise. However, the limitations of this study were that the behavior modification of participants in activities under the supervision of the program manager, and the social support, not from their perceived efficacy, and the expectation of success from the

perceived efficacy resulted in discontinuity of weight control, when there was a lack of social support, the practice was discontinued.

The theory of planned behavior referred to the theory of planned behavior developed by Ajzen (1991). It consisted of four main structures: attitude toward the behavior, subjective norm, perceived behavioral control, and behavioral intention. The main factor that determined a person's behavior was the intention of action, behavior or effort. It would carry out that behavior successfully, consisted of 1) the main factor in changing behavior to prevent obesity i.e. the needs and intentions of behavior modification, if the person intended to perform the behavior, it would be more likely to behave. In addition, and there may be other factors. That supported successful behavioral changes, including time, money, skills and support from other people, and 2) behavioral determination in the theory of behavior that was used to describe health behaviors, there were many theories including belief patterns in Health, rational action theory, planned behavior theory, and change models.

Technology and advertising media were one of the factors related to the weight reduction of Thai youths and youths (Yuktanon, 2006; Yucharoensuk, 2011). From the study of selected factors, which related to the behavior of drug use among the late female adolescents (Yuktanon, 2006), found that the late female adolescents who were deferring the influence of technology media was very high, tended to have the behavior of using anti-obesity drugs to control weight as well. In addition, the study of factors affecting weight reduction behavior of female students in higher education in Ubon Ratchathani province (Yucharoensuk, 2011), also providing support information, found that the influence of technology media was related to the weight reduction of the sample, with the nature of the technology media and advertising that would be prominent. It, in addition, wanted to provide information, also needed to be persuasive. Therefore, every aspect that could be used as a selling point or creating an impressive point would be used. In the case of teenage women, the issues used to create motivation were the beauty of the shape and appearance, as well as the dress, and the good personality of the actors in the technology and advertising media. Most of them are professionals, models, celebrities, singers, actors, famous and popular people of the same youth group, the model that offered products through technology and advertising, had only conveyed the offering of products, but also served to convey the culture that came with the communication process, media type, technology and advertising as well. As a result, teenagers had a behavior to reduce weight in order to get a satisfied shape, according to the popular consumption trend (Daoduang, 2002; Tienthai, 2006).

From the survey of the health status of Thai people in 1991 - 2009, found that people aged 15 years and over have increased overweight, from 17.2 percent to 34.7 percent, and obesity has increased by almost 3 times, from 3.2 percent to 9.1 percent (Lekuthai, Ingsrisaworg, Sunsomboon, & Teerawattanon, 2011). Health promotion, therefore, required communication to be involved and was used as an important tool. At present, found that Social media could be used to seek knowledge easily, with the use of Smartphones as much as 82.1, because it could be accessed without age limits, unlimited time, users had the opportunity to choose information according to interest and desire to learn (Knowles, 1975), was considered what people used to seek health knowledge in order to promote their own health, from the advancement of technology. The government had established a government application center, for the people had accessed to useful information more conveniently and quickly, was able to access information anywhere and at any time, and helped to develop and innovate the system for maximum benefits to leaders in health, both medical personnel and the general public. By the National Electronics and Computer Technology Center (NECCTEC) in collaboration with the Office of Health Promotion Foundation, Institute of Nutrition, Mahidol University, Food and Drug Administration (FDA), and the Department of Health, Ministry of Public Health. The Application development for the dissemination of food and nutrition information such as applications which allowed users to make healthy food on their own, food safety applications. The Applications for food and nutrition journals, behavioral research, Using mobile applications for health and wellness, mostly in foreign studies (Mateo, Granado-Font, Ferre-Grau, Montana-Carreras, 2015) Users of most applications (90 percent), had Smartphones and had the ability to search for information, according to the health information concept (US Department of Health and Human Service, 2013) For health-type applications that are available on Smartphones, they could be divided into 4 major health applications, namely food, exercise, treatment, or self-care, and drug use. And to study health promotion behaviors, and health conditions. Such applications could be utilized and as a guideline to promote the development of mobile applications, which would be an alternative to be used to create health this could lead to good health.

Smartphones were mobile phones that could connect to the Internet, had a built-in high-level operating system, had high flexibility, could install a variety of programs currently; the most popular was the iPhone, Samsung Galaxy Tab, and Nokia, etc. From the launch of the Android operating system, that was becoming prevalent, thus enabling users to access through applications on the Smartphones easier in real time, which was currently the application that attracted the most attention of Thai people, involving photography and linked with online social networks such as

8

Instagram applications on Facebook, including websites that provided users with the ability to create websites, write web sites, post blogs, pictures, videos, music, music, including Share ideas and could link to other websites, to find interesting information. At present, there were more than 7.2 hours of mobile phone users a day, representing 27% of the time in 1 day, mobile phones were used in places such as 67% printed on the bed, 47% used for killing time in waiting for something, 39% while watching television, 25% communicating with others, 22% used with family, 19% in the bathroom, 15% during shopping and 15% in various parties, etc. Mobile phones had a greater impact on consumer behavior in purchasing various products and services, which found that 42% use advertising on mobile phones, 23% Presenting information that provided better alternatives, 26% helped to find information, and 14% bought products and services via mobile phones, for analysis of situations, and the use of mobile applications in Thailand was found to be a leap forward, with the factor being the expansion of the Smartphone market, the unique features of Smartphones in Connect to the internet system, and could install various applications, could be easily accessed, thus creating a high demand for application development to create new services in response to the needs of today's consumers National Electronics and Computer Technology Center (NECTEC) had shown results from the survey of internet users in Thailand in the year. 2010, in terms of mobile application usage, it was found that the factor that made Thai people use the most mobile applications already installed on the device. (31.1 percent), followed by to increase the efficiency of use on the device (21.4 percent), for convenience and entertainment (15.2 percent), and necessary for work and daily life (14.1 percent), respectively. For demand Applications from mobile devices, most respondents had the need to use applications to respond to social media usage

(24.2 percent), followed by to increase the efficiency of the application. Work of mobile devices (19.2 percent), and to meet the needs of daily news (17.3 percent), respectively. And the survey of popularity in using applications also found that the popularity of Use Each type of application was similar, with communication applications having the most users (44.2 percent), followed by multimedia applications (42.1%), and applications to increase work efficiency (31.8%), respectively.

For promoting healthy eating habits, should be implemented in adolescents in order to prevent the occurrence of diseases related to food consumption that were not correct early Mobile Applications, to promote healthy eating habits for adolescents, by creating applications Which were effective and up-to-date for providing information, content, that promoted happiness, food consumption habits, and usage of this application in a fast and convenient way for teenagers In addition, research on the effectiveness of such applications was also being conducted, by researching to study the effect of using application programs to promote food consumption habits of adolescents, which were guidelines for using modern technology for good health promotion in adolescents from correct food intake.

Objectives of the research

1 To construct a mobile application to encourage the monitoring of obesity and consume food appropriately according to nutritional principles

2 To study the effects of weight control programs that focused on changing eating habits in overweight or obese students

3 To survey the satisfaction with the implementation of application among the sample group

Benefits of the research

1. A mobile application to monitor obesity was constructed with nutrition suitable for age and being useful and easily accessible with modern technology.

2. Application could be used to promote the consumption of foods with teenagers accurately.

Scope of the research

The scope of this research was to apply modern information technology to promote obesity monitoring, in the consumption of food according to the nutritional principles as follows.

1 Constructing the mobile application that was used to promote food consumption behaviors of those who wanted to take care of their health, including various knowledge related to beneficial nutrition, proper eating, various food information, weight control, recording daily food consumption habits, calculation of the energy received from food, types of nutrients received each day, dietary recommendations for health, including weight tracking, BMI, waist circumference, in relation to the health of the user, the program used to test adolescents who were volunteers and understood how to use this application when the volunteers tested the program.

2 There was an evaluation of the application on the mobile phone for using and promoting the monitoring of obesity in the consumption of food according to the nutritional principles. 3 The assessment from users (the samples in this research), mobile phone application used to promote obesity condition monitoring, in food consumption according to the principles Nutrition.

4 Application of the theory of planned behaviors, (TPB), which explained that self-efficacy in diet control, the belief that the surrounding society agreed with weight control and availability Good attitude, resulting in intention to change behavior, and when the level of intention and efficacy was sufficient, would lead to behavior change, which consisted of The main factor that determined a person's behavior was the intention of action, behavior, or attempted to accomplish that behavior, consisted of 1) the main factor in changing behavior to prevent obesity was the need, and intend to change behavior, if the person had the intention to perform the behavior, would be more likely to perform that behavior successfully, and 2) Determinants the intention of conducting behavior to control the disease which would reduce the waist circumference, reduced the occurrence of obesity, and various diseases that would follow.

Definition of Terms

Mobile application refers to an application that allowed the user to operate on a portable communication device, such as a mobile phone, in which those applications operated on the operating system (OS) was different. Examples of mobile operating systems were Symbian OS that were used in many mobile devices, including Nokia, Windows mobile, Microsoft BlackBerry camp, OS of RIM (Research In Motion), Web OS of Palm iPhone, OS. Apple and Android OS of Google, which was the last camp at the moment, and so on. **Obesity condition monitoring** refers to a continuous and consistent process, in collecting data and analyzing it in order to obtain indicators, changes in current and future obesity conditions, and to lead information for planning, operation, control, prevention and correction of obesity problems.

Obesity refers to the condition in which the body had excess fat in the abdomen and subcutaneous fat accumulates, and this accumulated fat causes health problems such as diabetes, high blood pressure, high blood cholesterol, coronary artery disease, knee pain. Ankle pain, or back pain. Obesity was an important factor that caused heart disease and stroke. (Cardiovascular disease: CVD), and also affected the quality of life of people with this disease. The current environment and society that was accelerating, resulting in more obesity, people with less physical activity but eating more food, and eating foods that were low in nutritional value, the energy imbalance that came in, and used it out, resulting in overweight, and resulting in obesity finally.

Overweight refers to the body condition that is overweight with the accumulation of body fat, the whole body more than normal or overall obesity or there is fat in the abdomen and/or under the skin, the abdomen increases, or fat. (visceral obesity and abdominal obesity); the whole body fat that is caused by the intake of nutrients rather than the energy that is used, which might adversely affect health.

RAJABHAT

1.6 Research Framework



Figure 1.1 Research Framework

Chapter 2

Literature Review

ALTER BALL

Problems related to dietary consumption among Thai teenagers

In adolescence, the body grows rapidly. There is an imbalance of metabolic processes in the body due to the rapid growth of various organs. In addition, teenagers like their independence and make more decisions for themselves. They often have emotional pressure from their studies and their family relations. The influence of advertising plays a huge role in adolescent behavior. All of these inputs have an effect on their eating behavior. According to Wongthong (1998), eating habits often follow popular fashion. The food that is popular among teenagers is fast food. A survey of people who frequent fast food restaurants found that patrons aged 15 - 20 years old and 21 - 25 years old were included in the restaurant category. This was up 52 percent and 56 percent respectively, with the most popular eating establishments being donut shops, followed by restaurants with fried chicken. Hamburgers, steaks, and pizza are composed primarily of starch, fat, and sugar, according to a fast food value study by the Institute of Nutrition. Out of 100 grams, fast food's main nutrient value was energy 232 kcal, protein 10.9 g (4.4 - 14.8 g), carbohydrate 23.4 g (17.2 - 36.2 g) and fat 13.8 g (10.3 - 19.1 g). Cholesterol content had an average of 72 milligrams (31 -79 mg), which can be compared with the cholesterol content of about 60 grams of lean pork, though the amount of dietary fiber was very low, only 2.6 grams, or 11

percent. In addition, most of these foods are fried in oil. Cutting meat into oil to make animal wax is a serious danger because saturated fats are substances that stimulate the body to produce cholesterol. This also reduces the body's ability to eliminate cholesterol. In the medical profession of the United States, it has been found that children aged 7 to 24 years have problems with fat clogging the blood vessels, which can result in death from this type of eating behavior.

Thai teenagers are at risk of the dangers of consuming fast food. Teenagers often refraining from certain meals and eat on inconsistent schedules. The fact that teenagers tend to abstain from breakfast might be due to the fact that many adolescents go to bed late and wake up late. By not eating breakfast, a teenager's first meal of the day may be lunch. Skipping meals means the body does not receive enough nutrients. Some adolescent girls abstain from breakfast for fear of obesity. If done regularly, this behavior can cause nutritional defects. (Nutrition Division, 2007)

In addition, teenagers often have poor nutritional habits, choosing to eat food that they prefer but which does not have the necessary nutritional benefits. This is sometimes due to a variety of activities, both educational and societal, that makes it difficult or impossible for teenagers to consume food at home. Food consumption habits change according to friends rather than parents. Not enough fruits and vegetables are consumed. The cause may be because of poor eating habits from the beginning. Adolescents tend to like to eat meat, sugar, and starch. Studies have found that children from good economic situations have more opportunities to buy food to eat all day. This is also true for children who have grown up over-eating or having fussy eating habits. This tends to cause obesity and dental cavities as well as misconceptions about food nutrition. Adolescents tend to consume foods that are advertised to them, believing false claims that these foods reduce obesity.

WHO nutrition data from the year 2009 concluded that the behavior of adolescents leads to the primary problem of insufficient nutrition. Micronutrient deficiency such as iron deficiency causes anemia, a condition in which the body has a lower number of red blood cells. Vitamin A deficiency disease in adolescents with nutritional status is the primary dietary deficiency condition. Macronutrient deficiency includes the condition of protein and energy deficiency. If the body receives insufficient energy and protein, it affects the growth of teenagers, resulting in stunted height, low weight, and learning deficiencies. These conditions are often found in the countryside among poorer communities with less access to nutritional needs and education. Malnutrition leads to growth stunting, causing body dwarfism in adolescents. On the other hand, obesity can cause cardiovascular disease, high blood pressure, gout, breast and uterine cancer in women, and prostate or colon cancer in men, gallstones, and tooth decay, as well as other associated illnesses. Malnutrition and improper diets are known to cause less milk production in post-natal women as well as babies born underweight.

1. The amount of food suitable for Thai teenagers

Changes in the growth and physiology of adolescents increases the demand for various foods. The daily dietary nutrition that teens should receive is discussed by Wongthong (1998) and Chayada (2007).

1.1 Energy: The energy needs of students depends on the growth rate of the body. Metabolism in the body and the force used in various activities, including learning and playing in one day, requires approximately 1,700 - 1,850
calories in female adolescents and roughly 1,850 - 2,400 calories in male teenagers. Milk groups, including fresh milk, contain complete nutrients, while flavored milk contains sugar and fat, which the body does not use. Adolescents should drink two glasses of fresh milk per day or eat two cups of yogurt per day.

The rice flour group provides energy that helps the body to be able to engage in activities. Eating a variety of foods provides more nutrients and should be encouraged.

The fat group includes foods that provide energy and warmth, including providing essential fatty acids that the body cannot synthesize, helping to dissolve and absorb fat-soluble vitamins such as vitamin A, vitamin D, fat, and vegetable oils such as soybean oil, corn oil, etc.

1.2 Protein: Adolescents needed more protein than adults. This is because adolescents are in a stage where the body is growing. Therefore, protein is needed to strengthen muscles, bones, tissues, blood, and hormones. Teens should receive at least 1 gram of protein per 1 kilogram of body weight. The protein received should be of good quality, derived from meat, eggs, fish, or dried beans, and products from beans such as protein and agricultural tofu.

1.3 Minerals: The body needs more minerals in order to strengthen itself. Minerals needed by teenagers are

1.3.1 Calcium: it is necessary for the growth of bones and teeth. In order for the system to work, teenagers should receive enough calcium. In one day, both male and female teenagers (aged 10 - 19) should receive approximately 1,200 mg of calcium. High calcium foods include milk and small fish. There is also calcium in some green vegetables as well. 1.3.2 Iron: Teens need to get enough iron, especially young

women who start menstruation, causing an increase in iron loss. Male adolescents should receive 10 - 12 mg. Young women should receive 15 mg a day, which can be obtained from animal liver, animal entrails, egg yolks, and green leafy vegetables.

1.3.3 Iodine: During adolescence, the demand for iodine increases as the thyroid gland grows, which can cause goiter if absent. Teenagers should receive 150 micrograms of iodine per day. Adolescents should eat seafood at least 1-2 times a week. Adolescents in the north and northeast should use salt that has added iodine.

1.4 Vitamins: Adolescents should receive enough vitamins to sustain growth and prevent vitamin deficiency.

1.4.1 Vitamin A: It is necessary for growth and various linings, such as human membranes and skin lining. Male adolescents aged 10 - 12 years should receive 600 mg of vitamin A per day, while those aged 13 - 16 years should receive 600 mg per day, obtained from animal meat, egg yolk, milk, butter, green vegetables such as kale, gourds, and morning glory, and yellow vegetables like pumpkin and sweet potato.

1.4.2 Vitamin B2 : This vitamin that acts as a coenzyme. Male adolescents should receive 1.6 - 1.8 mg per day and female adolescents should receive 1.3 mg per day.

1.4.3 Vitamin C: It is necessary to create collagen, which Is a component of various tissues. Vitamin C deficiency leads to scurvy. Adolescents should receive about 50 - 60 mg of vitamin C per day, which can be obtained from fresh vegetables and fruits. 1.5 Water: It is a very important nutrient. It is a component of various cells in the body. Water helps control bodily functions. Therefore, adolescents should receive enough water for the body, especially when exercising and losing a lot of water through perspiration. Adolescents should drink 8-9 glasses of water a day.

2. Nutrition for teenagers

At present, it is found that adolescents have greatly changed their consumption behavior. Teenagers are influenced by social, cultural, and technological changes, the lifestyle of their family, friends, and society, the environment, and competition for time to study. Therefore, teenagers often change their food nutrition behavior by turning to the consumption of fast food. This is because fast food is prepared to be sold to consumers for convenience and speed, saving time, and can be eaten immediately, which is suitable for a society always on the move. Hamburgers, steaks, sandwiches, pies, pizza, fried chicken, sausages, etc., are easy to pick up and eat on the go. Desserts such as donuts, pudding, cakes, and ice cream are also easily accessible and ready to eat (Virapong, 1992). Fast food is typically starchy food, full of fat and sugar, and when ingested causes obesity and the risk of diabetes, high blood pressure, hyperlipidemia, ischemic heart disease, and ischemic stroke. These unfortunate trends are increasing. It has been found that teenagers have poor dietary habits and an impaired nutritional status. Teenagers tend to eat poorly due to misunderstandings of nutritional needs, misconceptions regarding body image, and the desire to imitate friends. Many teenagers eat fast food to save time and money. Eating fast food affects the health of the body, causing illness and various preventable diseases such as obesity. A study of 7,437 excess weight secondary school students in Bangkok found that students under the Office of the Private Education Commission

and the Ministry of University Affairs would be obese more than students under the Department of General Education, who were underweight by 7.8 percent. Among students under the Office of the Private Education Commission, 11.6 percent were obese and 11.8 percent of the students under the Ministry of University Affairs were obese, with being more obese than female students (Manee, 1992). A group of obese students liked to drink soft drinks. Yamborisut (1996) found that this resulted in school-aged children who drank more soft drinks and consumed high-energy main meals got an inordinately high proportion of that energy from high fat meals. The Thai Public Health Report 1997 - 1998 found that obesity and high blood fat content increased in the age group of 20-29 years, from 2.9 percent to 20.4 percent.

A food consumption survey of 112 food technology and service students at Suan Dusit University (Lampang Center) from the academic year 2013 - 2015 found that more than 80 percent of students each day consumed food that was not nutritious, i.e. their daily food intake was not proportional to dietary principles. The survey also revealed that more than 80 percent of students in the cooking technology major had a non-nutritive consumption rate of dietary consumption, leading to obesity and malnutrition, as well as adverse effects on other aspects of health related to incorrect consumption. Such information was consistent with the Thai Public Health Report in 2014. It has been found that both obesity and high blood fat content has increased among Thai adolescents in each area from the previous year.

For adolescents, each period is associated with mental and emotional stress. As well being involved in many activities, Thai adolescent's behaviors and eating often changes according to what is currently popularity. Modern young teens drink coffee and tea instead of eating nutritious food in order to control their weight. While those drinks may provide a temporary burst of energy, they provide no other nutrients. Some teenagers imitate celebrities by fasting or eating only western meals that are harmful to the body and do not provide enough nutrients.

Adolescence is an age that has stress - physically, mentally, emotionally, and socially. These factors affect the body's need for various nutrients, the amount of food to eat, and the absorption and the use of various nutrients in the body. The eating habits of adolescents are often incompatible with their needs. Due to various activities, both in education and society, it is impossible for teenagers to eat all their meals at home. Eating habits are often influenced more by friends than by parents. Children of this age often skip breakfast. When having to hurry to get to school, there is often not enough time to eat. Girls often eat too little for fear of being excess weight, regardless of the reality of their body type or shape. Meals are often skipped, even though the body needs nutrition to provide energy and continue to grow. Many teenagers do not get enough vitamins. They often eat foods that have fewer calories to limit weight gain but often lack protein and iron. Teen boys have fewer problems because they tend to eat more. However, the food they consume often does not contain enough nutrients for their body's needs. Excess weight adolescents often eat overly large quantities of food. They should eat fresh fruit and vegetables instead of sweets at this age. Both boys and girls may be anemic, though girls are more likely to be due to the loss of blood through menstruation every month. Iron is essential at this age. Children of this age often have acne, which is caused by hormonal changes in the body, not by of food. Teenagers should eat fruits and vegetables for every meal and reduced fat foods, especially animal fat, which is improper nutrition and causes problems for society at present. Therefore, the researcher had the idea of developing

an application to promote adolescent nutrition to help prevent the occurrence of incorrect nutrition, which causes many problems with adolescent health. The application would include behaviors that need to be corrected and would promote a correct understanding for teenagers of the various nutritional information that is useful for them. TIN B

Excess weight and obesity

Excess weight and obesity are important risk factors for chronic noncommunicable diseases, especially diabetes, high blood pressure, high blood fat, cardiovascular disease, and cancer (Health Promotion Foundation, 2012). In addition, research from the Thai Burden of Disease and Risk Factors Working Group (2006) found that obesity was associated with insulin resistance. Cardiovascular disease and obesity result in reduced health years. Chronic diseases affect the quality of life and result in economic loss due to increased health costs and loss of health-related years of disability and premature death.

In 2004, obesity (body mass index \geq 25 kilograms / square meter) was a risk factor for disability-adjusted life years (DALYs). It was the second highest factor for Thai women and the sixth highest factor among Thai men. The 2nd Thai People's Health Survey, in 2004, found that 22.5 percent of men and 34.4 of women aged 15 years and over were obese, while 15.4 percent of men and 36.1 of women in the overall Thai population were obese.

1. Methods of screening for excess weight and obesity

1.1 Body mass index is the relationship index between height and weight, calculated from weight (kg) divided by height (Squared meter).

The World Health Organization uses the body mass index (BMI) criteria as a screening test for excess weight and obesity. According to the body mass index, a BMI of equal to or more than 25 kg / sq. m. is considered excess weight, while a body mass index of 30 kg / sq. m. is considered obese among the Asian population. There is an intersection proposal for grouping, with a body mass index of 23 kg / sq. m. being excess weight and a body mass index of 25 kg / sq. m. indicating obesity (table 2.1).

 Table 2.1 Body mass index (BMI) according to World Health Organization

criteria	and	the	inters	ection	of	Asian	popu	ilations.
			7.7	211	-		0.0.7.0	

Body mass index (kg / sq. m)								
1211	The criteria of the World Health	The criteria for Asian						
Group	2 ANTESS							
151	Organization (1998)	populations						
121								
Underweight	< 18.5	< 18.5						
15								
Normal weight	18.5 - 24.99	18.5 - 22.99						
-								
Excess weight	≥ 25	≥23						
Pre-obese	25 - 29.99	At risk 23 - 24.99						
	TALINIA							
Obese Class 1	30 - < 34.99	25 - 29.99						
	JADA							
Obese Class 2	35 - < 39.99	≥ 30						
Obese Class 3	≥ 40.00	-						

Source: World Health Organization, 2004

1.2 Waist circumference is the value obtained from waist circumference measurement with a standard gauge cable, measuring from the middle position of the waist, between the lower edge of the lower rib and the upper edge of the iliac crest, and in parallel with the ground. Abdominal obesity refers to a waist circumference \geq 90 cm in men, and \geq 80 cm in women.

Survey results found that the average body mass index in the Thai population aged 15 years and over was 23.1 kg / sq. m. for men, and 24.4 kg / sq.m. for women. The average body mass index increased according to age, with the highest values in the age groups of 45–59 years. After age 60, body mass index decreased, with the lowest at the age of 80 years and older. When considering the average body mass index according to region, men and women in Bangkok had the highest body mass index, followed by the central region.





Figure 2.1 Average body mass index (Kg / sq. m) in the Thai population aged 15 years and over by age group and gender

Source: Thai Health Promotion Foundation, 2015

Prevalence of obesity in the Thai population aged 15 years and over found that 28.3 percent of men and 40.7 percent of women are obese (body mass index \geq 25 kg / sq. m), with the highest prevalence in the 45-59 year old age group.

The waist circumference of the male and female population aged 15 years and over is an average of 79.9 cm and 79.1 cm, respectively. In the same age group, men have a larger waistline than women among all age groups. In general, both men and women have the smallest waist circumference in the age group of 15-29 year olds, while the 45–59 year old age group had the largest. The waist circumference reduced among the elderly.



Figure 2.2 The average waist circumference (cm) of the Thai population aged 15 years and over by age group and gender

Source: Thai Health Promotion Foundation, 2015

Causes of promoting factors and effects of excess weight and obesity

The causes of being excess weight: excess weight and obesity are caused by the accumulation of fat in various organs throughout the body, which normally contain two types of fatty tissue, white fat and brown fat. White fat is important for metabolism to produce energy, while brown fat is found in infants. When the body receives fat in the form of triglycerides, it is broken down by bile into smaller pieces. The pancreas then secretes lipase to capture the skin of the micelle, causing the fat to break down into even smaller parts, where it moves into the intestine. These small particles of fat are made up of fat molecules called chylomicron and are coated with a protein to dissolve them. After that, the chylomicron is released into the lymphatic system, which meets the vein and carries the fat into the bloodstream and other parts of the body. Remaining in the bloodstream for 8 minutes, the lipoprotein lipase enzyme breaks down the fat particles into acids. Fats and enzymes are found in the blood vessel walls, adipose tissue, muscle tissue, and heart tissue. The function of the enzyme lipoprotein lipase depends on the level of insulin. In the body, when more energy is brought in than is used up, there is a process to absorb fatty acids from the blood into fat cells, muscle cells, and liver cells, which then convert the acids into fat molecules by stimulation of insulin and accumulate fat cells throughout the body (Phoomsawat et al., 2005).

Factors that affect excess weight and obesity

1. Literature review found physical factors such as age, sex, genetics, and the use of certain drugs leading to excess weight, with age being the most significant factor, especially in females (Piasue, 2007). Excess weight and obesity in women aged between 20-34 years accounted for 52.8 percent and 28.4 percent, respectively. It was found that as a person's age increases, excess weight and obesity are found to increase, according to research on women aged between 35-44, at a rate of 60.6 and 32.1, respectively (Thompson et al., 2004). In addition to gender and age factors, it was found that genetics is one of the causes of obesity, with obese children more likely to have obese parents (Phoomsawat, 2005). Fowler's study from the years 1971 – 2003 (Fowler, 2007) found that if direct family members were obese, the chances that brothers would become obese increased by 40 percent.

In addition, certain diseases that caused cortisol formation or the body receiving cortisol could cause excess weight and obesity. Endocrine system diseases, such as those of the thyroid gland, may cause excess weight due to the body's inability to burn fat. Cushing syndrome, a primary adrenal gland disease, causes the body to produce excess cortisol hormones, resulting in the accumulation of fat and adrenal tumors. The use of certain maintenance drugs, such as birth control pills, steroids, insulin, sodium valproate, tricyclic antidepressant phenothiazine, some antihypertensive drugs, beta-blockers, and antihistamine group drugs stimulate overeating due to increased appetite. (Srimada, 2001).

2. Psychological, social, economic, and cultural factors: psychological problems from economic and cultural factors, such as stress, often cause excess consumption in an effort to alleviate resentment or anger (Phokleen, 2 0 0 4). In addition, economic problems affect people's eating behavior, such as limited time to cook or eat a healthy diet. While a lack of time can lead to poor dietary choices, so too can excess time lead to recreational or social eating and the tendency to consume more than is required and thus excess weight gain (Rungroj et al., 2005).

3. Behavioral factors: Studies have found that the problem behaviors leading to excess weight include inappropriate eating behavior and a lack of exercise (Blumenkrantz, 1999). Inappropriate eating includes eating patterns such as eating more than the body needs, poor consumption habits, improper eating choices, and social eating in groups on special occasions leading to excess nutrients or excess calories unsuitable for health. Research results from the Medical and Biochemistry Unit, Department of Medicine, Ramathibodi Hospital, found that most Thais enjoy eating on a regular basis, like to eat a variety of foods, share their meals, and thus eat more than is healthy for their bodies (Komin, 2006).

In addition, it was found that the behavior of eating foods high in fat is a major cause of excess weight in Thai people, according to the 2003 Survey of

29

Nutrition Division data. This study found that Thai people consume palm oil at a rate as high as 37.9 percent while eating foods that have a fat content of as much as 41.7 percent. In addition, it was found that the results of the study of blood lipid levels in public health personnel, who should have a good understanding of responsible health care, found that blood cholesterol levels are higher than the average 62.80 percent (Pornnaruwan et al., 2003). Additionally, health research studies were conducted at Sukhothai Thammathirat University. From 2005 – 2009, a study of 87,134 students, both male and female, found high-risk consumption behavior at 50-55 percent, with students preferring to consume high fat fried foods as frequently as 3-6 times per week, along with soft drinks, dessert foods with coconut milk, and grilled and smoked food (Sueb-Saman, 2008.)

4. Factors other than consumption behavior include the fact that Thailand has changed from an agricultural society to an industrial society, changing people's lifestyles, especially their exercise habits and activities that are labor-intensive. People have reduced the amount of physical activity they do, using machines to increase productivity in jobs where human labor was previously needed, including housework with the advent of convenience equipment such as washing machines, vacuum cleaners, and dishwashers. Physical activity that previously helped reduce fat accumulation has been replaced by time saving devices that are convenient but also increase the sedentary lifestyles of the users.

Effects of excess weight

Excess weight affects many health conditions, with relationships to chronic diseases divided into three groups (Tangtrongjit and Pholrat, 2007; WHO, 1998).

1. Chronic diseases associated with obesity

1.1 Hypertension: Obesity is a factor that is associated with hypertension and has a direct relationship with body mass index. Obese people are more likely to suffer from hypertension than thin people because fat sticks to the walls of the arteries, resulting in stenosis and blockage and an increase in blood pressure (Phrom Prasit, 2007). Results show that obese people have higher blood pressure than normal weight people. People with hypertension tend to see their blood pressure decrease upon losing weight (Techapaitoon, 1999). A U.S. study (National Health and Nutrition Examination Survey: NHANES II) found that the rate of hypertension is directly related to weight gain in obese adults. (Mogelvang et.al, 2006). In addition, it has been found that hypertension is increasing in obese people (Reinhard et al., 2006). High blood insulin levels due to hypothermia result in increased circulation of sodium in the kidneys, which caused these people to have higher blood pressure (Stamler, et.al, 1989). A study of obese children aged 12-19 years, found that when body mass index increased by 1 kilogram/m², risk factors for blood pressure levels in males and females increased by 0.90, 0.74 mm Hg, respectively (Domingo et al., 2007).

1.2 Heart disease: obesity is the main factor in heart disease, with common symptoms including high blood pressure and high blood lipid levels due to obese people having an accumulation of fat that sticks to the vascular walls in the intima layer (a fragile layer subjected to the blood stream that causes tearing, resulting in lesions, stimulating blood clotting factors, including platelets and followed by the occurrence of arterial stenosis and obstruction) (Sermsawan, 2008). This in turn causes the heart to work harder, with a blockage of the blood vessel to the heart potentially causing heart disease, ischemic heart attack, and death (Phoklin, 2004). In addition, the results of a prospective study found that obesity is a significant factor in cardiovascular disease that does not depend on other factors (Berrios et al., 1997), while a study from the United States showed that a higher body mass index in women increased the risk for cardiovascular and cerebrovascular diseases (Freedman et al., 2006). The study looked at 5,881 women with an average age of 55 years and found that a one point increase in body mass index elevates the risk of heart failure by 14 percent in females, and 11 percent in males. In addition, it was found that those with a BMI greater than or equal to 30 kg per square meter who increase their body mass index by one point upwardly affect their risk of stroke 1.95 times, with total fat and LDL-cholesterol increasing by 2.75 and 2.24 mg / dl respectively (Kenchaiah et al., 2002; Domingo et al., 2007).

1.3 Cancer: Excess weight and obesity are directly related to cancer, resulting in an increase in carcinogens. Cancer-related mechanisms are associated with endocrine systems such as breast cancer or endometrial cancer, known as fat tissue, as a source of energy which, if it exists in excess, can affect the functioning of the endocrine system and contribute significantly to the secretion of adipokines. In addition to having an important role in the immune system, target cells may to divide and result in obese people being affected by increased morbidity, especially as a result of metabolic syndrome, which is caused by insulin resistance from high levels fat and reduced insulin production in the pancreas. An insulin-resistant condition can result in toxicity from fat as a resulted of the production of fatty acids, including adipokine. Both substances have a severe effect on the body's circulatory system and may cause carcinogenicity, with obesity affecting the sex hormone-binding globulin. Plasma levels, androgens levels, and estrogens levels affect changes and increases of cells,

necrosis of the uterine lining, breasts, as well as the prostate gland. Additionally, obese menopausal women are at high risk due to obesity's effect on the prevention of infection and the production of free radicals with an inadequate supply of antioxidants. As a result, the destruction of DNA, proteins, fat, and other small molecules promote the development of cancer (Ceschi et al., 2007).

Based on previous studies, women with a higher BMI 40kg /m² have a greater chance of developing cancer of the uterus and breast, while men are more likely to develop colorectal cancer and prostate cancer than people with a lower BMI (Mekworawut and Chaisirirat, 2001). A prospective study of a population of 75,000 people over a 12-year period found that people with obesity have a higher mortality rate due to cancer, at 1.33 and 1.55 in females and males, respectively, compared to people of average weight. This is especially true in males, where it was found that there is a relationship with prostate cancer, while in females it is associated with cancers of the conjunctiva, uterine cavity, gallbladder, cervix, ovaries, and breasts. In addition, it was found that the accumulation of fat in the center of the body in postmenopausal women results in a faster rate of breast cancer in people of excess weight and those who are obese (Pi-Sunyer, 1991). Excess weight and obese conditions also increase the risk of gallstones at a rate 3-4 times that of average weight people, because obese people have high cholesterol bile circulation, causing precipitation. (Mekworawut and Chaisirirat, 2001) (Tanphichit et al., 2001).

33

2. Diseases of the endocrine system and metabolic disorders

2.1 Diabetes: Obesity is directly related to the incidence of noninsulin-dependent diabetes mellitus, especially as caused by abdominal fat accumulation (central obesity). In addition to being an energy storage source, it also acts as an endocrine system, including secretion of free fatty acids (FFA) that affect the functioning of organs, as well as proteins called adipokines, include leptin, adiponectin, resistin, and tumor necrosis factor α : TNF- α). The addition of free fatty acids over a long period of time causes insulin resistance, with leptin the protein secreted by adipose tissue and enhanced insulin sensitivity. Adiponectin has the ability to increase the response to insulin sensitivity. In obese people, it has been found that adiponectin production decreases, increasing insulin resistance, and most importantly, enhancing tumor necrosis factor α , which causes insulin resistance through inflammation of the body (Soonthornyothin, 2006).

According to a study in Thailand, obese patients are more than three times more like to have diabetes than non-obese people (Siwattanakul, 2001), while studies of women aged between 30 and 55 years of age found that patients of excess weight or who are obese have a 40 times greater chance of developing insulindependent diabetes, compared to those of normal weight (Tangtrongjit and Pholrat, 2007). When a severe imbalance occurs in the making of beta cells (β -cell) in the pancreas, insulin production is insufficient to meet the needs of the body, resulting in increased blood sugar, causing diabetes, which affects the health and is linked to various body systems such as the cardiovascular system, the endocrine system, and renal function. 2.2 Hyperlipidemia: In the presence of hyperlipidemia, cholesterol levels and/or triglycerides are combined in a condition called lipoprotein, which consists of three types of fat particles, namely cholesterol, triglycerides, and phospholipids, in which blood lipoprotein is divided into five types, as follows (Chotivichian, 2008).

2.2.1 Chylomicron is created in the small intestine, carries cholesterol to the liver, and triggers triglycerides to the fatty tissue.

of triglycerides from the liver and the small intestine that metabolizes triglycerides into energy.

2.2.3 Intermediate density lipoprotein (IDL) is a precursor to low-density lipoprotein (LDL).

2.2.4 Low-density lipoprotein (LDL) has smaller particles that use triglycerides as energy, causing more cholesterol than triglycerides and phospholipids to transfer cholesterol. If a high enough level of energy is received, cholesterol accumulates on the inner wall of the blood vessels.

2.3 High-density lipoprotein (HDL) is the smallest and most important lipoprotein, acting to transport cholesterol from the artery wall into the liver.

People with obesity often have total cholesterol, low density lipoprotein cholesterol (LDL-C), and triglyceride levels higher than normal people, while high-density lipoprotein cholesterol (HDL-C) levels are lower than normal (Tangtrongjit & Pholrat, 2007), causing risk to the cardiovascular system. 3 Diseases or conditions caused by excess weight and excess fat

The groups of diseases caused by carrying excess weight are major common diseases in the system affected by body weight: knee, hip, and spine pain, osteoarthritis, and respiratory diseases.

3.1 Osteoarthritis: Obese people often have knee problems, degenerative spine diseases, and knee and back pain due to weight gain and body fat increases that result in increasing deterioration over time. In addition, it was found that obese people have a higher level of uric acid than normal people and a higher likelihood of having gout (Tanpaijit et al., 2001). A study of people of excess weight found that excess weight was negatively correlated with the width of the inner knee joint and the side of the knee narrow (Cimen et al., 2004). Spectroscopic studies (Hart & Spector, 1993) revealed the effect of knee osteoarthritis by radiological screening in 1,000 female samples showing that when the body mass index is 23-26 kg / m^2 , there is an increase in osteoarthritis of the knee of 2.9 times that of normal weight people.

3.2 Respiratory diseases: Obese people have difficulty breathing due to increased fat in the breasts. In addition, excess fat causes the diaphragm to not drop normally, resulting in oxygen depletion, exhaustion (especially at bedtime), and intermittent sleep apnea syndrome. Occurrences are found in approximately 10 percent of obese men and women with a BMI greater than or equal to 30 kg/m². Intermittent breathing stops during 65-75% of sleep time, while obese people with a BMI of more than 40 kg/m² show intermittent sleep apnea syndrome at 77% (Tanpaichit et al., 2001; Tangtrongjit & Pholrat, 2007). 3.3 Social and psychological problems: People who are particularly obese often have large, bulky, and slow-moving movements that are not well received in certain social settings, such as when applying for jobs, obtaining state aid, or continuing education. Obese people often feel discouraged and suffer from social inferiority complexes (Wichai Tanpaichit et al. 2001). A survey of people with excess weight conditions and obesity showed participants to have twice the health care issues as normal weight people, with psychological problems more prevalent in women than in men. Chronic diseases and cancer are also seen with increased frequency (Tangtrongjit & Pholrat, 2007). Mental health studies in obese people in the United States show black women to be two to three times more likely to have psychological problems in white women (Felson et al., 1992).

In addition to the physical effects, excess weight or obesity also affects mental health, causing loss of pride, lack of self-confidence, low self-esteem, and depressive feelings (Phaktoop, 2002). Along with the physical bodily effects of obesity, it also affects mental health, and is found to raise costs incurred by a country's health care system for the treatment of complications caused by excess weight and obesity. A report from the World Health Organization in the year 2000 studied obesity in various countries. From 1981-1989, The Netherlands had to pay four percent of the country's health budget towards treating obesity-related issues and complications, while Australia (1989-1990) and France (1992) paid out two percent of their country's health budgets. The highest cost was found in a 1994 study from the United States, which spent 6.8 percent of its health care budget on excess weight and obesity-related issues (Phoomsawat et al., 2005). Clearly, excess weight affects both the physical and mental health of the individual, as well as adding to the cost of treating illnesses associated with obesity. Methods that could result in an improved quality of life for individuals with weight issues include weight control through drug treatment as well as weight loss without the use of medications, as detailed below.

Losing weight in the benchmark

Losing weight in the benchmark can be divided two ways:

1 Weight loss by medication / medical methods. Weight loss by medical methods is weight loss through the use of medications or medical methods, including drugs, surgery, and liposuction, as detailed below.

1.1 Weight loss through drug use: Medications and products used for weight loss in the treatment of obese people require long-term treatment using moderate weight loss methods, i.e. the weight of the patient gradually decreases by roughly 5 to 10 percent, which has been proven to be a healthful pace at which to lose weight. At the same, weight loss must be sustainable, therefore it is not recommended to use medication in every case of excess weight or obesity. Only patients with a BMI greater than 30 kg/m², and when diet, exercise, and behavior modification is unsuccessful, is the use of medicine recommended. Risk factors such as diabetes and high blood pressure need to be considered when prescribing medicines to aid in weight loss, as well as an examination of dietary habits and exercise routines (Phumasawat et al., 2005). Important principles in the use of obesity medicine look at the effectiveness of the medicine when used in combination with diet and exercise behavior adjustments (Rungphisuthipong, 2007). 2) Medications help control weight, but do not treat obesity once the drug is discontinued, with weight gain recurring. 3) Drugs may be a suitable option when body mass index is greater than 30, and when controlling eating and exercising are not effective. 4) Complications caused by obesity must be considered. Drugs that are effective and safe for long-term use of 1-4 years and are approved for use in European countries are Orlistat, licensed in the year 1998, Sibutramine, licensed in the year 1999, and Rimonabant, licensed in the year 2006 (Rungphisitphong, 2007).

Obesity medicine is classified by position of action: 1) Drugs that affect the nervous system. Sibutramine is a drug that acts as a re-uptake inhibitor against serotonin, while norepinephrine reduces appetite by inhibiting the activity of mono-enzymes and finding increased absorption and increased inhibition of metabolic processes in laboratory animals. In addition, energy consumption is also increased in obese patients with diabetes. Sibutramine is good for controlling blood sugar and fat levels in the blood vessels. Side effects include headaches, dry mouth, insomnia, constipation, high blood pressure, and increased heart rate. The recommended dose for first use is 10 Mg / day and is used in conjunction with diet control and behavior modification. After 4 weeks of treatment, if weight is less than 1-8 kg, or 1 percent of original body weight, the does can increased to 15 mg / day. The medication should not be used for more than one year. Contraindications are heart disease, blood deficiency, congestive heart failure, cardiac arrhythmias, stroke, liver disease, and severe kidney disease. The US Food and Drug Administration approved the use of Sibutramine obesity. (Navanapharatsakul, for the treatment of 2002; Rungphisitphong, 2007).

Rimonabant is a drug that helps control appetite and affects adipose tissue and muscles, causing triglyceride levels in HDL and hemoglobin HbA1c improvement in patients with diabetes while helping to reduce the occurrence of metabolic syndrome (Rungphisitphong, 2007). 2) Drugs acting on the gastrointestinal tract: Orlistat is a derivative of Lipstatin and works by inhibiting lipase in the gastrointestinal tract, enabling the inhibition of the absorption of fat foods by as much as 30 percent in studies using olives over a two year time period. Results showed that weight loss occurs faster and more significantly in the group receiving the drug. Side effects include oil flowing out of the rectum, fat or oil in the stool, defecation, fecal incontinence, and disruption of the absorption of fat-soluble vitamins. Recommended dosage for first time use is 120 mg, taken with meals. Patients should not eat more than three times per day, and if used over a long time period, extra fat-soluble vitamins should be consumed. Use in patients with chronic gastrointestinal absorption or those with obstructive biliary tract may require extra fat-soluble vitamins if using Orlistat for a long period of time (Navanopharatsakul, 2002; Rungphisutthipong, 2007).

1.2 Surgery: Surgery has played a role in treating people who are overweight or obese. However, surgery is not the best treatment method, though it can help those who have a BMI \geq 35 kg/m² and those with severe obesity (BMI \geq 40kg/m²) that cannot lose weight by means of changing their dietary habits, through exercise, using medications, who have life-threatening by or diseases (Rungphisitphong, 2007). At present, surgery is acceptable, including surgery to remove the small intestine or gastric bandage surgery (vertical-banded gastroplasty or kuzmak adjustable silastic band). This type of surgery reduces dietary intake absorption and is referred to as garstric bypass surgery. It is generally effective in reducing excess body weight by about 50% on average, and in maintaining that new body weight over time. Nearly 60% of patients maintain their lower body weight after five years. However, patients must control their diet and and exercise regularly in order not to put the previous weight back on. In Thailand, doctors do not use these methods frequently due to the potential for post-operative complications. The most common surgical methods among Thais are abdominoplasty and liposuction, though these techniques do have their disadvantages, which may include the stomach becoming stiff for many months or years (Phoomsawat et al., 2005).

1.3 Liposuction: Liposuction is a method that uses a tube-like tool inserted under the skin to absorb excess fat from areas such as the abdomen, hips, buttocks, thighs, upper arms, neck, etc. Liposuction cannot be used to reduce obesity throughout the body, but can reduce the amount of fat that accumulates in specific areas. Liposuction does not reduce muscle mass. The area to be suctioned must be strong, and the skin must have good elasticity. Liposuction methods begin with the injection of anesthetic and epinephrine, which do not promote bleeding. The skin is then cut in small areas and a vacuum tube is inserted into the area to suction the fat out. Healing is typically fast and the skin remains tight. Complications, though not common, include knotted skin, subcutaneous nodules, scarring, numbness, and infection (Phoomsawat, 2005). Although weight control via medical methods may be effective and popular, they are also expensive, thus limiting the number of people who can afford this option as a weight loss method. Weight loss methods that do not require drugs or surgery can be effective when followed closely.

2 How to lose weight without using drugs or medical methods / Behavior modification for weight loss.

Weight loss without the use of drugs or medical methods is a change in weight loss behavior, which according to a literature review, found that the key

41

factors related to weight loss are proper nutrition together with exercise to lose weight.

2.1 Nutrition and weight loss: Food is an important factor related to obesity. The main cause of obesity is consuming more energy than the body needs, particularly in the form of fatty foods (Nitithongyong, 2006) those who are overweight or obese often experience trying to lose weight through various methods, such as fasting and eating low fat foods. These methods are not usually effective in the long term. It has been found that dieting can cause anorexia and fatigue, and when the dieting ceases, overeating resumes. (Komin, 2006). Therefore, understanding the correct amount of calories for weight loss and the proper type of diet to lose weight is important.

An important principle in food intake is to obtain sufficient nutritional value and energy that the body requires, without consuming too much such that the excess weight is gained. The sufficient amount of energy for each individual in pre-menopausal women depends on each person's body weight and the activity level. Usually, people who do not do much physical activity should consume 30 kcal per 1 kg of body weight. Thus, an average sized woman would consume 1,600 kcal per day, while an average sized man would consume 2000 kcal per day. Neither males nor females should consume less than 1,200 kcal per day, as this is likely to have a negative effect on the body's ability to function properly as metabolism decreases. (Kitworaphat, 2006). For those individuals who perform heavy labor or extreme physical activity, 40 kcal of energy per kilogram of body weight per day is generally recommended, while a person whose activity levels are very light might need only 20 kcal of energy per 1 kilogram body weight per day. Food consumption must include complete and adequate nutrition, eating as a percentage less than 20-30 percent fat in their diet, 15 percent protein, and 55-60 percent carbohydrates (Rungpisutikulphong. 2007) Each person's food needs depend on that person's size and activity level. Reductions of 500-1000 kcal per day generally result in weight loss of 0.5-1 kg per week, while any more than that can adversely affect the body. Dietary weight loss foods have fewer calories than non-weight loss foods. The way to calculate energy consumption to lose weight is as follows:

Example of calculation: Pre-menopausal women aged 35 years, weight 50 kg. Desired weight loss of 5 percent. How much food must be consumed for energy? Calculation method:

Energy required by the body = $30 \times 50 = 1500$ kcal per day

Desired weight loss of 2.75 kg (5 percent)

Food consumption = $30 \times 47.25 = 1418$ kcal per day

Type of food suitable for weight loss. The type of food that is suitable for weight loss can be divided into three groups, as follows (Kitworapat, 2006): 1) Foods in group 1 include unpolished rice and fiber, such as brown rice, corn, boiled fresh vegetables, blanched vegetables, green leafy vegetables, oranges, apples, guavas, papayas, watermelons, fish, egg whites, shrimp, crab, white tofu, red bean, fat-free milk, and mineral water. The foods in this group should make up the majority of the nutrition consumed. 2) Foods that should be eaten moderately fall into group 2. These include white rice, glutinous rice, rice noodles, pumpkin, carrots, ripe mangoes, bananas, jackfruit, custard, red pork, whole eggs, whole milk, low fat yoghurt, skimmed milk, peanuts, and coffee. 3) Foods that should not be eaten or eaten in very limited amounts for those who wanted to lose weight include sweets, chicken rice, durian, longan, sweet tamarind, lean meats, omelets, fried fish, sausage, pork, butter, soft drinks, liqueurs, beer, stir-fried foods, or foods cooked with coconut milk.

In order to avoid boredom, food consumption for weight loss needs to be suitable for each person's eating habits (Rungphitipong, 2007), according to the food categories, as follows (Sangpuag & Sirichakwal, 2006). 1) Vegetables are divided into two types. The first type provides low energy, with one portion equal to 100 grams or 1/2 cup, and can be eaten in unlimited amounts because they contain fewer than 20 kcal of energy per portion. These include lettuce, white cabbage, cucumber, winter melon, lotus stem, etc. The second type of vegetable consumed at 50-80 grams or ¹/₂ cup per portion and contains approximately 25 kcal of energy. These include vegetables such as kale, tomatoes, gourd vegetables, Chinese morning glory, flowers, bean sprouts, eggplant, and bamboo shoots. 2) The fruit food group has both a sweet and a very sweet taste, and should be eaten in different proportions. Less sweet fruits, which contain about 60 calories Kcal per serving, include apples (two large apples, approximately 29 kcal of energy), 6 pieces of ripe papaya (22 kcal of energy), and six pieces of pineapple (51 kcal of energy). 3) Starchy foods: One serving contains 90 kcal of energy (half a cup of cooked rice, 1 piece of bread). These foods should be eaten in moderation. 4) The meat food group. This category provides protein energy, though meats should be chosen that are low in fat, such as chicken breast or fish, which contain 55 kcal per 30 grams. Pork skin, chicken skin, duck skin, and pork legs should be avoided as they contain up to 100 kcal. 5) The milk food group is divided into three types, namely whole milk, low fat or skimmed milk, and fat-free milk. 240 ml of whole milk provide energy up to 150 kcal, while the same amount of low-fat milk or skimmed milk provides 120 kcal, with fat-free milk having only 80 kcal of energy. 6) Fatty foods should be limited. For those people needing 1,600 kcal of energy per day, they should receive no more than 25 grams of fat (5 teaspoons), and those who need 2,000 and 2,400 kcal of energy should get no more than 35 grams (7 teaspoons) from fat.

Group	Quantity	Protein (g)	Fat (g)	Carbohydrate
	(1 part)	1		(g)
Rice/carbohydrate	1 ladle	R1.4 3	0.65	17.9
Vegetable	100 grams	2.25	0	4.75
Fruit	70-120 grams	0.98	0.12	15.4
Meat	1 spoon	2.7-3.5	1.7-4	0
Egg	1/3 egg	2.3	1.6	0.2
Skimmed milk	1glass	7	3.2	9.8

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Table 2.2 Nutritional value of various food groups

Source: Kitworapat, 2006

Energy required	Morning	Daytime	Afternoon	Evening
(Kcal)				
200	2 ladles of rice	2 ladles of rice	Skimmed milk	2 ladles of rice
	2 spoons of	2 ladles	5	1 ladle
	meat	vegetables	JUN	vegetable
	1 serving fruit	2 spoons of	S.C.	2 spoons of
	$\langle \rangle / \rangle$	meat	1 10	meat
	SIL	1 serving fruit		1 serving fruit
300	2 ladles of rice	2 ladles of rice	Skimmed milk	2 ladles of rice
15	2 ladles of	2 ladles of	1 serving fruit	2 ladles of
	vegetables	vegetables		vegetables
0	3 spoons of	2 spoons of	7 VI //	2 spoons of
1	meat	meat	SL/	meat
	1 serving fruit	1 serving fruit	Mar Carl	1 serving fruit
100	3 ladles of rice	2 ladles of rice	Skimmed milk	2 ladles of rice
12	2 ladles of	2 ladles of	1 serving fruit	1 ladle of
11	vegetables	vegetables	PAC-	vegetable
		CITT P C	11111	

Table 2.3 E weight

1200

1300

		2/// 30 \	TCL -	-
1400	3 ladles of rice	2 ladles of rice	Skimmed milk	2 ladles of rice
12	2 ladles of	2 ladles of	1 serving fruit	1 ladle of
11	vegetables	vegetables	PAC.	vegetable
	3 spoons of	2 spoons of	VIIR	2 spoons of
17	meat	meat	PLAN /	meat
	1 serving fruit	1 serving fruit	a M	1 serving of
	12			fruit
1500	2 ladles of rice	3 Ladles of	Skimmed milk	2 ladles of rice
	2 ladles of	rice	1 part fruit	2 ladles of
	vegetables	2 ladles of	11	vegetables
	3 spoons of	vegetables		2 spoons of
	meat	2 spoons of		meat
	1 serving fruit	meat		1 serving fruit
	1 serving	1 serving fruit		
	Skimmed milk			
			·	

Energy required (Kcal)	Morning	Daytime	Afternoon	Evening
1600	 3 ladles of rice 2 ladles of vegetables 3 spoons of meat 1 serving fruit 1 serving Skimmed milk 	 3 ladles of rice 2 ladles of vegetables 3 spoons of meat 2 servings fruit 	Skimmed milk 1 serving fruit	 2 ladles of rice 2 ladles of vegetables 2 spoons of meat 1 serving fruit
1700	 3 ladles of rice 2 ladles of vegetables 3 spoons of meat 1 serving fruit 1 serving Skimmed milk 	3 ladles of rice 2 ladles of vegetables 3 spoons of meat 2 servings fruit	Skimmed milk 1 serving fruit	 3 ladles of rice 2 ladles of vegetables 2 spoons of meat 1 serving fruit
1800	 3 ladles of rice 2 ladles of vegetables 3 spoons of meat 1 serving fruit 1 serving Skimmed milk 	 3 ladles of rice 2 ladles of vegetables 3 spoons of meat 2 servings fruit 	Skimmed milk 1 serving fruit	 3 ladles of rice 2 ladles of vegetables 2spoons of meat 1 serving fruit

Table 2.3 Examples of the amount of food to eat per meal in order to lose weight

(Continued)

Source: Kitworapat, 2006; Tansupasiri, 2008

Day / meal	Morning	Daytime	Afternoon	Evening
Monday	Steamed rice,	Fried rice with	Skimmed milk	Steamed rice,
	pork blood	shrimp paste,	~	fried mackerel
	soup, fried	Liang Curry,	SIN	with shrimp-
	bean sprouts,	mixed	SU.C.	paste sauce,
/	tofu, orange	vegetables,	112	soup with
· / .	$\leq \rangle$	Muskmelon		gourd, minced
			1/1 / /	pork,
				rambutan
	Shrimp	Yentafo	Skimmed milk	Steamed rice
Tuesday	porridge with	noodles		Crab chili
	eggs	guava	KIN.	paste
	orange		Mar C	fresh
	Set			vegetable
12	1- AY		9.	tofu soup
12	10	Wint S	202	ripe papaya
Wednesday	Porridge with	Duck noodle	Skimmed milk	Steamed rice
17	fish	rose apple		nam prik ong
	banana flower		$a \gamma l$	fresh
	salad		//	vegetable
	Cavendish			orange
	Banana	1.7.	11/	
Thursday	fish maw	Spicy Mee	Skimmed milk	Pork suki
	grape	Salad		guava
		Papaya salad		
		with boiled		
		crab		
		watermelon		

 Table 2.4 Menu sample for weight loss

Day / meal	Morning	Daytime	Afternoon	Evening
Friday	Steamed rice	Noodles	Skimmed milk	Steamed rice
	clear soup	topped with		Liang curry
	with gourd	shrimp		fried mackerel
	ripe mango	pumpkin in	5	with shrimp-
	12	sweet coconut	SIN	paste sauce
	1.12	milk	S. Co	rose apple
Saturday	Steamed Rice	Rice noodles	Skimmed milk	Steamed rice
	sweet radish	in fish curry		dried chili
15	fried pork	sauce with	12 1	with grey
10	garlic pepper	vegetables		knife fish
	pineapple	X	41////	fresh and
0		Grass jelly	711/1	boiled
	12	22 MD	SIT.	vegetables
			West.	rambutan
Sunday	Pork porridge	Steamed rice	Skimmed milk	Korean grilled
12	with eggs	Tom Yum		meat
二	Chinese pear	Goong	202	pineapple
$\langle \rangle$	N P21	mixed	VZIR	121
17		vegetable stir-		AS /
	*, M	fried		14
	Z	jackfruit		~/

 Table 2.4 Menu sample for weight loss (Continued)

Source: Kitworapat, 2006; Tansupasiri, 2008

In addition to determining the appropriate amount of food intake for each individual, the important thing to consider is the improvement of eating behaviors. Principles of changing the consumption behavior for weight loss are significant. The

principles of changing the consumption behavior for weight loss is as follows (Rungphisuthipong, 2007): 1) Individuals should keep a record of various eating and environmental factors when considering why they eat, what they are encouraged to eat, and how much they exercise. 2) Taking control of principles of previously uncontrollable behaviors, such as eating alone, in order to limit the amount of food consumed. 3) Substituting healthy food choices for previously unhealthy ones. 4) Improving thinking and setting goals for weight loss. 5) Finding supportive relationships with others in order to adjust and maintain diet by allowing friends, relatives, and family to offer and provide support. 6) Avoiding negative behaviors that lead to weight gain rather than weight loss.

The study of the College of Sports Medicine, USA (Otto and Jakicic, 2004) concluded that weight loss requires significant behavioral training to control diet and focus. Dieting alone does not result in long-term weight loss, but must be done in conjunction with behavioral changes by making it normal in everyday life. Therefore, changing behaviors in order to reach weight loss goals must begin by analyzing current behaviors and eating habits, including careful monitoring of behavior, eating patterns, and diet, with adjustments required for those who want to lose weight. Listing daily food intake helps raise awareness about eating habits and is recommended, according to the College of Sports Medicine in the United States (Otto & Jakicic, 2004) Suggestions include: 1) The recording of the start and end times of eating at each meal, with the speed of eating directly affecting the craving for food as well as the amount of calories received. People of excess weight usually eat faster than people of normal weight. This is because when eating, it takes about 20 minutes for the stomach to signal it is full. When eating slowly, the body has more time to

recognize the proper amount of food to eat, with a feeling of fullness signaling that it is time to stop eating before too much food is consumed (Otto & Jakicic, 2004). Drinking water before and during the meal can also help the body to feel full, thus limiting the amount of food consumed. 2) Recording the amount of food and the type of food eaten in each meal in order to help in adjusting the amount of food eaten for weight loss. Foods that are high in volume but low in calories, such as vegetables, make the stomach feel full faster, again reducing the total amount of food consumed. In addition, writing down the types and amounts of food consumed aids in making evident what is being eaten, leading to healthier food choices. The desired goal of the practice is for individuals to examine their eating habits, which helps them reduce the amount of food they eat as well as the amount of calories they intake. Simple guidelines recommend drinking one cup of water before eating, then to start with lowcalorie soups or salads in order to reduce the amount of high-calorie foods consumed, followed by eating vegetables for a feeling of fullness without many calories. 3) Those individuals who want to lose weight should record every meal, because most excess weight people tended to lose weight by avoiding or refraining from eating. According to research, most people who have excess weight eat fewer meals compared to those who are of normal in weight, but they snack between meals on foods that have more calories. (Otto & Jakicic, 2004). The goal of recording the number of meals in order to help reduce hunger, which is the cause of snacking between meals, is done by dividing the calories from the larger meals into smaller meals that total the same number of calories. Instead of eating two to three large meals per day with snacks in-between, a healthier way to eat to lose weight is to eat five to six smaller meals per day, with the appropriate number of calories in total, while avoiding snacks between meals. The study found that this practice led to successful weight loss in many subjects (Otto & Jakicic, 2004).

Monitoring eating patterns for those who want to lose weight is therefore necessary to successfully change the behavior for weight loss, which may be done in the form of daily food item records. A study by Miller et al., 1997 analyzed weight loss by controlling food alone for a period of 15 weeks. The study found 10.7 kilograms of weight loss from a comparison study of weight loss with low fat diets and low carbohydrate diets of Meckling.et.al, 2004. Low fat diets have a positive effect on waist circumference reduction, and low carbohydrate diets have a positive effect on reducing body mass index. In addition, a study of weight loss through diet control (Lepananon, 2005) found that a food replacement program combined with the health belief model and the self-efficacy theory of changing food consumption behaviors in elementary students focused on various educational activities, such as lectures and practicing cooking skills. The results of the study show that prior to the program, the experimental group has greater knowledge but cannot recognize the risks and severity caused by complications of obesity, nor can they perceive the selfefficacy in diet control and eating behavior. After participating in the program, results show improvement, with strategic advantages focusing on food notes, allowing participants to enjoy the program. In terms of the amount of food ingested, excess consumption needs to be controlled, bringing emotional awareness to behavioral control. The results of the study show that the experimental group has improved eating behavior and increased exercise. However, the limitations of this study show that changing the behavior of the participants under the supervision of the organizer and social support is not caused by individuals' perceived self-efficacy, which results in unsustainable weight control once the program ends and social support is limited or removed. Improvement, therefore, should be applied to the theory of self-efficacy by creating a higher level of self-efficacy perception in order to achieve expectations for weight loss results and by adding follow-up home visits in order to encourage continued weight loss practice. Even though eating behavior changes are important for weight loss, continued and effective weight loss must be done in conjunction with exercise, which requires an understanding of the principles of proper exercise for health and weight loss.

Principles of exercise for health

Exercise refers to activities of the body that help to build and maintain the health and strength of the body. Exercise helps build muscle strength and support for the circulatory system, as well as enhancing sports skills. Regular exercise helps strengthen the immune system and prevent diseases, such as heart disease, circulatory diseases, and diabetes. In addition, exercise helps build mental health and reduces stress.

Health refers to the level of functional or metabolic efficiency of living organisms, humans in this particular context, according to the definition of the World Health Organization. The complete state of the physical, spiritual, and social conditions of the person does not mean the absence of disease or defects alone, although this definition is criticized. In the absence of clear indicators or intellectual issues that follow from the use of the word "perfect," it is still the most accepted definition. Various classification systems, such as those from the Family of International Classifications of the World Health Organization (WHO, 2014), which
consists of International Classification of Functioning, Disability and Health (ICF) and International Classification of Diseases (ICD), are the most popular criteria for defining and measuring elements of health.

1. Benefits of exercise

1.1 Physiological Benefits: By increasing the efficiency of the circulatory system and the respiratory system, aerobic exercise helps to increase exchange oxygen in the blood and muscle cells and increase the amount of blood that nourishes the muscles. This allows the muscles to work harder and longer, the blood vessels to be flexible, the heart muscles to became stronger and run lighter, and facilitates a decrease in heart rate and blood pressure levels. Increasing the amount of fat burned adds to the body's balance. Muscles recover faster after exercise faster and metabolism increases, resulting in more energy to help to normalize work. Increased muscle flexibility helps reduce the occurrence of injuries from exercise and daily life. Increasing the amount of good HDL (High Density Lipoprotein) while decreasing bad LDL cholesterol (Low Density Lipoprotein) helps reduce the risk of coagulation in the blood. Blood vessels also maintain calcium levels in the bones. Increased fiber size and muscle bundles enable more efficient work productivity, as well as helping to develop coordination, balance, and self-control while moving.

1.2 Psychological Benefits: Helps with concentration and relaxation. Helps in perceive own abilities, boosting confidence, and assertiveness. Increases motivation to exercise. Helps to cultivate a positive attitude towards exercise and sports.

1.3 Social Benefits: New friends and social acquaintances. Boosts self-confidence and belief in self. Encourages increased socialization.

2. Types of exercise

Exercise can be divided into two types:

2.1 Aerobic exercise: There are many forms of exercise that each person can choose as activities to suit their needs and benefit their body and mind. Aerobic exercises can make the body strong and healthy, i.e. activities that are done continuously, for no less than 20 minutes at a time, such as brisk walking, jogging, cycling, swimming, etc. These activities help to develop the musculoskeletal system throughout the body, the circulatory system, the respiratory system, and the nervous system, as well as help to control weight and body fat percentage (Vejpaet, 1996). Aerobic exercise is defined as any activity that increases the level of energy use within the range that brings oxygen to the muscles. Aerobic exercise refers to those exercises that stimulate the heart and lungs over an extended period of time, causing changes in the body. The purpose is to maximize the amount of oxygen over a limited time in order to increase breathing frequency and the pumping of blood to the heart. Exercise effectiveness depends on the efficiency of the lungs and heart in oxygen delivery. Srisaengnam (1986) said that the purpose of aerobic exercise was to manage the body to increase the maximum ability to receive oxygen, called "Aerobic Capacity" which makes: 1) The heart beat faster to get the most air volume. 2) The heart beat faster to pump more blood. 3) Increased blood circulation. 4) Oxygen BHE distributed to different parts of the body.

The Office of Sport and Recreation Development (2006) said that aerobic exercise was a type of exercise that requires movement throughout the body. By using oxygen all the time while exercising, the heart beats faster. Blood pressure changes slightly from normal. Muscles receive energy from the use of oxygen in the metabolism. As the arms and legs are in motion, heart rate rises to 60% of the maximum heart rate for more than 20 minutes, which is good for the cardiovascular system and weight control because the body uses nutrients from fat as the principle elements of metabolism to produce energy. Aerobic exercise, therefore, positively affects the lungs, heart, and circulatory system.

2.2 Anaerobic exercise: Aerobic exercise is muscle exercise, meaning exertion for a short period of time (not more than 2 minutes), followed by a break. The energy that the muscles use is derived from chemical reactions in the body - the decomposition of phospholipids and the degradation of glycogen that the body accumulates in the muscles. This process does not use oxygen. The production of energy from this process results in acidic muscle cells, which the body responds to by increasing blood pressure. The pulse does not increase. This type of exercise helps to strengthen muscles more than it does the cardiovascular system, and incudes activities such as short runs, throwing exercises, the long jump, weight lifting, etc.

Theory of Planned Behavior: TPB

Theory of Planned Behavior: TPB was developed by Ajzen in 1991. The TPB Model originated to be an important cognitive process model to evaluate the results of the purchase intention model and to explain the complexity of the relationship between human behavior and its most important related factors, indicating that the behavior of humans is caused by the mind (Ajzen, 1991). Human intentions are directly affected by three factors, as follows: Attitude, narcissism according to the reference group, and control awareness behavior. The author further explains that

planned behavior can be used in many areas of interest, especially in understanding certain behaviors, such as buying behavior, relaxation behavior, and others.

The theory of planned behavior is a theory that is further enriched by the theory of reasonable action and the integration of behavior control awareness (Jaffar & Musa, 2013). This provided the theory of planned behavior as one of the most influential and popular conceptual frameworks. In the study of behavioral forecasting from attitude variables, the theory of planned behavior according to its plan consisted of three parts: a) Attitude towards behaviors b) Confirmation, and c) efficacy in controlling behavior associated with beliefs and behaviors.

1. Attitude towards Behaviors

Attitude towards behaviors refers to the positive or negative assessment of an individual, to an action, or to the overall feeling of a person, not a positive, negative, or anti-supportive action. The amount of negative attitude should be intentionally strong and not show much behavior. According to the theory of planned behavior, attitude towards behavior would indirectly affect behavior (Ajzen & Fishbein, 1980).

Ajzen (1988) said that attitude is a personal element that determines the intention of a person to behave differently. There are three general attitude elements: 1) the cognitive component is made up of personal beliefs that are generally thought of by people, responses to individuals, or various stimuli in the manner of perception due to thoughts, beliefs, and understanding. 2) Affective components are emotional feelings of individuals associated with stimuli as a result of the person evaluating the stimuli. 3) The behavioral component is the tendency of a person to respond to stimuli with the same or opposite actions, depending on their beliefs, attitudes, and behaviors. Attitude affects the behavior of individuals, but at the same time the expression of a

person's behavior affects the attitude of a person. However, was only one component causes the behavior.

Triandis (1971) stated that the behavior of individuals is influenced by social attitudes and norms. He studied attitudes with the suggestion that cognitive attitudes could be changed when a person received new information, such as news from various news and media channels. If the knowledge changes, it could affect the attitude, feelings, and behavior of the person. This is a change of norms, habits, ways of living in society, and expectations about reinforcement, which people receive from learning and results in individuals having to adjust their behavior to change behavior.

2. Subjective Norm

Subjective Norm is the perception of one person that other people who are important to that individual want or do not want this person to exhibit a particular behavior. This recognition may or may not be accurate. Conceptual principles, the theory of planned behavior, and subjective norms all affect indirect behavior, together with attitude toward behavior and perception of behavior control, through intent to express behavior (Ajzen & Fishbein, 1980).

Ajzen and Fishbein, in 1980, proposed two methods to measure normality, namely direct and indirect measurement of subjective norms: 1) Measurement of direct subjective norm is an assessment of a person's beliefs about their opinion. This person will either exhibit or not exhibit a particular behavior. 2) Indirect measurement according to the subjective norm is derived from the sum of the product of beliefs about the views of the reference group in reference to their actions, meaning the belief that each person in the subjective norm wants or does not do exhibit specific behavior. The motivation to defer to the expectations of the group is cited, suggesting that the perception of the person is that they are choosing to exhibit the subjective norm behavior.

3. Perceived Behavioral Control

Perceived Behavioral Control refers to a person's perception that it is difficult or easy to perform a certain behavior, which is reflected in past experience, and is a prediction of favorable factors and obstacles (Ajzen, 1991). Perceptions of the ability, behavior, and intention from Figure 2.3 show this theory in a structured diagram for ease of presentation and therefore do not include the influence of possible responses of behavior on previously existing conditions.

In rational action theory, the theory of planned behaviors are the intentions of a person to demonstrate behavior as expected to by the control of stimulating variables that influence these intentional behaviors. This indicates how much an individual is willing to try, and how much effort they have to show for that behavior in general, how much an individual intends to display that behavior. Therefore, it becomes clear that behavioral intentions can be transformed into behavioral representations, though only when that behavior is under the control of the individual.

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A person can intentionally display or not display a particular behavior. Even though some behaviors have elements that are readily apparent, there are others that depend on variables not related to motivation, such as opportunities and necessary resources (time, money, skills, and cooperation from others). These variables represent the actual controller. If the person has the opportunity and resources available, the intended behavior will be evident as he or she can exhibit this behavior successfully. The idea of the success in acting out the behavior depends on motivation (intent), and ability (behavior control). This was previously understood through animal behavior learning experiments (Festinger & Sears, 1944). Similarities in the concept of behavior control, which is a general form of human behavior, presents ideas in the form of variables (Factors & Triandis, 1977), context of opportunity (Sarver, 1983), resources (Liska, 1984), or action control (Kuhl, 1985). Typically, assumptions are created by motivation and ability, until they become a behavioral success. The intention to influence the expression of the person, having control of the behavior, and the expression also increases the control of the behavior until the person has enough motivation to try. (Mento & Katcher, 1978).

Behavior Control Awareness: The importance of behavior control is selfevident. Resources and opportunities available to individuals have a great influence on success in behavioral displays, and as such are the subject of psychological interest. Perceived control of behavior affects intent and action, and is an important part of the Theory of Planned Behaviors. In fact, the Theory of Planned Behaviors differs from rational action theory on behavior control perception. Before considering the function of perceived control of behavior in forecasting intent and subsequent action, it is important to note that perceived behavior control is very different from the perceived condition. An individual's self-control (Rotter, 1966) and perceived behavior control can be difficult to perceive. In behavioral representation, the selfcontrol of individuals represents fixed predictions in all situations, while patterns of behavior control can be varied in all situations and actions. Therefore, a person may believe in the results that determine their own behavior (internal self-control of individuals), while at the same time that person may also believe their opportunities are limited (low behavior control perception). Perceived behavioral control is stated in the achievement motivation theory (Atkinson, 1964). The important variable in this

theory is the expectation of success. It is described as perceiving the possibility of success according to one's own actions. This view is similar to the perceived ability to control behavior, wherein both of these variables refer to the behavioral context, not the general inclination. However, there is also a conflict of motivation for success, which is not interpreted as an incentive to succeed in the assigned duties, but is interpreted as a general inclination that each person adheres to in a given situation (Atkinson, 1964). This achievement motivation is a combination of situational expectations, of as well as other variables in each situation.

The current perspective on behavior control perception has the greatest compatibility with the perceived self-efficacy concept that refers to judging whether a person can perform a desired behavior in order to better manage a specific situation (Bandura, 1982, p. 122). Knowledge about the role of behavior control is derived from Bandura's research program and co-researchers (Hardy and Howells, 1980). These studies showed that people's behavior is strongly influenced by their confidence in their ability to express their own behaviors. Belief in recognition of ability influences choice in activities and preparation for activities, effort in expression, and emotional patterns and interactions (Bandura, 1982). The Theory of Planned Behavior states that the structure of beliefs and perceptions, one's own abilities, and perceived behavior control within the conceptual framework are more general than the relationship between belief, attitude, intent, and behavior. According to that theory, perceived behavior control and behavioral intent can be used to predict behavioral success. There are two factors in support of this hypothesis. The first is that having an intention that does not change in the attempt to accomplish that behavior increases with the awareness of behavior control. For example, even if two people have the same intention and effort to learn to ski, the person who is more confident in their ability to learn will exert greater effort than the person who is unsure of their own ability. The second factor is behavior control awareness, which is often used as a representative for controlling measurements, regardless of what the behavior control awareness measurement was based on. The behavior control awareness may not be accurate if the subject has little information about that behavior when the needs and resources change, or when new unfamiliar factors arise under that situation the measurement of perception. If, however, the controlling behavior is true, it may be used to predict the possibility of success in showing that behavior (Ajzen, 1985).

4. Adequacy of theory of planned behaviors

The theory of planned behaviors describes three different types, namely behavioral beliefs, control norms, and structures that are related to attitude, conformity, and recognition ability. Behavioral control sometimes questions the need for classification (Miniard & Cohen, 1981). There are reasons one could argue that all beliefs linked to behavior are interesting, especially with behavioral and normative beliefs, (and between attitudes and confirmation), but one can still argue for reasons that all beliefs are related to the behavior of interests that have various qualities, which may be the result of normative expectations or resources that are needed to show behavior. Therefore, there should be a blending of all beliefs in various behaviors under the same conclusion in order to obtain behavioral habits, including basic arguments, to make it clear from both theoretical and practical perspectives. In theory, personal assessment of one's behavior (attitude) is a practice expected by society (conformity), self-efficacy with conscious behavior (perception of behavioral control) as a different concept, which exists in social research and behavioral research. In addition, research on rational action theory and the theory of planned behavior create a clear pattern of classification by demonstrating that various structures have relationships that sometimes predict intention and behavior, and more importantly the possibility of further classification of beliefs and habits. In principle, the theory of planned behavior is open to the inclusion of all predictors. It shows that there is a significant proportion of various intentions and behaviors. In fact, the theory of planned behavior help to expand the theory of action by adding concepts, perceptions, abilities, and behaviors.

Important trends of Five IT in the information age (Five IT Megatrends)

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As information technology advances, the use of technology to disseminate information throughout society, together with the development of web technology, has become more complex, leading to changes in the type of information technology that is used. Figure 2.4 shows important trends in how five IT influences work life and personal life of individuals.





Figure 2.4 Important trends of Five IT affecting changes in organization and society

Source: Aimsiriwong, 2017

1. Mobile

Many people believe that we are in the age of using modern electronic devices that are not PCs (Post-PC Era). Today, mobile devices - mobile phones and smartphones, as well as tablets, smart TVs, etc. - are used by almost everyone and everywhere. People today use mobile phones to communicate and talk, but also for Internet access 24 hours a day, with many companies trying to improve technological support for these devices. Whether developing a website or a version for a mobile phone or device, customers can download applications to install in their device and transfer data between mobile phones, PCs, etc. Global companies are trying to market

to support this growing consumer group, through application development (apps), software that has been developed to be installed on mobile devices in order for consumers to access their products and information.

2 Social Media

The second major trend to be discussed here is the online society, such as Facebook, Google+ and Twitter. There is no doubt that today's social media has come to play a major role in our daily lives, as can be seen by the number of people who have Facebook accounts (more than 1.65 billion accounts according to the year 2016 statistics as shown in Figure 2.4), with that number growing steadily. Social media users want to share stories, pictures, and status updates for various activities or inform friends in their network. Instructors use social media to distribute news about academic programs and various social support activities and to distribute news to students. Companies use social media to foster cooperation among employees, as a channel to advertise products, and to enable contact between employees and customers. Social media can be used to harness the power of crowds to participate in activities, events, or gatherings. Social media takes the form of communication that can reach people at all levels of society, and it is also likely to become the main media outlet for people in the future as well. As more and more consumers get their news online, there is also an increasing need for careful screening in order to be sure that the information available to consumers online that purports to be true is in fact accurate.



Figure 2.5 A quarterly statistics showing the number of active Facebook users, quarterly, from 2008-2018

Source: Aimsiriwong, 2017

3. Internet of Things

The third major trend is the Internet of Things or IoT. This is the concept that appliances and accessories can be connected to the Internet and communicate automatically. At present, electronic devices and home appliances have been developed to be more "intelligent" by embedding chips and radio transmitting devices to achieve inter-communication. In addition, these devices have identification methods, recognize their role in the environment, and can communicate, interact, and work together. Thus, the "Internet of Things" concept allows electronic devices to communicate with each other to share information over the Internet. In the year 2008, there were more devices used worldwide that were able to connect to the Internet than there were people living on the planet. Due to the advancement of the processing chip, the technology of radio waves, and the reduced cost of sensor devices, the future may hold ideas that we've yet to realize. Wireless sensors and radio communications in electronic devices or electrical appliances may someday create information easily access and controllable over the Internet.



Figure 2.6 The concept of the Internet of Things and the things that can be connected automatically Source: Wordpress, 2014

Connections between all things, or "Things," whether they are sensors, signals, heart rate monitors, motors, or cameras, have the potential to collect unlimited amounts of useful information, resulting in various applications that may be increasingly convenient. One example is checking the temperature of the house in order to lead to remote air conditioning temperature adjustment. In the same way, the application of integrated sensors, with the ability to detect the temperature of the road

surface of a cold winter country, can limit the speed of a dynamic car operating on a dangerous road surface, such as one covered in snow or ice. Perfect sensor application technology could lead to home automation technology, smart cities, smart farming, an online health examination system (e-health), and other technological advances. Utilization of sensors and Internet-connected devices will evolve into the Internet of Things, with various improvements, until they reach the Genius level.

4. Cloud Computing

The fourth major trend is cloud technology. Originally, software was installed directly on individual PCs for users to make use of on their own. Today's communication and application technology runs on the Internet infrastructure, such that programs that were previously installed on individual computers can now be presented through the cloud instead, allowing users to share software and data much more efficiently and rapidly. Cloud resources can be accessed and operated through a common web browser program, meaning multiple users have the ability to work on the information simultaneously as well as share their work with one another. Cloud computing applications can be accessed anywhere an Internet signal is available, and by a variety of devices.

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Figure 2.7 Data and applications access to cloud computing by a variety of devices

Source: Laudon, 2016

Cloud computing technology applies to and supports a wide variety of applications, with group resources used for processing in the cloud computing performed by software rather than by human beings. In other words, users immediately specify the requirements to the cloud software, then the software requests the system to allocate resources and prepare the service according to the needs of the user. The user need not wait for use from the system administrator (a human being) to know when to proceed. The software controls the use of resources, increasing or decreasing them as needed, and adjusts them to suit the needs of the users at all times, thereby reducing concerns because users themselves do not need to be aware of which resources are being allocated and to where. Processing procedures are handled automatically according to specified requirements, such as how much storage capacity is required and what services need to be provided in order for the system to allocate resources and resolve any problems as they may occur.



The American Institute of Standards and Technology has determined that cloud computing technology has the following important features: 1) On-Demand Self-Service: Users can define requirements to request resources such as servers or network storage at any time as needed. The system will respond to their needs automatically and immediately. 2) Ubiquitous Network Access: Users are able to access cloud resources via standard network and Internet devices, including portable devices such as mobile phones or tablets. 3) Resources are collected from various locations. (Location-Independent Resource Pooling: Computer resources are collected from many service providers at different locations. At the same time, general users feel as though they are using those resources alone, without knowing where those computer resources were located. 4) Flexible and quickly adaptable (Rapid Elasticity): Computer resources can be prepared for use quickly, whether it means adding or reducing usage, in order to meet the needs of users, which can change at any time. 5) Measured service for the expenses related to the use of upper resources.

The cloud depends on the actual usage, which is similar to the utility system, such as water supply, or electricity, that the service user has to pay for the actual service, according to the number of units used. In other words, the more a person uses the cloud, the more they pay for it, while those who use less, pay less. In addition, cloud computing is divided into three categories of service, namely: 1) Infrastructure as a Service (IaaS) - an IT infrastructure service that customers can use to process, store, network, and make use of other computer resources from cloud providers in order to run their information systems. 2) Platform as a Service (PaaS) - Customers use the infrastructure and tools to support programming from cloud providers to develop their own applications. For example, IBM has launched Smart Application Development & Test for Development, a way to test their software on the cloud. Another example is Salesforce.com, which allows developers to create applications that are hosted on their servers. 3) Software as a Service (SaaS) - Customers use the software from the host, under the cloud-computing infrastructure of the service users who transmitted to the network, by looking at the software as a service rather than buying the software directly. In the past, software purchases required a lot of investment, especially for the software licensing fees. Now, customers benefit from the use of modern software from service providers, such as Google Apps, that services applications for use by general businesses. The website Saleforce.com

provides customer relationship management and other software over the Internet, charging an annual membership fee. Google Apps provides free versions of some of its programs, allowing users online access to these applications, where the data and software is maintained on the service provider's remote server.

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5. Big Data

The fifth major trend is "Big Data." Today's Internet boom generates huge amounts of data, especially social media platforms that produce and host tremendous stores of information, because every user can create content (text, images, and videos) with many built-in tools, and publish them online. The Internet of Things helps to promote the connection of devices and sensors to the Internet, thus resulting in the ever-expanding growth of big data, both at the corporate and individual levels. This is especially true of unstructured data and management decisions that often use external data rather than internal. These large amounts of data can therefore be used to scrutinize and analyze information in order to make significant business decisions.

The dimension of Big Data consists of three important features, known as the 3Vs: (1) Volume = large data, (2) Variety = diverse information that can be text, images, and/or video, and (3) Velocity = the speed of data processing, in which big data's challenge is based on all three features, not just the amount of data, but also the high-performance software necessary to capture the importance of current or real-time data, inevitably leading to a more precise analysis of consumer behavior and needs, ultimately leading (hopefully) to a competitive advantage.

However, the success of the major trends of five IT depend on the "Network effect," that is to say the network results refer to the maximum number of users, which indicates the value of a product or service. It does not depend on the characteristics of the product or service in any way, but solely on the number of users of those products or services. The number of users multiplies the value – a small number of users means there is almost no value to the service or product. How valuable would social media (Facebook) be if few people used it? What value would eBay have if it had few users and little or no bidding on their auctions? Both of these services thrive and grow by having a large and ever-increasing number of users all over the world.

The answer is that at the most basic level, it is clear that the ability to use information systems, to assess the impact of new technologies, is crucial to any business, and most people's personal lives, as is the readiness to learn and understand new technologies and increase our knowledge and skills.

IT Infrastructure and Emerging Technologies

1. IT Infrastructure

Computers and information systems are necessary to use it to manage a business. Businesses in the present day need a variety of computer equipment, software, and communication systems capabilities in order to operate and solve basic business problems. IT is relied on, at work and at home, using desktop computers, notebooks, and various mobile devices.

IT infrastructure consists of a set of physical devices and software applications that are essential to the entire organization. In addition, IT infrastructure also includes budget management, which is made up of both human resources and technical capabilities, and various services as detailed below. 1) Processing platforms prepare for processing services that link employees, customers, vendors, and suppliers of production factors together under the environment of digital communication systems, including mainframe-level computers, midrange computers, desktop computers and notebooks, and mobile devices that have access to remote services via cloud computing. 2) Telecommunication services can transmit data, audio, and video to link employees, customers, and suppliers of production factors. 3) Data management services store and manage corporate data, as well as being able to analyze it. 4) Application software services and online software services are capable of enterprise-wide resource planning, customer relationship management, supply chain management, and knowledge management systems that share information across all business units. 5) Physical facility management services install equipment necessary for processing, telecommunications, and data management. 6) IT services, with infrastructure planning and development, coordinate with business units for IT services, accounting expenses management, and project management. 7) IT standard services, armed with the policy and schedule of IT usage, prepare the company and its various business units in the organization when and how to use. 8) IT education services provide training on system usage for employees and offer training to executives in the areas of IT planning and investment. 9) IT research and development services promote research on non-feasible IT projects in the future, including investments that enable organizations to make a difference in the market. It is important that the platform service based on such views helps the company to understand its business value and obtain investment in IT infrastructure more easily.



Figure 2.9 Connections between organizations and IT infrastructure and business capabilities

Source: Schneider, 2015

2. Evolution of IT infrastructure

The IT infrastructure for organizations that is in use today has grown over the past 50 years, along with the evolution of computer platforms. This evolution consists of five eras together, with each era different in terms of processing power and components in the main structure, as shown in Figure 2.9. The evolution of the five ages is evident through the development of mainframes and mini-computers, computer PC models, client / server networks, enterprise-class processing, and cloud computing and mobile devices. However, just because technology first appeared in one era does not mean that it cannot still be used effectively in a future age, either in the same way as when it was first developed, or in other ways and for other purposes that are more practical for the time. For example, some companies still use traditional mainframe computers, or use a mainframe as a server, to support large websites, including enterprise application applications.





Figure 2.10 The evolution of the IT infrastructure in each era.

Source: Nattakornmis, 2018

2.1 Mainframe and minicomputer era (AD 1959-present).

Starting with the IBM-1401 and 7090 machines that IBM manufactured using transistors, the beginning of the commercialization of the mainframe-class computers for commercial purposes began in the year 1965. IBM developed the mainframe computer 360, which was a complete version, had substantial processing power, and used an operating system that supported time sharing, multitasking, and virtual memory (Virtual Memory). IBM has been in the mainframe machine market ever since. The mainframe computer was powerful enough to support thousands of terminal connections, all of which were linked to the mainframe by using a protocol as a communication tool on the transmission line. The mainframe era was a time of centralized computing systems, under the control of professional programmers and system administrators (usually working in the company's data center headquarters), and with the majority of hardware and software components under that infrastructure all from a single manufacturer.

Computer usage patterns began to change after the arrival of the mini-computers produced by Digital Equipment Corporation (DEC) in 1965, with the DEC mini-computer PDP-11 and VAX holding the high ground in terms of processing power. These machines were much cheaper than IBM mainframes, made use of new processing principles, such as a distributed processing system (decentralized computing), and could also be tailored to meet the needs of each department or each business unit, saving time by processing smaller amounts of data on individual computers instead of loading all the work onto a single mainframe. Later, the move was made towards utilizing midrange computers, or server-level machines, that were part of a network. 2.2 Personal computer era (AD 1981-present)

The appearance of the IBM-PC (Personal Computer) machine in 1981 became the beginning of the PC era. Since then, computers have become small devices that can be placed on desks for work or personal use. In the beginning, the DOS operating system was implemented and the interaction was text-based. Later, Microsoft developed a Graphical Interactive Windows operating system (GUI), which is still popular today. The proliferation of PCs contributed to the overwhelming use of desktop PCs, along with office software packages, such as the Microsoft Office program, which included a word processing program.

Spreadsheet programs, presentation programs, and small data management programs have created a lot of value for both business and home users. New versions created since 1990, have added features to connect computers in the form of small networks.

2.3 Client / server network era (AD 1983-present)

The era of connecting computers to a network through a central device (a server) offers resource services for clients. Servers used as data centers may be a big machine, like a mainframe, though using a smaller PC server is also very popular because it is much more cost efficient. The PC server has been developed as a very cheap, high efficiency, well-supported multi-PCU processing device. However, modern organizations are also increasingly using blade servers, which are discussed in the next section.

The client / server network in its simplest simple form consists of a client computer that is linked to the server, which distributes the work between the server and the client, by dividing the processing tasks between the two machines. This

type of Two-Tiered Client / Server network Architecture is referred to as wellbalanced; it is suitable for general small businesses, while in the case of large organizations with more complex systems, they can expand the system by connecting to a multi-tiered, often called N-Tiered, network architecture, as shown in Figure 2.10. This structure connects various types of servers, such as web servers, application servers, and database servers, in order to share the processing load for each server in the network, instead of pushing the entire load to one server, or splitting it in half, like the two-tier system. The multi-tiered network architecture can easily extend the network's capabilities without affecting the network structure in any way, as well as being an investment that helps reduce costs compared to centralized connections on the mainframe system.





Novell NetWare network operating system was a client / server network leader from the beginning of the networking days, though today Microsoft holds most of the market share, with Windows Server products, including client machines that use Windows operating systems such as Windows 7, Windows 8, and Windows 10, easily able to be set up to connect to the servers.

2.4 Enterprise computing era (AD 1992-present)

In the early 1990s, large organizations turned to network standards and adopted various software tools to integrate networks and applications. To be unified throughout the organization, at the same time Internet technology was developed to be reliable in communication. After 1995, businesses began to take seriously the introduction of information systems to connect networks throughout their organizations, including cross-network connections via Internet communication. TCP / IP protocol was used as a network communication standard.

The result of linking the IT infrastructure to each type of computer, and linking a small network into the enterprise network, allows information to flow freely, across the organization and between organizations, and with such technology, can connect different computers, including mainframes, servers, PCs, and mobile devices, as well as public infrastructure such as telephone, Internet, and public network services.

Enterprise-wide infrastructure requires software to connect various applications to enable data to flow to various business segments independently.

present) The growing bandwidth rate on the Internet has helped to drive the client / server architecture to the next level, which is the source of cloud computing technology.

Cloud computing is made up of a large cluster of computers that can be deployed to hosts, to run programs or applications efficiently, according to the needs of users. Cloud computing is primarily based on user needs, with the technology developed based on the Internet network. For example, IBM and Google provide hardware, software, and services through the cloud computing system for many universities together, such that each student can use cloud computing services to bring large-scale work groups into parallel processing. In addition, modern business systems that use the Internet infrastructure for business operations, such as industrial estates in Wuxi City of the People's Republic of China, where most customers rent space in such industrial areas, are small software companies that are just starting out, but are able to use the entire IT infrastructure, within the industrial estate. By connecting the company's computers to the central IT system of the settlement, it allows companies within the industrial estates to access the network without the need to invest in many IT systems like in the past. In building a cloud-computing center to support the use of tenants, IBM provides IT services as part of the infrastructure in this industrial estate, similar to air conditioning, utility systems such as electricity, or waterworks.

3. The Components of IT Infrastructure

The IT infrastructure currently has seven organizations, as shown in Figure. 2.11. These components are considered an investment and work together in order to make use of all of the connected infrastructure.



Figure 2.12 The ecosystem of IT infrastructure

Source: Turban, 2013

3.1 Computer Hardware Platforms

It is estimated that organizations around the world paid more than 669 billion US dollars for computer hardware in 2013, which consisted of mainframes, servers, PCs, tablets, and smartphones, with these computers covering processing both at the enterprise level and at the level of personal use. Over two billion PCs are used worldwide today at more than two thousand government data centers covering more than eight billion businesses, including the Cloud Computing Center, at which almost all computers use chips or microprocessors designed by the companies Intel or AMD. At the same time, the server market has begun to use specifically designed computer blade servers more frequently, consisting of a motherboard with a processor, memory, storage device, and a network connection port that is packaged inside a rack (see Figure 2.12). In addition to saving space, these servers can be easily expanded.





Figure 2.13 A blade server in a rack and the inside of a blade server Source: Volonino and Wood, 2013

The market for computer hardware is highly competitive, with world-class vendors such as IBM, HP, Dell, and Sun Microsystems, and three main chip manufacturers - Intel, AMD, and IBM. Most of the industry uses processors from Intel camps as the standard for production to enter the general business market, with the exception of servers that use Unix and Linux operating systems, which often use processors from Sun Camp or IBM.

Mainframe computers have not disappeared. Mainframe-level machines are still being used continuously, especially in the high-risk areas of reliability and security. The mainframe computer is used to handle a large number of transactions, including massive data analysis and large workload management within a cloud-computing center. Mainframe computers are also used in banking and telecommunication networks. However, the number of service providers has been reduced to just one, IBM, which continues to support the mainframe systems that are often used by large organizations, including corporate websites.

3.2 Operating System Platforms

Windows Server operating systems from Microsoft has a market share in network operating system products of about 35%, with the remaining 65% going to the affordable and highly durable open source Unix and Linux operating systems. However, Windows Server still has the capacity to provide services. At the corporate level, Windows is widely popular as well, whether as an operating system or for its network services, it attracts the attention of organizations looking for IT infrastructure under the Windows-based model.

Unix and Linux are operating systems that are highly reliable and can also be scaled to meet user needs, in addition to being able to run on various types of processors. For major providers of Unix operating systems, including IBM, HP, and Sun, each may create slightly different products, and may not be compatible with some versions.

At the client level, over 90% of all PCs use Windows operating systems. However, today there are more operating systems to choose from, compared to the past, when there were fewer options available. For example, new operating systems, have been created for use with mobile devices and used to connect with cloud computing.



Figure 2.14 The most common PC applications running under the Windows platforms.

Source: Aimsiriwong, 2017

Google has a version of its operating system, Chrome that is used with cloud computing, by using a computer connected via the web, and the programs used, are not stored in the user's device, but are instead used over the Internet and accessed via the Chrome web browser. At the same time, Android, an open operating system, was created for use on mobile devices, such as smartphones and tablets, developed by Google and its partners. This popular smartphone platform is a major competitor of iOS, developed by Apple, which was created to be used solely with its own products, including the iPhone and iPad.



Figure 2.15 Operating system platforms from various manufacturers on mobile devices

Source: Reynolds, 2015

Traditional operating systems that are commonly used are designed to be interactive through keyboard and mouse devices, Meanwhile, Apple camps have developed touch technology on iOS, which is an operating system used on mobile devices like iPhone and iPad, that primarily uses the touch of a finger. There is also a multi-touch interface, in which more than one finger can be used to manipulate objects on the screen without using a keyboard or mouse. Following this, Microsoft developed an operating system, Windows 8, which worked on both tablets and PCs to interact via touch-screen, which worked well with mouse and keyboard devices. In addition, multi-touch capabilities appeared on Android devices as well.

3.3 Enterprise Software Applications

It was estimated that organizations around the spent over \$3 2 0 billion USD in 2014 on enterprise-class software, which is considered part of the IT infrastructure. The largest providers of enterprise applications were SAP and Oracle
(PeopleSoft), while Microsoft also tried to get involved in this market by focusing on small and medium businesses that have never used enterprise applications before.

Data Management and Storage: Enterprise database management software is responsible for organizing and managing corporate data in order for it to be accessed and used efficiently. Providers of front-end database management software include IBM (DB2), Oracle, Microsoft (SQL Server), Sybase (Adaptive Server Enterprise), and MySQL.

In the storage device market, EMC became a giant for large-scale computer storage devices, while Seagate and Western Digital produce hard drives for the PC-based computer market. Digital news has doubled in volume every two years, while the data storage market has grown 1 5 % every year over the past 5 years. Moreover, traditional storage devices such as disk arrays and tapes used by large organizations have been transformed into network data records instead. Storage Area Networks (SAN) connect multiple storage devices from different locations to a servers on high-speed networks to increase the ability to store large data at the enterprise level as well.

3.4 Networking/Telecommunications Platforms

There were estimates that in 2014, organizations around the world spent more than \$1.65 million on the services of communications systems related to the enterprise network environment, consisting of the Internet and Windows Servers, connected to local area networks (LAN). The second and third most popular were Linux and Unix. Large organizations connected to the national sales network (WAN) use Unix operating systems, and both LAN and WAN networks most often use the TCP / IP protocol as a communication standard. The world's leading network equipment providers include Cisco, Alcatel-Lucent, Nortel, and Juniper Networks, whose telecommunication platforms are supported by telecommunication and telephone service companies such as voice and data communications services, WAN networks, wireless network services, and Internet access. In Thailand, telecommunications and Internet service providers include CAT, Telecom, TOT, 3 BB, and True. The telecommunications service provider market often provides opportunities for new service providers to participate, to develop the nation and facilitate communication and services to people such as cellular telephone services, high speed Internet, and Internet phone.

Internet platform: The Internet platform is related to the enterprise network infrastructure, combined with hardware and software platforms, which include hardware, software, and managed services, to support corporate websites, and also include web hosting services, routers, cable devices, and various wireless media. In this way, web hosting service providers offer a group of web servers with infrastructure and a complete security system to enable members to rent space to store their websites, which is suitable for organizations not yet ready to invest or create a web server for its own use.

The Internet revolution has affected the growth of server-level computers. Many organizations have connected thousands of small servers, machines to run and perform their Internet operations, and since then there has been a drive to push these servers together, to reduce the number of servers, to expand the size and processing power of each machine, and to use software to run multiple applications on one server. At the same time, the hardware market for servers and the Internet is fiercely competitive, through leading service providers like IBM, Dell, HP, and Sun (Oracle), resulting in the current server prices being much cheaper.

3. 5 The company provide consulting and systems integration Services

Today, not all large organizations have teams that are fully equipped with the skills, knowledge, and experience in IT to develop and maintain their entire IT infrastructure. These organizations do not have enough experience to develop new IT infrastructure, including business and work procedures, training and education, and the integration of software. Therefore, companies are formed to provide consulting, with leading global companies with expertise in this field, including Accenture, IBM Global Services, HP, Infosys, and Wipro Technologies.

Software integration means ensuring that the new infrastructure with the pole system can work with each other, ensuring that the new elements of the infrastructure will work with other parts as well. However, for Legacy Systems to be meaningful, a daily list processing system needs to be created at the mainframe level to avoid the cost of replacing it with a new machine or designing a new system. It must be understood that the new system change in this section has high expenses, and that normally there is little or no need to do it if the old system can be integrated into a new contemporary structure.

3.6 The Current Trends in Computer Hardware Platform

With the power of computer and network technology affecting the changing business methods and methods of organizing computer usage, mobile phones and various other mobile devices have become more actively used to access the network. Here were the latest trends to watch for in this technology: 1) The

Mobile Digital Platform for smartphones and tablet computers has become an important tool to access the Internet. These devices are being used more and more with business processing tasks. For example, high-level executives in General Motors use applications on smartphones to drill down into the details of car sales data, financial management, capacity management, and project management status. 2) Using technology and personal portable devices at work (Consumerization of IT BYOD): Almost everyone in this generation has a smart phone for personal use. At the same time, employees in the organization often use mobile phones that are their personal property in the workplace, a phenomenon called "Bring Your Own Device (BYOD)," which is considered one aspect of the concept "Consumerization IT," in which employees have requested to use personal technology in the workplace. Important IT equipment that is the personal property of employees may be newer or higher technology than that which the organization provides. Based on the concept of Consumerization of IT that affects large organizations, companies have to rethink the ways and management of these IT devices. Organizations often have IT departments that were responsible for the selection and management of information technology, including the consideration of software programs used by organizations, to prepare the environment and furniture, office tools, desktop computers, or notebooks for employees to use. For secure access to the system, the IT department controls hardware and software devices to ensure that the information system used meets the needs of the organization's objectives, along with guidelines for protecting sensitive data and systems and reliable security systems. Today, employees and business units in various departments have a role in choosing technology, and in many cases organizations allow employees to use their own devices at work, whether they are

notebooks, computers, smartphones, or tablets, to access the network in the organization. Organizations must therefore find ways to manage and control the technology of their employees, particularly to ensure that important information from the business does not leak out. The organization must ensure that it can manage, control, and respond to the needs of the business if it allows employees to use personal IT equipment at work. 3) Quantum Computing is a new technology that has the potential to increase computing power and quickly find answers to problems that, if tackled conventionally, may take many years to get an answer. Quantum Computing uses the principles of quantum physics to represent data and operations with these data. Quantum computers contain tremendous processing power, challenging the ability to simulate multi-task operations while at the same time solving problems in some areas of scientific work. IBM, MIT researchers, and Los Alamos laboratories all work on quantum computers, while the airline company Lockheed Martin bought a quantum computer for commercial use. 4) Nano technology: In the past few years, microprocessor manufacturers have increased the processing power of the processor while simultaneously reducing chip size by applying nanotechnology to the chip manufacturing industry to reduce the size of Transistors, allowing thousands of transistors to be loaded into small devices. Nanotechnology has made the transistor smaller at the atomic level, which is considered to be the smallest particle of matter. Nanotechnology uses each atom and molecule to create computer chips and other devices that are over a thousand times smaller than the technology presently used. IBM and other research laboratories have created nanotubes, molecules composed of carbon atoms that can be applied to create new technology to play an important role in the industrial sector. 5) Virtualization is a technology that brings resources from one computer system to run many types of tasks within the same device, as if running on multiple computers. For example, a server or mainframe, when using virtual systems, can install multiple operating systems in the same device, as if it were running on multiple computers, despite only running on one device. VMware is the leading virtual machine software used on PCs. The obvious ability of a virtual machine is that it can host multiple systems while also operating independently on the same device. Virtual machines help organizations make the most out of each device as well as help save data center space and energy usage. Typically, servers used by organizations work sporadically, with a working rate of only 15-20% of the capacity, while virtual machines can increase the server utilization rate to 70% or higher, thus allowing the organization to be more productive with fewer resources, instead of having to invest large amounts of money in computers and physical space to set up and operate those devices. In addition, virtual machines facilitated both central and distributed hardware management, and it is now possible for companies and employees to perform all computer tasks by using virtual IT infrastructure, similar to cloud computing.

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4. Green Computing

From the widespread use of hardware devices and the unlimited power burn, the virtualization system has become an important part in promoting environmental processing, also known as green computing. Green computing or Green IT, refers to operations and technology for design, production, use, and disposal of computers, servers, and other related devices, such as monitors, printers, storage devices, and communication systems and networks, in order to reduce the impact on the environment. The definition of green IT is related to three important things: (1) Reduced energy use, (2) Choosing environmentally friendly technologies, and (3) Recycling.

Reducing energy consumption from computer usage has been given a very high priority within the computer manufacturing industry. Manufacturers are paying more attention to the environment by trying to invent and produce IT products that are safer for and less harmful to the environment. In particular, in terms of energy savings, turning to LCD monitors instead of CRT monitors, reducing power supplies to accessories in the event that they are not being used, printing paper on both sides, and reducing energy consumption from servers or data centers by using more virtual machine systems. In addition, much of the existing electronic waste can be recycled, while at the same time encouraging consumers to support products that are branded green for the environment.

5. High-Performance and Power-Saving Processors

Another way to reduce energy consumption is to use high-performance and energy-efficient processors, especially modern microprocessors, which within the same processor contain more than one brain core, also known as multi-core processors. In addition to allowing for faster processing, they are also being developed to reduce consumption. Today, all PCs use multi-core processors, with two, four, and eight core processors found on most PCs, while 16-core processors are found on most server-level machines.



Figure 2.18 Modern processors using multi-core technology with low energy consumption

Source: Rainer and Prince, 2015

Intel and other chip manufacturers have developed chips that help reduce energy consumption. The results of this development have also helped to extend product battery life, especially in mobile devices like a mobile phones and tablets. Examples of energy-efficient microprocessors, such as ARM CPUs, are used on various mobile devices. A6 and A7 CPUs from Apple are used for iPhone and iPad products, and ultimately Intel Atom is used on netbooks, portable players, and smartphones. Recently, Intel released an ultra-small microprocessor that uses lower amounts of power, under the name "Quark," used to wear computer equipment sheets for skin care, or even swallowed to collect medical information.

6. Autonomic Computing

Large computer systems that are surrounded by thousands of network devices cause difficulties in management and maintenance, thus making the management of computer systems today a more complex task. Some experts believe that in the future we may not be able to deal with these problems effectively.

The way to solve the problem is to use autonomous technology, which has an important feature: it is a self-managed system, with a global industry effort towards the development of an Autonomic Computing system that can: (1) Configure various values in itself, (2) self-adjust, (3) Self-heal when abnormal symptoms occur, and (4) Protecting itself from external threats or intruders. PC computers will find that computer viruses and intruders are protected by anti-virus software installed inside the software. These should catch and eliminate viruses automatically, along with sending a warning report to the user to be informed every time, and the program can also be automatically updated as soon as it is connected online to increase efficiency in detecting new strains of viruses. As a minor example, IBM reported that it is

developing an autonomous computing technology for its processor, such that if any abnormalities are found in the system, they will be remedied automatically, without users needing to ask for help.



platforms:

7.1 Open source software and Linux operating system. Open source software or open system software is software that users can use without having to worry about software licensing fees, as well as allowing them to distribute, publish, and use, including the disclosure of source code to allow others to improve upon it, edit it, and develop it as open source. This software is a collaboration between development groups from all over the world, including organizations that are interested in and support the same subject, with the use of channels through the Internet to communicate the benefits of open source. The main software helps to reduce the cost of software licensing and reduces software piracy. The definition of open source software is that it is not attached to or up to any operating system and hardware technology. The most current open source software is usually developed based on the Linux operating system, or Unix. Open source software has been developed for over 30 years, proving that it is high quality and commercially accepted software, and includes popular open source software tools consisting of Linux and Apache operating systems, HTTP Web Server, FireFox, and Apache OpenOffice.

The Linux operating system is the most widely known open-source software, and is also an operating system that is closely related to UNIX. Linux operating systems can be used for embedded systems in mobile devices such as smartphones, tablets, and electronic devices. Linux has both a free version that can be downloaded from the Internet, and RedHat, low-cost open source software with various support tools set up by the company RedHat. Although the Linux operating system is not popular on most desktop computers, Linux operating systems are the leader in the server, mainframe, and supercomputer markets. Linux has also become an alternative operating system in the high performance computing market, with over 97% of the world's fastest computers, manufacturers like IBM, HP, Intel and Oracle, all looking at Linux as an important part of the system, while Andrew, which is based on Linux, is a highly popular operating system for mobile devices. The origin of open source software, especially Linux and other supported applications, significantly affects the enterprise software platform, especially helping to reduce costs while increasing reliability, flexibility, and integration, since Linux can work on all platforms, from mainframes, to servers, to user level machines.

7.2 Web-based software (Java, HTML and HTML5)

Java was an object-oriented programming language, created by Sun Microsystems. It was a leader that enabled changes in programming patterns on applications running on the World Wide Web, and Collaborate with intranet and extranet networks. Java language was closely related to C and C ++ languages. It was easy to write and could be independently processed without platform, hardware and software, we could write Java language programs to respond immediately, or interact with each other, to be applied on a network based on the web.

At present, the Java platform is being installed in more mobile devices and products, including phones, cars, game consoles, and cable TV systems for interactive content and pay-per-view services. At the same time, Java is the most popular development platform for mobile devices running on Android operating systems. Sun Microsystems created a Java Virtual Machine to be used as a link between Java applications and various operating systems, with the code written to be translated only once. Transmission can be deployed on any machine with an installed Java Virtual Machine.

Developers can create small programs with Java, also known as Applets, to be embedded on web pages and then downloaded to run on web browsers, in which the browser is a program that allows users to access web and other resources on the Internet. Examples of such web browsers are Internet Explorer, Mozilla FireFox, and Google Chrome. In addition, at the enterprise level, Java can also be applied to e-commerce systems and more complex electronic businesses by communicating with the Transaction Processing Systems (TPS) of the organization.

HTML (Hypertext Markup Language) is a language used to create and format documents on the World Wide Web, with a writing format called Tag. HTML is a basic language that is important for web-based programming, enabling HTML to be displayed via the browser program. However, even today, there are tools for creating web sites like DreamWeaver or FrontPage that facilitate users to create web pages without having to learn HTML at all. Learning HTML is still necessary for professional website developers, though the casual user no longer needs knowledge of the HTML language.

HTML Example with HTML Editor

In this tutorial, you will get a lot of examples, in fact one example for HTML editor.

<!DOCTYPE> <html> <body> <h1>Write Your First Heading</h1> Write Your First Paragraph. </body> </html>

Figure 2.20 HTML code examples with the results running through a

browser program

Source: Wathanonukul, 2013

The original HTML version was designed to create and link static documents, most of which were text and still images. Now, however, web technologies are being used to interact more socially. Almost every webpage presents elements in the form of multimedia, whether it is still images, sounds, or videos, which the browser runs and requires the installation of various plug-ins, such as Flash, Silverlight, and Java, in order to integrate various media. These are completely rendered on the page. Therefore, the next evolution of HTML was HTML5 that solved compatibility problems. In other words, HTML5 allowed the browser to run this multimedia without having to rely on other plug-ins such as Flash. Media became directly accessible via HTML.

HTML5 made it easier to work on web pages with different display devices, whether it was a desktop PC or a mobile phone, and also supported offline storage on the device. In terms of popular tools used to write programs on the web, Ruby and Python facilitated the creation of web applications, including creating applications on the cloud. Large companies such as Google, Facebook, Amazon, and Twitter use Python and Ruby as well as Java.

7.3 Web services and service-oriented architecture

Web Services are a software component that is based on a web framework and object-oriented standards. This technology is used on the web to link between applications on a network, even if there are different system platforms, solving major problems that many organizations faced. Active applications are developed for a variety of platforms. In the past, many organizations tried to link these applications together, but such operations had a very high cost, because each system had different complexity levels. Therefore, the ideal solution was that there should be a standard of communication between applications in order to achieve convenient and fast collaboration and the ability to share information between each other. The web service chose XML (eXtensible Markup Language) as a standard language for communication, since the strength of XML is that every system can understand it by describing the data format that each computer can process. Web services therefore had the ability to work across systems (interoperability), allowing one program to talk to another program (program-to-program). With this capability, the web service is a technology that many organizations are watching due to the ability to connect multiple services functions together and work effectively.

Table 2	.5	Differences	between	HTML	and XML
		80 11	1111	115	Van DV

HTML	XML		
HTML is used to describe the display; in	XML is used to describe data; in other		
other words, what data is displayed in	words, what the data is.		
the facing			
HTML is designed to display data with a	XML is designed as a software and		
focus on how the data looks.	hardware tool, used to transport and		
1 SIV PER	store information that is important to the		
	information.		
HTML is used for designing Web pages	XML is used as a space for transporting		
to be displayed on the client side.	data between programs and databases.		
HTML has its own predefined tags.	XML is flexible and can assign tags		
(I) A	invented by the author.		

Source: Ayunthika, 2016

The collection of web services that have been created and assembled into the system for the organization is called Service-Oriented Architecture – SOA which acts as a complete set of services in itself, able to communicate with other parts of the web to create applications that businesses can access and use through the operation of these service packs. Software developers use various services. These are reused by incorporating them together with other services to assemble into other applications as per the need. Almost all major software vendors have provided the tools and platforms to create and integrate application software using a web service. For example, IBM has prepared a web service tool in the WebSphere e-Business Software Platform software suite, while Microsoft has integrated web service tools into the platform under the name Microsoft.NET

7.4 Outsourcing software and cloud services

Most business sectors still use the same work system because they are able to meet their business needs, and because if they wanted to create a new system to use instead of the old system, it would require a large investment. Therefore, they often rent or buy new software from external sources instead, in which the method of providing software packages can be done in four ways: 1) Ready-made software and enterprise-class software: In the case of organizations not ready to invest in building their own systems, including businesses that are running, are generally not complicated, with a wide variety of Software Packages. This provides a good alternative by which the package is software that has already been created for commercial distribution. They are affordable, users can install them quickly for immediate use, and they are popular to use in various business units such as wage or order management programs. Enterprise software is another type of readymade software, suitable for large-scale applications that are used in order to support all business processes to be connected, both within and outside the organization. Because this type of software has very high capability, it was very expensive as well (the overall price for large work systems is in the tens of millions of dollars). The world's largest manufacturers of enterprise-class software are SAP, Oracle-PeopleSoft, and Microsoft Dynamics, with major systems including Enterprise-wide business resource planning systems, supply chain management systems, customer relationship management systems, and knowledge management systems. 2) Outsourcing: hiring external agencies to develop and maintain the system instead of using internal personnel. The main goal of outsourcing is to require the organization to focus on their core business according to their needs, getting support for work such as information systems that the organization may not be as well versed in or does not have the personnel or to handle on their own. Hiring an external agency with professional skills ensures that the work is done correctly without taxing the resources of the company. Nowadays, outsourcing the business of IT systems is increasingly popular, with data from industry analysts estimating that global IT costs for outsourced services was worth over 440 thousand million dollars in 2014. 3) Using software and tools from the cloud: In the past, common application software such as MS-Word or Photoshop came in the form of an internal packaging box with DVDs, software license documents, and manuals. Installation and operating instructions contained within the box were designed to be used only on one device. Nowadays, the opportunity exists to download software directly from the manufacturer, which is cheaper, or use the software from the cloud provider over the Internet. Many IT service providers today are turning to cloud computing technology, in the form of software as a service, instead of buying software and installing it on their machines. Turning to software from a service provider means that organizations do not have to spend a lot of money on software licensing fees, which used to cost large organizations with hundreds of thousands of computers tremendous amounts of money. An organization using cloud services today can reduce their software costs significantly. Software services from the cloud are similar to using standard utilities. In other words, rather than paying a flat fee for something a company may or may not use, now payment is based on the amount of the product actually used and can be accurately assessed. Additionally, software from service providers is always up to date, so there is no concern about upgrading the software version, or hiring people to maintain them as in the past. 4) Mashups and Apps: The software used, whether it is for personal or business use, may be a large program that is complete and works in itself, or may consist of various elements that can be exchanged freely and works with other programs on the Internet. Individual users, including companies, can mix and match these software elements in order to create their own applications, as well as sharing this information with others. The result of using software in such a manner is known as a "Mashup," though the term does cover a very broad definition. There are many benefits to be brought to use, depending on what they are used for. For example, the update between personal data (such as personal cars) with the functionality of the Google Maps program, which is complete software itself, provides the ability to display maps at any location and can be used in most parts of the world through a browser program. It can also track the movement of the car (or track a lost car). These mashup apps are small, specialized software programs, which are most often used on mobile platforms. There are currently many applications that

can be downloaded and used either for free or for a small fee. Today, there are over 1 million applications running on the iPhone / iPad platform from Apple and Android from Google. The most downloaded applications are games, news, weather reports, maps and navigation systems, social networks, and music and videos / movies, though there are also applications for businesses that play an important role, allowing users to create and edit documents, connecting their phones to the company network, scheduling and meeting participants, tracking products, and enabling voice commands. In addition, there are many applications that are used for e-commerce for research, product purchases, and online services.

Mobile Application

The most popular communication device currently is the smartphone. The proportion of smartphone sales has increased considerably due to the development of the capabilities of mobile phones that are now available. Users now have more activities available to them, from using mobile phones to connect to the Internet, to reading the news, watching movies, listening to music, gaming, much of which is available both online and offline. As a result, more mobile applications are being developed, either from mobile phone service providers or from many software development companies.

1. The definition and types of Mobile Application

Kanawut Chuensom (2010) said that applications are software that is used to help users of the application, so there is something called user interface. User Interface (UI) can be divided into sub-categories according to the working platform, as follows: 1) Desktop applications are applications running on computers, such as Windows Media Player, Microsoft office, etc. 2) Mobile applications, applications running on mobile device or mobile phones, such as IM +, etc. 3) Web applications are applications that run on the web, such as Hotmail, Gmail, Google +, etc. The web application might be divided into intranet applications, referring to those used only within the organization, as opposed to the World Wide Web Internet.

Mobile application consists of two words, mobile and application, which has the following meanings: Mobile is a portable communication device, which, in addition to being able to use as a phone, also works like a computer. It is a portable device, so it has features that are small, lightweight, and energy efficient. The applications are software designed to help the user. The applications have something called the user interface (UI), which is the medium for various applications. Therefore, mobile application refers to applications that help users work on portable devices, such as mobile phones, whose applications operate on different operating systems (OS). Examples of mobile operating systems are the Symbian OS, which is used in many mobile devices, including Nokia, Windows Mobile from Microsoft, BlackBerry OS from RIM (Research in Motion), Palm iPhone OS from Apple and Android OS from Google.

Smartphone are mobile devices that have become increasingly popular with most users in modern times because the operating systems can now support the use of applications. Mobile phones, therefore, are bringing users of all ages into the digital age and into today's online society.

NEK symbian CIOFC

Figure 2.21 Popular brands of operating systems on mobile phones Source: Suharitdamrong, 2015

Figure 2.20: Google's Android operating system and Symbian. The iPhone operating system developed by the Apple Company.

Sirisuda Rodthong (2014) noted that the use of mobile phone applications gained widespread popularity around the world during the end of the 20th century due to the birth of the App Store. Prior to that, the use of applications on mobile phones was only downloading ringtones. The emergence of the App Store has led to many changes in the factors related to the communications software industry, such as improving the business model between service providers and application developers, and allowing developers to have more revenue opportunities. Increased revenue has result in incentive for application development and related infrastructure technology development by increasing communication support in order to send and receive data sufficiently for the use of quality and efficient applications. There is a steadily increasing number of mobile phone users, with greater acceptance for convenience and portability everywhere.

Holzer and Ondrus (2011) stated that the expansion of the application content was fast. The result of the emergence of the Application Market Place for major mobile phone makers divided the revenue proportion among more application developers. Application developers have sales channels for applications within the structure that is beneficial to all parties, from developers to mobile phone service providers and users. Developing applications in each country varies according to the nature of the economic and social environment, with surveys finding that the countries with the highest downloads are European nations, North America, and Asia.

2. Applications running on mobile phones are divided into two types, as follows.

2.1 An application system is the system software that supports the use of applications or programs. Currently popular operating systems from mobile companies are as follows: Symbian OS features a simple user interface (UI), complete basic functionality, and also installed applications, including media files, including a picture, movie, or music. It has powerful memory resources in the device that offer a wide variety of choices. Windows Mobile, developed by Microsoft, produces operating systems that support many computer functions, including Windows 7, Windows 8, and Windows 10. Windows Mobile features are similar to Windows in computers. For example, smartphone makers using Windows Mobile include HTC, Acer, and Nokia, along with an operating system that consists of a set of basic applications for mobile devices on the Microsoft Win32 API. For Windows mobile devices, there is a Pocket PC, PDA phone, and smart phone, which is an automatic

mobile device that is designed to have a Windows mobile operating system. There was the Pocket PC 2000 operating system, which Windows Mobile later updated. BlackBerry OS was developed by RIM to support the functionality of various BlackBerry applications. It focuses primarily on email. Once an email arrives, the server forwards the message to BlackBerry. Screen status alerts users to timely information that the BlackBerry email system is highly secure with data encryption. Another important feature is Conversations via BlackBerry Messenger, which allow users to print messages, chat with friends using BlackBerries in real time, and connect to the Internet to receive and send data to other mobile networks, which is suitable for those who need or wish to tackle various tasks via email, and teenagers who love to chat via computer. The iPhone OS was developed by Apple to support the functionality of various iPhone applications directly. Groups that choose iPhones are usually those who like multimedia, such as listening to music, watching movies, and playing games. Many game companies, therefore, produce games to support the iPhone, especially where users can trade applications on the Internet and pay via credit card, another Apple business. The types of businesses are growing along with the usage of the smartphone. Android is an operating system (OS) or platform that can be used to control operations on various electronic devices for mobile phones and portable devices, with Google Inc., T-Mobile, HTC, Qualcomm, Motorola, and many other companies developing Android projects through the Open Handset Alliance, an international group producing technology and media tools. Android, which consists of operating systems, libraries, frameworks, and other software, is equivalent to Windows Mobile, Palm OS, Symbian, OpenMoko, and Maemo (by Nokia), in using many open source elements such as Linux Kernel, SSL, OpenGL, FreeType, SQLite,

WebKit, and other library frameworks, all of which are Apache Licensees. This partnership is aimed at promoting innovation on the Internet in order to gain a superior experience over existing mobile platforms while presenting a new dimension of the open platform for developers to help these groups work together more efficiently. Up, by Android, helps accelerate and drive new communication system services to consumers. (Poolpakdee, 2011).

Android is an operating system for mobile devices, including mobile phones, tablets, computers, and netbooks, and runs on Linux. The kernel was developed by Android, Inc. The Android Company was purchased by Google, and later Android developed it on the Open Handset Alliance. Google allows developers to edit code using Java and control devices via the Java libraries that Google developed. The advantages of Android: 1) Android is a free program for mobile companies and can be used for free. It can be further developed, giving the device quality, value, and diversity. 2) Android has a free application development kit, which means that individuals can write applications for their own use, or for commercial purposes. 3) There is a Market to download applications for free. 4) Working on the basis of Linux, Android has excellent performance in connecting to satellites, cameras, and the Internet. 5) It is safe and highly stabile. 6) Android is very easy to use because there are various Google services attached to Android. 7) Android allows updating the operating system itself, without having to wait for the mobile phone manufacturer if there are problems (Maithaemklang & Khapaeng, 2011).



Figure 2.22 Various operating systems on mobile phonesSource: Marakas and Brien, 2015

2.2 Applications must meet the needs of the user groups, because users have different application requirements. Therefore, there are many manufacturers and new application developers, including 1) Applications in the game group. Due to the large number of popular game players on phones, game makers have invented more new games to bring to market. Players often prefer to play online games and establish connections through social networking groups, such as games on Twitter or Facebook, etc. 2) Applications in social networking groups so that users can keep up-to-date with information, such as groups popular with teenagers on Facebook, MySpace, Hi5, and even Blackberry, which has a channel for customers to chat via Blackberry Messenger by exchanging PINs with friends in the group. 3) Multimedia group applications for users to access data files in various formats, including audio files in mp3, wav, or midi, still images in gif, jpg, or bmp formats, or movies and video clips in mp4 or avi formats, etc.



Figure 2.23 Examples of applications on smart phones Source: Marakas and Brien, 2015

3. Types of applications on smartphones

Suchada Palachaipiromsil (2014) said that applications on smartphones (Smart Phone Application) is defined as programs created for use on smartphones or tablet devices, with the classification of applications into six categories, as shown in Table 2, as follows: 1) Education & Reference is an online teaching and learning program, including E-book and Language Courses, etc. 2) Multimedia & Entertainment is a program for entertainment, such as listening to music, watching movies, etc. 3) Games are a variety of game programs, including Action, Puzzle, and Arcade, etc. 4) Lifestyle & Healthcare is a health program, including healthy food

menus, healthy cooking methods, calorie calculations, and health care, etc. 5) Social Networking is a program for social communication, including Twitter, Facebook, and WhatsApp, among other apps. 6) Finance & Productivity is a program about financial transactions, including money transfer via mobile phones and mobile payments, etc.

Categories	Description		
Games	There are many types of game groups, such as action,		
121	arcade, puzzle, card, casual, etc.		
Lifestyle and Healthcare	Lifestyle and Healthcare are health care programs, such as		
	calorie trackers or pedometers, and programs related to		
	lifestyle, such as location-based search, navigation, news		
	& infotainment, photography, and travel.		
Education & Reference	Education & Reference is a program in the study group		
	and reference evidence, including E-books, language		
	courses, encyclopedias, IQ tests, atlases, other educational		
	aids, etc.		
Multimedia &	Multimedia & Entertainment is a program for		
Entertainment	entertainment, such as listening to music, watching		
1311	movies, watching TV, or decorating the phone		
181	background, etc.		
Finance & Productivity	Finance & Productivity is a financial program that		
12	includes currency converters, tax calculators, budget		
\sim	management, mobile banking, personal management,		
	typing tutorials, document readers, spreadsheets, spell		
	checkers, etc.		
Social Networking	Social Networking is a program that facilitates access to		
	online social networks, such as Facebook, IMs, Tweetie,		
	etc.		

 Table 2.6 Details of application categories

Source: Booz Company Analysis, 2015

4. Interesting Mobile Application Trends

Today's mobile phones have developed many applications in order to meet the needs of users. Experts like Gartner, a business and technology research firm, said that in the future, the application market will become a niche market aimed at niche customers, without focusing on a broad market or penetrating customers at all levels as before. Gartner also predicted that the trend of applications that would have the most use fall into 10 interesting categories, namely: 1) Money transfer via mobile phone, as it is convenient, economical, and fast. 2) Mobile Search, whose main purpose is to promote sales on mobile phones, with an analysis that if customers are familiar with search services for products or services of any service provider, then they will return continuously to use the service again. 3) Mobile Browsing, allowing access to the Internet as a basic function of modern phones, will continue to develop. 4) Providing services based on geographic location (Location-Based Services: LBS), giving information about where the mobile device is located, via the wireless network. In the event that a friend calls, our friend will immediately know where our phone is located. 5) Mobile Health Monitoring, as a service to watch patients, especially those with chronic diseases, who do not in-patient care at hospitals. Patients stay at home with ongoing care, allowing health agencies to save money by tracking patients' symptoms through mobile phones. This should also improve the quality of patients' lives. 6) Mobile payments, similar to number one, but this service has three distinctive features, which are payment options when other payment channels are not available, added convenience, and speed to help in confirming the identity of the customer in order to increase the level of data security. 7) Near Field Communication Services (NFC), short-term wireless communication that can be used for payment at locations that require speed and small payments, payments of fares for vehicles, or to verify ID numbers of customers before entering various systems, etc. 8) Mobile Advertising. The mobile advertising market through social networks will continue to grow in reaching more customers in the same way as advertising on TV, radio, or brochures. 9) Mobile Instant Messaging is available to chat via mobile phone, which is very popular nowadays. 10) Mobile Music as a service to listen to music or download music on the phone.

The use of applications to meet the needs of mobile device users is getting more and more popular as the result of the ability of the device to support new technologies. Operating systems (OS) and new applications are invented to meet the needs of today's users, together with the ability to download various applications without cost, or through trade via a network system, and with convenient and fast payment channels. In the future, mobile phone users are likely to use more applications on their devices, as users find many more activities, such as using the Internet, paying money, transferring money, reading news, watching movies, listening to music, chatting, accessing to social networks, and searching for information was easy and fast. For this reason, mobile phones are competing to provide application services to be a market leader with consumers, in terms of price, service, and quality.

5. Application Component

This is the main component used to create the Android Application. The Application Component is divided into four categories: Activity, Service, Content Provider, and Broadcast Receiver. Each part of this Application Component has different goals for use. There are different activation patterns (i.e. some application components are triggered by the system and some application components are triggered by other application components).



5.1 Activity is a component used to control the creation of user interfaces, such as screen display, email lists, email form, etc., and controls the interaction between the user and the user interface. For example, when a user selects an email list, it responds to the user by displaying the item information selected. Only one Activity controls a User Interface, which shows that one application contains a multitude of activities working together. However, although the Activity as a whole is working together, those activities remain independent of each other.

5.2 Service is a component that does not have a user interface and is processed in the background, i.e. the processing that runs along with the user being able to use other applications at the same time. The processing in the background is a process that can be run in parallel with other functions of the user, in order to create any work that the user does not need to be on the screen. This work might take a long time, such as using a particular service, opening music to allow users to use other applications, but the music is still playing or using the service. Downloading large amounts of data allows users to use other applications, but downloads can still be in progress. Creating a service is done by creating Class and inheriting from Class Service or inheriting from any class inherited from Class Service.

5.3 Content Provider is a component that controls the information of any one application that is needed to be shared other applications. The information can be used by both applications (including editing data if the Content Provider permits it). Creating a Content Provider can be done by creating a Class and inheriting from the Class Content Provider, or it can be inherited from any class that has been inherited from the Class Content Provider.

5.4 Broadcast Receiver is a component that does not have a User Interface. It acts to recognize what is happening in the system and informs the user of certain information, such as when the battery is low, when the screen is captured, when there is a screen saver, etc. In addition, any application can use the Broadcast Receiver, such as when the application has successfully downloaded data, which in most cases results in a response from the Broadcast Receiver done via a Notification in order to inform the user what has been done. For creating a Broadcast Receiver, it can be done by creating a Class and inheriting from Class Broadcast Receiver or inherited from any class inherited from Class Broadcast Receiver, which therefore is collected as a general database. 5.5 Application development: Android application development has four steps, as follows: 1) Creating: Starting with the creation of a project, the development of applications stores files in various folders such that the Android code can be written. 2) Designing: The design of the application screen is designed in the user interface (UI) first. The language used to develop is the Extensible Markup Language (XML), with a file named main.xml stored at res/layout, as well as various layout controls. 3) Coding: Writing all the functions of the working process for the Android application in order to do the work as assigned, then storing the code in the src/package/.java file, which uses Java as the development language. 4) Testing: Testing of the developed programs in both the Android Virtual Device (AVD) and mobile devices in the Android operating system.

5.6 Application development methods

5.6.1 Android Application Developer file structure.

It is the file structure of the Eclipse program that is used to develop applications for supporting food consumption habits (promoting food consumers hygiene). The file structure and functions are as follows:

> /src/PACKAGENAME/ACTIVITY.java is a file that needs to be installed to start the program. PACKAGENAME is the package name that is created, and ACTIVITY is the class name that is specified at the time of creation. (It matches in the file AndroidManifest.xml).

/ assets - storing multimedia or other files such as images, music, etc.

/ res / drawable - store images, icon.

/ res / layout - to store XML files that indicated the display, if compared to the web is to store the HTML code that does not have a part in the program at all.

/ res / value - keeps the values that are declared, which consists of the following:

/res/value/arrays.xml - is an array declaration

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/res/value/colors.xml - is a color value declaration
/res/value/dimens.xml - is a declaration of various object sizes
/res/value/strings.xml - is a message announcement or letters
/res/value/styles.xml - is an object style declaration

/ gen / PACKAGENAME - finds R.java, which is the configuration.



5.6.2 Android Components in Mobile Application

Research related to mobile medical applications.

The Mobile application for controlling weight, according to the theory of content analysis, adopts the smartphones application in order to help weight control. They are becoming more prevalent as the quality of these applications becomes increasingly accurate and is evaluated, which is the goal of studying food / nutrition and tracking application proportions based on integration of features and their correspondence to the theory of behavior change in comparison with evaluation of lectures and implementation of popular free applications in health and fitness categories. These are available in the iTunes App Store. Health and fitness Applications are evaluated and defined using the selection criteria, based on the user,

according to the nature of work, features, and explanations that the researchers have evaluated. The application used is divided into five categories: (1) food tracking (2) health food cooking (3) weight / proportional tracking (4) decision making at the grocery store, and (5) decisions on places to eat / restaurants. Applications have an effect on weight loss and adopting behavioral theory that influences change for subjects (Kristen et al., 1970). Research design and implementation of social control considers weight loss from mobile use for teenagers (Smart Project). This study explains the reasoning, theory, design, and weight control for active teens through technology and mobile media, with a total of 404 subjects, who are of excess weight or obese. Students from three Southern California universities (Male = $22 (\pm 4)$ years, BMI = 29 (\pm 2.8), Female= 70%) were randomly assigned to participate and received web-based information, weight loss programs, messaging, smartphone usage, blogs, and e-mail. Participants received social support among their peers by themselves, checked their weight every week, posted their health habits, answered weight loss questions, and focused on their health. Responses were measured in the form of usage and opinions of users, body mass index, waist circumference, diet, active behavior, weight management, smoking, alcohol, etc. All participants selected to participate in the activities were in their final year of study, and participants engaged in activities related to regular exercise and changes in eating habits caused by the use of technology to communicate in telephone systems that could result in weight loss behaviors in of teenagers who participated in the activity (Patrick et al., 2014).

The development and feasibility of using web-based applications, helping to save daily information, and opinions of situations through the use of smartphones, would support the self-management of patients with the Type 2 diabetes. Research
development and testing of a three-month trial using smartphones allows access to daily and web-based diaries, comments, and written situations. Participants register their eating habits, medication, daily exercise activities, and blood sugar levels using a mobile phone. The purpose of daily records and situation suggestions stimulate selfmanagement. There are 15 participants in the study, 11 of whom have completed the study, assessed the technology, provided encouragement, and most meaningfully reported positive lifestyle changes. Daily response rates proved effective, with the understanding that the study should be expanded to a larger size for smartphone applications. It appears that developing a tool that is likely to support patients with Type 2 diabetes would bring about important lifestyle changes (Nes et al., 2012).

Education determines an increasing number of Chinese seniors, leading to an elderly society. Health services are a kind of health information that provides personal health counseling to those who need it, especially the elderly and middle-aged people. For the introduction of mobile health services in this survey, there is a research model based on behavior patterns, attitudes, and theoretical values of behavior. The planning and unique age structure to examine the methods of middle-aged people adopts mobile health counseling. Hypothesis testing models include observed data usage collected from 424 residents of China over a 40 year period, creating structural models, which found that individuals' physical conditions can be understood based on behavior. The intention is to use the mobile phone for health services of the two groups, and the results of theoretical part of this study (Deng, Mo & Liu, 2014).

Research used Facebook as an effective strategy to recruit low-income women in for online nutrition education. Keeping a record of recruitment costs, nutrition, education, research, and effort, the selection of samples is important for evaluating the effectiveness and cost of using Facebook to recruit lower income women. In the online nutrition program being examined, including the biopsychosocial response of Facebook, advertisements appeared on the Facebook page of low-income women, aged18-45. Access to an online nutrition program offered participants the right to complete a survey of food-related eating behaviors, including the ability to maintain food safety. Using the assistance of 465 people found that Facebook can be a powerful tool to recruit low-income women into a nutrition education program (Lohse, 2013).

Social media can be a fast, low-cost, and direct way to provide nutritional education and to expand the scope of a program's goals. The author's perspective is that social media can be an effective strategy to use. Work should follow good practices; this prospective approach showed the best practices of social media, depending on the experience gained from the campaign. Social marketing and an understanding of nutrition education can take advantage of social media as a new mechanism to reach target groups, as necessary, including best practices for operations, management and evaluation (Lauren et al., 2014).

The study has developed an application for smartphones to be used in clinical management with obesity studies to develop and evaluate the use of the app. as a guide for managing obesity. Monitoring developments in this study will be useful for weight control because it can provide quality health information. However, a clinical picture of the applications still needs to be tested for further evaluation. (Jeon, Park & Faan, 2015).

Education with self-monitoring of daily meals, making weight loss successful, as well as smartphone application usage makes tracking food consumption easier. The researcher evaluates the use of Smartphone applications for food consumption by monitoring as well. Participants are able to follow the time period of the method used by the researcher in o n e of three methods: using the Lose It application, recording various characteristics related to their own food consumption on a smartphone, or taking notes on traditional paper sheets. The study is able to summarize the smartphone application as a means of self-examination of food consumption, making it possible for individuals who want to lose weight by traditional methods to track their progress (Wharton, 2014).

Based on the study by doctors, there is a limited time for weight loss counseling, and there is a lack of resources available for doctors to see patients for help with weight loss. A weight loss mobile application has the potential to be a useful tool, and the scope of the study includes strategies used in relation to the behavior included in weight loss control, which is not yet clear. The main aim of education is to determine the level at which commercial mobile applications can be used to help individuals lose weight, including strategies related to evidence-based behavior, which can be used to control weight loss and to identify features that help increase strategies behavior created through technology. Therefore, this mobile application has a specific role, enabling weight loss through methods that lead to behavioral changes. By studying behaviors that help to increase motivation to reduce stress, there is help to solve the problem, which included the additional methods used that make this application more useful for users who are interested in continuing to lose weight. (Pagoto, Schneider, & Jojic, 2015)

For studies that have developed an interesting advancement in the use of data communication technology in the treatment of obesity, control by delivering information through smart phones might be convenient, fast, modern, cost effective and far-reaching strategy to manage body weight. Any study of controlled applications that use messaging and usage through smartphone applications can be used as a complement to other methods available now. There is currently no randomized control trial (RCT) of smart phone applications used to treat people who want to lose weight. The main focus of self-examination, tracking food consumption, and exercise by monitoring the transmission of information through the application on smartphones can be compared analyzed for its effectiveness. Therefore, MMM applications can be an acceptable tool and can affect weight loss by a full RCT test, which can be guaranteed by this research study (Carter, 2015).

For foreign countries and in Thailand, the development of applications that have ready-to-use nutritional information and health-related details may be useful. Application rates associated with many nutritional principles can be applied for analysis, compiling detailed information on various applications and based on articles recommending the use of the application details, download rates from websites, the Android Market in the category of Health and Fitness, and from the list of paid applications, free of charge. Popular download rates, from the top 100 paid and top 100 free ratings in 2017, include www.thaiware.com, www.samsung.com, www.kapook.com, and www.fwd.co.th. There is a mobile phone application download, in various formats, with details of different information including a variety of applications, which the researcher summarized in Table 2.7. A summarized comparison of applications related to nutrition in Thailand can be seen in Table 2.8 In each application, there is information, details, and different methods of use, which are related to health care, nutrition, diet, and exercise. By studying this research, the researcher has developed a mobile application that can monitor obesity conditions by using the theory of planned behavior, which controls consumer behavior, including exercise in adolescents, in developing applications that are different from those summarized in Table 2.7 and 2.8. Nutrition and health detail information in the correct use of this application leads to positive results in the health and correct nutrition of teenagers. The mobile application collects information and details of all parts that are useful and available to teenagers - or anyone who wishes to use it - with additional new functions. Therefore, the development of mobile applications, or applications related to nutrition and health of users, are useful and practical, with results that can influence behavioral changes in teenagers. By creating the adiCET nutrition application using the behavior control program from the theory of planned behavior, the researcher includes the survey of the satisfaction of using this mobile application.



 Table 2.7 Comparisons of applications related to nutrition internationally



131

 Table 2.7 Comparisons of applications related to nutrition internationally (Continued)

No.	Name of the application	Record the user's basic information.	Food and nutrition records	Health records	Record exercise data	Exercise advice	Health and nutrition advice	User warning system	Summary of energy metabolism from activities and exercise	Summarizing the amount of nutrients and energy from consumption
	Bodybuilding	¥.	81			=(/)		The second second	/	
8.	workout trainer	X	x	X	V.	X		X	V	V
9.	(EN) Calorie Counter by FatSecret (EN)	~	24	M	120	X	X	x	\checkmark	\checkmark
10.	Mynetdiary calorie counter pro (EN)	~	1	X	8 ×	X 2	x	х	~	\checkmark
11.	Lose It (EN)	1	DY-	x	SKO	6x3	x	X	\checkmark	\checkmark
12.	Withings Health Mate (EN)	~	E1	x	And a	x	X	x	\checkmark	\checkmark
13.	Diet Point Weight Loss (EN)	~	Z	A		x	x	Sx/	\checkmark	\checkmark
14.	My Diet Coach (EN)	\checkmark	x	x	x	x	x	x	X	\checkmark
				K	AJA	внь	Ŋ			

Table 2.7 Comparisons of applications related to nutrit	ion internationally (Continued)

No.	Name of the application	Record the user's basic information.	Food and nutrition records	Health records	Record exercise data	Exercise advice	Health and nutrition advice	User warning system	Summary of energy metabolism from activities and exercise	Summarizing the amount of nutrients and energy from consumption
15.	Diet Assistant (EN)	x	\sim	x	x	x	x	x	X	\checkmark
16.	7 Minutes (EN)	х	a X	X	K	X	X	x	х	Х
17.	Tracker Gym Log	X	x	X	E A	x	L	х	~	X
18.	(EN) Fitocracy (EN)	x		X	Eka		X	x	~	X
			HIANG M.		AJA	BHI		LERSII		

	134
Table 2.8 Comparisons of applications related to nutrition dom	estically

No.	Name of the application	Record the user's basic information.	Food and nutrition records	Health records	Record exercise data	Exercise advice	Health and nutrition advice	User warning system	Summary of energy metabolism from activities and exercise	Summarizing the amount of nutrients and energy from consumption
1.	MPlus BMI (TH)	✓	~	x		x	x	x	X	X
2.	Foodieat (TH)	1		x	K	x	x	15	\checkmark	\checkmark
3.	Cal Dairy (TH)	~	1	x	J.	Nx	X	~	~	\checkmark
4.	BMI and WHR (TH)	X	x	x	50	x	x	х	1	\checkmark
5.	DooCalorie(TH)	~ \ 2	21-	x	640	9x3	x	x	\checkmark	\checkmark
6.	CalTracker (TH)	~	51	x	xd	(x)	x	x	X	\checkmark
7.	Check Calories (TH)	~	3	x	x	x	x	x/	\checkmark	\checkmark
8.	CalkCal (TH)	\checkmark	1-3	x		x	x	x	\checkmark	\checkmark
9.	OnDiet (TH)	\checkmark	X	1 x	X	X	x	x	X	\checkmark
L				V.	AJA	BHA				

 Table 2.8 Comparisons of applications related to nutrition domestically (Continued)

No.	Name of the application	Record the user's basic information.	Food and nutrition records	Health records	Record exercise data	Exercise advice	Health and nutrition advice	User warning system	Summary of energy metabolism from activities and exercise	Summarizing the amount of nutrients and energy from consumption
10.	BMI Calculator (TH)	~	\sim	X	x	x	x	x	X	\checkmark
11.	Ground Miles (TH)	x	o X	x	K	x	x	x	х	Х
12.	My Fitness Best Body (TH)	X	x	x	E a		Lx	Х	Х	X
13.	adiCET Nutrition	✓	×	×	81	349		✓	\checkmark	\checkmark
			CHIMNG M.		AJA	BHI		Y ERSITY		

From Table 2.7 and 2.8, the researcher can create the mobile application or adiCET Nutrition related to nutrition and monitoring obesity conditions, using information in each source and different details, developed from the origin of the application, including download rate, or the ranking of data sources both domestically and internationally. This indicates the differences and functions that can be applied to adiCET Nutrition, which would be different in its functions for users, starting from the initial data recording of the user, data recording of food and nutrition, health records, exercise data records, exercise advice, health and nutrition advice, analysis of user data by health and nutrition experts, health risk assessment, nutrient analysis in each meal, user notification system, energy metabolism summary from activity and exercise, and an automatic summary of nutrition and energy consumption. This is different from applications in Thailand and abroad, which have the most users according to Table 2.7 and 2.8, namely M Diet Helper. That application uses a warning about obesity reduction, as well as a management plan for each meal for the user automatically, easily and with different details. Ranked second and third are Foodieat and Cal Diary. The applications are easy to use and have quite similar details, though there are differences as detailed in Table 2.7 and 2.8 above. Therefore, the creation of the adiCET Nutrition application is able to respond to comments, record additional information, offer a warning system, obtain the correct nutrient analysis, receive comments and suggestions from experts, focus on the management of consumption behavior and exercise, and monitor correctness in nutrition of overweight and obesity conditions.

Chapter 3

Research Methodology

The objectives of this research on a mobile application to monitor obesity were to construct a mobile application to promote the monitor of obesity in order to consume food according to the nutritional principles, to investigate the results of the weight control program that focused on changing eating habits of the participating overweight or obese students, and to explore the satisfaction of the sample group with the implementation of the application, The research methods were carried out as follows:

A system design to construct the mobile application to promote the monitoring of obesity

1 The problem analysis

From the literature review on mobile applications relating to nutrition and health to monitor obesity and from the "Adolescent Health and Development" (WHO 2017), "FDA issues final guidance on mobile medical apps" and "Mobile Medical Application" (FDA, 2015; US Food and Drug Administration, 2015), as well as from the comparative details of applications in Chapter 2, the adiCET Nutrition application was constructed, based on both domestic and international applications that had been downloaded or ranked. Different aspects and functions of these applications were selectively incorporated into this constructed mobile application. Functions and icons in this application were complete for users, ranging from automatic records of basic information of the user, food and nutrition, health, exercise, advice on exercise, advice on health and nutrition, analysis of users by health and nutrition specialists, assessment on health risks, analysis of nutrients in each meal, user notification system to summaries of metabolism from activities and exercise as well as nutrients and consuming energy.



2. Design and programming with computer language

Figure 3.1 Design and programming with computer language

Figure 3.1, illustrates the construction of Data Flow Diagrams Level 0 or Context Diagram of the system. It is a widely used tool for writing new systems, in writing work simulation diagrams of processes in the system, in which there were 2 parts that were related to the obesity monitoring program system, namely the Member with the Administration. It shows the top-level Data Flow Diagrams, in the overall picture of the system that is related to the external environment as follows: 1) The Member sends the Data Flow to the system, i.e. Basic Information, Height, Weight, Wasitline, Meal, Activity Data, Health. 2) The Administration sends the Data Flow into the system, namely Menu of Calorie, Activity of Metabolism. 3) Obesity management system sends the Data Flow into Member, including BMI suggestion, Summary of energy, Summary of Metabolism, and Admin including Report activity of metabolism, report menu of calorie, report data user.

3 Testing and editing the programs

After designing and constructing the program, the program was tested in order to determine the format, rules of language and the performance of the program. When it was found that the program was not working correctly, corrections were carried out. The procedure for testing and editing the program involved checking the accuracy of the program's processing. The program was correct according to the format and rules of the language, but might result in the processing being incorrect. Therefore, it needed to check whether the processing was correct as needed or not. The method was to assume that the agent data from the actual data was brought to the program and then validated the results. If found to be inaccurate or incorrect, modification and correction had to be carried out. The assumption of the agent data for testing was very important, the characteristics of a good agent should contain both correct and erroneous data, in order to test whether the developed program could cover all operations in various conditions. The process of checking the program was written to work correctly according to the needs of the user or according to the nature of the program or not. The errors could occur from programming as follows: 1)

Syntax Error is caused by using the wrong format that the language defined, such as forgetting the variable declaration, writing the wrong command, such as while () as WHILE (). 2) Logic Error is caused by the program being misplaced from the steps, such as checking the wrong condition, not meeting the objective, calculating the value that has been answered incorrectly, or misbehaving steps. 3) System Design Error is caused by the program not working according to the needs of the client, which was the testing and editing process, such as Desk-Checking, when program authors checked the program by themselves. It assisted by others, it would be called Structured-Walkthrough or Translating, checking various command patterns used in the program by the translator as the inspector. Debugging was a real program trial in order to find bugs, such as results that did not meet the requirements. This may be caused by Logic Errors, and if tested with real users, it would be able to check System Design Errors.

4 Information and data sources

4.1 Primary data are processed as shown in Figure 1, showing the process of adiCET Nutrition applications, which would collect user data based on the obesity management system, which could display incorrect consumption management at invalid, and users had obese basic information. Therefore, there was a correct consumption management system, as shown in the diagram above. The programs could be used in various linking steps and properly connected to users, which could be used in real life, by implementing the adiCET Nutrition application. The work process started from the sample group who was members of the system. They log in to register and record their information in each section, which was the basic information and data for each day. The system would perform, collect and analyze the

data to perform day-to-day data transmission, with a goal to reduce obesity, including weight, waist circumference, value BMI, calculation of exercise, calculation of energy consumption in each day of the samples. The sample group could test the system, select the steps to use the application in each category and determine the achievement of the goals for each day by using the application, and the summary of food consumption and exercise. The information provided in each category of the apps was both basic information and data that the samples recorded.





Figure 3.2 The process of adiCET Nutrition application according to the obesity management system

4.2 Secondary data for adiCET Nutrition application were based on nutrition information for calculating energy for each meal, from the Nutrition Division, Mahidol University. Exercise information was used to calculate each type of energy, based on the information from the Office of Health Promotion Fund. Medical information including blood pressure data, heart rate and health data was based on standardized data from the Ministry of Public Health. The standard criteria for overweight assessment were Body Mass Index (BMI) derived from body weight (in kilograms) divided by height with the unit in square meters (WHO, 2004). It is evaluated by scales and height meters (Audiometer), using two decimal numbers. Waist circumference refers to the length of the waist line measured at the middle of the navel, allowing the measuring line to be parallel to the floor, pulling the strap tightly next to the skin, measuring while exhaling the most, before inhaling. While the measuring, one must not pull or tense the abdomen. The unit is in centimeters (WHO, 2004). For Asian people, the World Health Organization sets the criteria for evaluating overweight standards as follows. (WHO, 2004)

4.2.1 The body mass index does not exceed 2.3 kg / m 2 ,

considered to be in normal weight.

4.2.2 Body mass index is 23-24.99 kg / m², considered to be obese

4.2.3 Body mass index is 25-29.99 kg / m², considered to be obese, Level 1.

4.2.4 Body mass index is equal to or more than 3.0 kg/m², considered to be obese, level 2

4.2.5 Waist circumference indicating overweight is more

than 90 centimeters in males, and over 80 centimeters in females (WHO, 2004).

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5. Instruments and methods for data collection

5.1 Use case Diagram



Figure 3.3 Use case diagram

5.2 Use case description

Table 3.1 Description of Use Case Login

Use Case Name	Login						
Actor	User	User					
Pre-Condition	Must first register and click the Login Button						
Post-Condition	Enter the main usage screen	7.					
Brief Description	Login using username and p	password					
Flow of Event	User	System					
CHIANG M	 Enter the Login screen Enter username and password Press the Login button or a use the application 	 2) Display Login screen 5) Check 5.1) If username or password is wrong 5.1.1) Show warning messages 5.2) If the username or password is correct 5.2.1) Displays the main screen. 					
Exceptions	Not complete information. n	Not complete information no internet connection					
	AJABH						

Table 3.1 shows the details of Use Case Login. The system consisted of users (Actor) who must first go through the subscription system, by clicking the Login Button (Pre-Condition), and then the system would enter the main usage screen. Post-Condition and users would be able to login using the username and password (Brief

Description). The process between the user process and the system is shown in the Flow of Event. If the user was unable to use the system (Exceptions), it was indicative that the data were not complete, or the internet was not connected. The sequence diagram is shown in Figure 3.4.



Use Case Name	Registration						
Actor	User						
Pre-Condition	Users must have an application; users must first open the						
	application.						
Post-Condition	Users subscribe successfully, can u	ise the username password for					
	login, and can know the BMI and r	metabolic rate each day.					
Brief	User submits a request to apply for	r membership					
Description	◇/、)(())(1821					
Flow of Event	User	System					
7 O CHIANO	 Enter the Login screen. Press Register Fill in the subscription details Login the username 	 3) Display the Registration screen 5) Check if the username is repeated 5.1) If username is not repeated 5.1.1) Sign up successfully 5.2) If username is repeated 5.2.1) Notification that the username is repeated 					
Exceptions	Not complete information, the inte username	rnet not connected, repeat					

 Table 3.2 Description of Use Case Registration

Table 3.2 is the description of Use Case Register. Users are required to login.Registration must have the application, and users must open the application first (Pre-

Condition). When the user was successfully subscribed, the username password are provided for login. He is able to know the BMI and daily metabolic rate (Post-Condition). Users must apply for a membership (Brief Description). The process of the user and the system would be displayed in the Flow of Event, if the user was not able to use the system (Exceptions), it was indicative that data was not complete, or the internet was not connected. Username must be repeated, which could be displayed as Sequence Diagram in Figure 3.5.



Use Case Name	Cal Burn Today				
Actor	User				
Pre-Condition	Users must first confirm then	nselves (Login)			
Post-Condition	Users know the rate of calorie	es burned that day.			
Brief Description	Show user information				
Flow of Event	User	System			
Clin o	 Enter the Login screen Enter the main page The user screen displays the metabolic rate. 	 3) Find the metabolic rate from the database by searching from username 4) The system displays the user's metabolic rate 			
Exceptions	Not complete information, th username	e internet not connected, repeat			

Table 3.3 Description of Use Case Cal Burn Today

Table 3.3 showed the descriptions of the Use Case Cal Burn Today, where users were able to use the Cal Burn Today system. Users must first confirm themselves in the Login (Pre-Condition) and users could know Calorie consumption rate of that day (Post-Condition), through the brief description system. The procedure between the user and the system was shown in the Flow of Event. If the user was unable to use the system (exceptions), it was indicative that the information was not complete, or the internet was not connected and username had to be repeated. The Sequence Diagram is shown in Figure 3.6.



Use Case Name	Weight Loss Today							
Actor	User							
Pre-Condition	Users must first confirm themse	lves (Login)						
Post-Condition	Users know the weight loss of the	hat day						
Brief Description	Display user information							
Flow of Event	User	System						
CLUT O	 Enter the Login screen The user screen will show the reduced weight of the day. 	2) Search for weight loss from the database by searching from username.3) The system shows the reduced weight of the user.						
Exceptions	Not connected to the internet, not logged in							

Table	3.4	Descri	ptions	of Us	e Case	Weight	Loss	Today
						0		•

From Table 3.4 was the descriptions of Use Case Weight Loss Today. Users were required to login and use the Weight Loss Today section, which users must first confirm themselves in the Login system. (Pre-Condition). Then, the user could know the weight of that day (Post-Condition), through the brief description system. The process between the user and the system is shown in the Flow of Event. If the user was unable to use the system (Exceptions), it was indicative that there was no internet connection or login was not performed. The Sequence Diagram is shown in Figure 3.7.



Use Case Name	Cal Today Total	
Actor	User	
Pre-Condition	Users must first confirm then	nselves (Login)
Post-Condition	Users know the remaining co	nsumption rate of that day.
Brief Description	Display user information	
Flow of Event	User	System
CHIAN CHIAN	 Enter the Login screen Enter the main page The user screen will display the remaining calories that can be consumed that day. 	 3) Find the remaining calories that can be consumed that day from the database by searching from username. 4) The system shows the user's metabolic rate
Exceptions	Not connected to the internet	, not logged in
		, 06

 Table 3.5 Descriptions of Use Case Cal Today Total

Table 3.5 showed the descriptions of Use Case Cal Today Total. Users were required to login and used Cal Today Total, which users must first confirm themselves in the Login (Pre-Condition). Then the user knew the remaining consumption rate of the day (Post-Condition), through the system of the user profile (Brief Description). The steps between the user and the system were shown in the Flow of Event, if the user could not use System (Exceptions), the screen would show that there was no internet connection, or Login was not performed. The Sequence Diagram is shown in Figures 3.8 and 3.9.





Use Case Name	Recommend Workout		
Actor	User		
Pre-Condition	Users must first confirm themselves (Login)		
Post-Condition	User receives exercise instructions		
Brief Description	Show user information		
Flow of Event	User	System	
0 1/1/1	 Enter the main page Select the recommended exercise menu The user screen shows the appropriate exercise 	3) Find the right exercise from the database.4) The system shows proper exercise.	
Exceptions	Not connected to the internet, not logged in		
	TOT STA		

Table 3.6 Description of Use Case Recommend Workout

Table 3.6 showed the descriptions of the Use Case Recommend Workout. Users were require to login and use the Recommend Workout section, in which the user must first confirm them in the Login system (Pre-Condition). Then, the user received Recommended in the exercise (Post-Condition), through the system of the user profile (Brief Description). The procedure between the user and the system was shown in the Flow of Event. If the user was not able to use the system (Exceptions), no internet connection or Login would be shown. The Sequence Diagram is shown in Figure 3.10.



Use Case Name	BMI Calculate		
Actor	User		
Pre-Condition	The user must first confirm himself (Login) and the user		
	must apply for membership first.		
Post-Condition	Users know the current BMI		
Brief Description	Show user information		
Flow of Event	User	System	
En CHI	 Enter the Login screen Press the Register button Fill in the details The user screen will show the BMI level. 	 4) The system will calculate the BMI from weight and height. 5) BMI system 	
Exceptions	Not connected to the internet, Not subscribing		

Table 3.7 Description of Use Case BMI Calculate

From Table 3.7, the descriptions of Use Case BMI Calculate were shown. Users were required to login and use BMI Calculate, where users must first confirm themselves (Login) and apply for membership (Pre-Condition). Then, users knew the current BMI (Post-Condition), through the system to display the information of the user (Brief Description). The steps between the user and the system were shown in the Flow of Event, if users were not able to use the system, exceptions would be shown, to indicate that there was no internet connection or subscription was not performed, The Sequence Diagram in shown in Figure 3.11.



Use Case Name	Show Food Cal and Activity		
Actor	User		
Pre-Condition	Users must first confirm themselves (Login)		
Post-Condition	Know the list of activities that have a metabolic rate		
Brief Description	Showing calories of food and activities		
Flow of Event	User	System	
CHINA CHINA	 Enter the Login screen Enter the main page Select the activity menu Select the activity menu The user screen shows the food searched from the database. 	 4) Food search system from the database 5) Food display system that searches from the database 	
Exceptions	Not connecting to the internet, not subscribing		

Table 3.8 Description of Use Case Show Food Cal and Activity

Table 3.8 showed the descriptions of the Show Food Cal and Activity Case. Users were require to login and use the Show Food Cal and Activity section, where users must confirm themselves before Login (Pre-Condition). From then on, the users knew the list of activities that had a metabolic rate (Post-Condition), through the brief description system. The process between the users and the system was shown in the Flow of Event. If the user was unable to use the system, Exceptions would be shown, indicating that there was no internet connection or subscription was not perform. The Sequence Diagram is shown in Figure 3.12.


Use Case Name	Add Activity		
Actor	User		
Pre-Condition	System users must first confirm themselves (Login)		
Post-Condition	Success confirmation system		
Brief Description	Users add information		
Flow of Event	User System		
Exceptions	 Enter the Login screen Enter the "Add Activity" page. Enter the information. Enter the information. Enter the activity name Enter the calories Select activity type Press the record button. 7) The user screen displays a confirmation message from the system.	 5) The system records the information into the database. 6) The system displays a message confirming the recording. 	
Exceptions	No internet connection, no Admin ID		

Table 3.9 Description of Use Case Add Activity

Table 3.9 showed the descriptions of Use Case Add Activity. Users were required to login and use the Add Activity, where the users must first confirm (Login) (Pre-Condition). Then the system user Successful confirmation (Post-Condition) was shown through the brief description system. The procedure between the user and the system was shown in the Flow of Event. If the user was unable to use the system. (Exceptions), it was indicative that there was no internet connection or no administration ID. The Sequence Diagram is shown in Figure 3.13.



Use Case Name	Search Food		
Actor	System administrator, user		
Pre-Condition	The system administrator and the user must fill in the information they need to search.		
Post-Condition	Show the information obtained from the search		
Brief Description	Show search items		
Flow of Event	User	System	
iten o CHIL	 1) Enter the Login screen 2) Enter the main page 3) Fill in the information you want to search. 4) Press the search button 7) The user screen shows results from the search. 	 5) Search system from the database 6) Information display system 	
Exceptions	Not internet connection, wro	ng keywords	

Table 3.10 was the description of Use Case Search Food. Users were required to login and use the Search Food section, in which the users needed to fill in the information to search (Pre-Condition). Then the users displayed the information obtained from the search (Post-Condition), through the system to display the search list (Brief Description). The procedure between the user and the system was shown in the Flow of Event. If the user was unable to use the system (Exceptions), no internet connection or wrong keywords would be displayed. The Sequence Diagram is shown in Figure 3.14.



Use Case Name	Edit Data		
Actor	System administrator		
Pre-Condition	The system administrator and the user must fill in the information		
	they need to search.		
Post-Condition	Show the information obtained from the search		
Brief Description	The System administrator wants to find information.		
Flow of Event	User System		
CHIANG	 1) Enter the Login screen 2) Enter the main page 3) Select the information you want to edit. 6) The user screen shows the results from the selection. 	 4) Edit information 5) The system displays a confirmation message box. 5.1) If "Yes" is selected, the system will edit the information. 5.2) If "No" is selected, the system will not edit the information. 	
Exceptions	Not connected to the internet, no	data is selected.	

Table 3.11 Description of Use Case Edit Data

Table 3.11 showed the details of Use Case Edit Data. The system administrator could login and use the Edit Data section, where the administrator and the user must enter the information to search (Pre-Condition). Then the administrator showed the information obtained from the search (Post-Condition), through the system required to search for information (Brief Description). The procedure between the user and the system was shown in the Flow of Event. If the user was not able to use the system (Exceptions), "no internet connection or no data selected" would be displayed. The Sequence Diagram is shown in Figure 3.15.



Use Case Name	Delete Data		
Actor	System administrator		
Pre-Condition	The administrator must select the data to delete.		
Post-Condition	Show the information obtained from the search		
Brief Description	The administrator wants to delete the data.		
Flow of Event	User	System	
a where	 Enter the Login screen Enter the main page Select the data you want to delete. Show results from selection 	 4) The system displays a confirmation message box. 4.1) If "Yes" is selected, the system will delete the data. 4.2) If "No" is selected, the system will not delete the data. 	
Exceptions	Not connected to the internet, no	data is selected.	

Table 3.12 Description of Use Case Delete Data

Table 3.12 showed the details of Use Case Delete Data. The system administrator was required to login and use some of Delete Data, where the administrator must select Deleted Data (Pre-Condition). Then the administrator showed the information obtained from the search (Post-Condition), through the administrator wanting to delete the brief description. The procedure between the user and the system was shown in the Flow of Event. If the user was unable to use the system (Exceptions), "no internet connection or no data selected" would be displayed. The Sequence Diagram is shown in Figure 3.16.



5.3 Application structure



Figure 3.16 showed the application structure starting from logging into the system. (1) Then it would be divided into the main screen (Home screen). (2) This section would divide the sub-categories into food. (Food), Activity recording, Weight History, Meal History. Each category was divided into sub-details as shown in Figure 3.15. Registration section (3) was divided into sub-categories, including 3.1 BMI calculation.



5.4 Entity Relationship Diagram

Figure 3.18 Entity Relationship Diagram of the application

From the figure 3.17 Entity Relationship Diagram of the application, the diagram showed the relationship of the system in each category, starting from the table of members which was related to the table of MemberDetail to the relationship of the system to the table of Foodselect and Foodrecommend. Also, the table of members also showed the relationship to the table of Sportselect and Sportrecommend.

6. Data Analysis

The Android system is able to store persistent data in many different machines, depending on the developers and application's suitability. It could be summarized as follows.

key-value pairs such as "ring", "slient") ("rec_id", 32) etc., suitable for storing a small amount of data, such as Setting value of the app, (font size, color, options ...).

as Text or general information.

memory, in a public manner.

- SQLite Database: stored in a database, suitable for storing large amounts of data, in which this research chose to use a database, with Android supporting database usage SQLite. It was a highly efficient and popular system in portable devices, for query usage, and recording. Reading would work like SQL Database in general.

Creating Database and Table

Creating a Database / Table was similar to preparing a file cabinet before storing data. If it was a database on the computer or server, we would create a database with separate tools such as MsSQL, PhpMyAdmin. However, for mobile devices / table or portable devices, that particular application must create a database (Create the first time only once, the next time you could read / write normally).

SQLiteDatabasedb; db = SQLiteDatabase.openDatabase(String path, SQLiteDatabase.CursorFactoryfactory, int flags)

Open the database according to flags mode. When opening the database and then get the reference value, continue to use, such as create a table, add row, and search. If there was an error, it would throw into SQLiteException.

Parameter value

path: the path and file name of the database.

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factory: The factory class options would be called to create an

instance, when querying. Normally, default was null.

flags: The mode of database usage was OPEN_READWRITE

OPEN_READONLY CREATE_IF_NECESSARY.

Query with execSQL

After opening the database, use execSQL to run queries, such as,

creating, tables or inserting rows.

db.execSQL("create table mytable1(" +"_recID integer PRIMARY KEY autoincrement," +"name text, "+ "phone text);");

db.execSQL("insert into mytable1(name, phone) values ('adiCET', '123455'0;");

Database creation and insertion

1. Create a new project: This example used the name SQLitetest

and the Package name was com.adicet.sqlitetest

2. Open the MainActivity.java class file, type the following codes:

packagecom.adicet.sqlitetest; //com.adicet.sqlitetest importandroid.app.Activity; importandroid.database.SQLException; importandroid.database.sqlite.SQLiteDatabase; importandroid.database.sqlite.SQLiteException; importandroid.os.Bundle; importandroid.widget.Toast;

public class MainActivity extends Activity {
 private final String DB_NAME = "mydbadicet";
 SQLiteDatabasedb;

@Override
Protected void onCreate(Bundle savedInstanceState) {
 super.onCreate(savedInstanceState);
 setContentView(R.layout.activity_main);

try {

String Path="/data/data"+getPackageName()+"/"+DB_NAME; db = SQLiteDatabase.openDatabase(Path, null, SQLiteDatabase.CREATE_IF_NECESSARY); Toast.makeText(this, "ເປີດ DB ແດ້ວ!", Toast.LENGTH_SHORT).show(); } catch(SQLiteException e) { Toast.makeText(this, e.getMessage(), Toast.LENGTH_SHORT).show(); }

//Transaction SQL

try { db.execSQL("create table mytable (" + " id INTEGER PRIMARY KEY autoincrement," + "name text," + "phone test); "); Toast.makeText(this, "Create Table ", 1).show(); // insert db.execSQL("insert into mytable(name, phone)" + "values ('att', '027315555');"); db.execSQL("insert into mytable(name, phone)" + "values ('atthapong', '021235555');"); Toast.makeText(this, "insert record แล้ว", 1).show(); db.setTransactionSuccessful(); } catch(SQLException e1) { Toast.makeText(this, e1.getMessage(),1).show(); ł finally{ db.endTransaction(); } } }

For creating databases, besides using getPackageName (), we could

specify the package name directly, as shown in the following sample.

db = SQLiteDatabase.openDatabase("data/data/com.example.sqlitetest/mydbadicet", null, SQLiteDatabase.CREATE_IF_NECSSARY);

Data creation could be done only once, since the parameters were

set to SQLiteDatabase.CREATE_IF_NECSSARY, After the database had been created, tables and data insertion could be conducted.

db.beginTransaction(); db.execSQL("create table mytable ... db.execSQL("insert into mytable ... db.setTransactionSuccessful(); use db.endTransaction();

Using the SQLiteOpenHelper wizard

Creating a database and tables, queries could be directly commanded. However, Google has created an abstract class named SQLiteOpenHelper, and it was recommended to extends the SQLiteOpenHelper class, for actual implementation, as follows.

```
public class DatabaseHandler extends SQLiteOpenHelper {
  //
  private static final int DATABASE_VERSION = 1;
  private static final String DB TABLE NAME = "mydbadicet";
  private static final String DB_TABLE_CREATE =
     "CREATE TABLE" + DB_TABLE_NAME + "(" +
     COLUMN NAME1 + "TEXT,"+
     COLUMN NAME2 + " TEXT0;";
  DatabaseHandler(Context context) {
          / Databse_adicet,
          Super(context, DATABASE_NAME, null,
DATABASE_VERSION);
  }
  @Override
  public void onCreate(SQLiteDatabasedb) {
     db.execSQL(DB_TABLE_CREATE);
                                                    //
  }
  // DATABASE_VERSION
  @Override
  public void onUpgrade(SQLiteDatabasedb, intoldVersion, intnewVersion) {
     android.util.Log.w(TABLE_NAME,
          "Upgrading database to new version, which will destroy all old
data");
     //
     db.execSQL("DROP TABLE IF EXISTS ชื่อตาราง");
     onCreate(dB);
  }
}
```

Required class structure methods were: 1) constructor methods, 2)

onCreate () and 3) onUpdate ()

If a table has not been created, it could be created via on Update ().

When adding numbers to DATABASE_VERSION, the system would drop the original database and create a new one for changing the structure or upgrading the version. Therefore, if there was important information, data backup must be conducted first.

Keeping constant values

In popular practice, column names were stored in constants such as COLUMN_NAME, for easy access to classes, and other related parts.

Query

There were two main forms.

1. Use rawQuery as a form of use similar to using the base query,

for example

Cursor c1 = db.rawQuery("select count(*) as total from Tablename", null); Cursor c1 = db.rawQuery("select * from MyTable", null);

The cursor was a pointer, which was used to check and point to a

row.

1. Check the location isFirst (), isBeforeFirst (), isAfterLast ()

2. Point to the record moveToFirst (), moveToLast (), moveTonext

(), moveToPrevious (), move (n)

3. Read the value / data from the required column field, getint,

getString, getFloat, getBlob, getDa ^ te.

4. Read the structure or schema information, such as getColumnName, getColumnIndex using the query.

It was another form to read the data from a single table, by sending

respective 7 arguments, as follows.

If any argument was missing, specify it as null.

The study of the effects of weight control programs focused on changing eating

habits of overweight or obese students

This Quasi-experimental research compared the weight control programs which focused on changing eating habits of the experimental group and the control group. The research methods are as follows. 1. Population and sample group

The population consisted of 85 first to third-year undergraduate students in the Culinary Technology and Services Program, Suan Dusit University at Lampang Campus, who enrolled in the Science in Daily Life Course and whose waist circumferences were beyond the standards (>90 cm for men and > 80 cm for women).

The sample group was composed of 40 students whose waist circumferences exceeded the standards and who were voluntary and willing to participate in the research project. The purposive sampling method was used to select the sample group, which was divided into 20 in the control group and 20 in the experimental group. The two groups had undergone the following experimental conditions.

Control group (n=20)	Experimental group (n=20)	
- Enrollment in the Science in Daily Life	- Enrollment in the Science in Daily Life	
Course.	Course.	
Measurement of their weight, height, waist circumference and BMI before-after the implementation of the obesity surveillance	Measurement of their weight, height, waist circumference and BMI before- after the implementation of the obesity	
program (Appendix B)	surveillance program (Appendix B)	
- Activity record for weight loss (Appendix B)	 Activity record for weight loss (Appendix B) Application (Appendix A) Education activities Asawin Market Tour Activity Supermarket tour Activity 	

Control group (n=20)	Experimental group (n=20)	
- Knowledge and weight control	- Knowledge and weight control	
questionnaire before - after accessing the	questionnaire before - after accessing the	
Obesity Monitoring Program (Appendix	Obesity Monitoring Program (Appendix	
D).	D)	
V 115 T 1	S ros	
- TPB questionnaire before - after joining	- TPB questionnaire before - after	
the obesity surveillance program	joining the obesity surveillance program	
(Appendix C)	(Appendix C)	
	- Satisfaction questionnaire for using the	
	mobile application (Appendix E)	

2 Data and data sources

2.1 The primary data were derived from the adiCET Nutrition application, which displayed incorrect consumption management and basic information of obese users. Therefore, it was necessary to demonstrate the correct consumption management system as shown in the above-mentioned diagrams about the program steps in a correct connection with the users, so that they could implement them in their actual daily lives. The steps started with the log-in of the users after registration. After that, they recorded relevant basic information as well as information on the daily basis. The system, in turn, stored and analyzed the data by receiving and transmitting the data on a daily basis. The goals were to lose weight, waist circumference, BMI and daily calculation of exercise and consumption energy of the sample group. The sample group was able to test the system by selecting the steps to use the application in each category as well as to specify their daily achievement goals through summaries of their consumption and exercise. The data in each category contained basic information and the information that users recorded.

2.2 The primary data derived from the activity log books included their height. The following data were used as the initial values, including knowledge about food and weight control and variables in the Planned Behavior theory, the clinical results included weight, waist circumference, BMI and other behavioral information affecting weight control (e.g. number of exercise times, information about weight control from media or information exchange among group). The questionnaire was used to assess knowledge about food and weight control. Scales were used to measure their weight and height. A scale strap was used to measure waist circumference at the narrowest point above the hips. One decimal was used to record the data into the log books. Furthermore, the data included number of exercise or activity days in a week, number of days discussing about food control among friends, a search for relevant information from other media in a week, and number of day going to parties or eating out with friends in a week.

3 Data collection methods and instruments

3.1 The research instruments were divided into:

Appendix)

3.1.2 Planned activity logbook consisted of knowledge about diet and exercise, body weight, waist circumference, body mass index, and other behavioral information that affected weight control. (Such as the number of times of exercise, information from various media on weight control, discussing, exchanging information between groups, etc.). Record of eating, exercise activities, number of exercise days, or activities must be exerted in a week. Other information included number of days having a conversation with friends on food control, information from various media in a week, number of days going to a party, or eating with a large group of friends in a week. (According to the documents in the appendix)

3.1.3 TPB diet questionnaire had the following details

3.1.3.1 Exercise movement behavior

Exercise movement behavior referred to the frequency of exercise movement behavior action which consisted of 3 sub-behaviors, namely 1) continuous exercise of large muscles such as field playing, ball playing, climbing, cycling, swimming, at least 30 minutes a day. 2) Activities other than exercising large muscles that caused the body to feel tired, sweat or faster heart beat at leisure, such as, running, dancing, and playing sports, etc., 3) avoiding stationary behavior such as watching television, listening to music, playing computer games for a long time. These variables could be measured by using the exercise movement questionnaire, which the researcher created, by applying the movement behavior questionnaire from various research work, (Sukhawadee, 2005: 115; Hiranpruek, 2005: 125-6; Mahawana, 2005: 68; Baker et al. 2003: 192). Measurements were made by the respondents to indicate that in the last 12 weeks round, whether they could do them or not, or how often they carried out the exercise movement behavior. The frequency ranged from never doing it to doing every day, with the scores between 1 and 7, respectively. Those who received high scores showed that they were more active than those who had low scores.

3.1.3.2 Food consumption behavior

Food consumption behavior referred to the frequency of food consumption behavior action. This variable could be measured by using the food consumption questionnaire, which the researcher created, by applying the food consumption behavior questionnaire from various research work (Sukhavadee, 2005: 115; Hiranpruek, 2005: 125-6; Coner et al. 2002: 196; Baker et al., 2003: 192). The measurements were made by the respondents to indicate that in the last 12 weeks, how often they consumed food, ranging from never to every day, with the scores between 1 and 3, respectively. Those who received high scores showed that they had better food consumption behavior than those who got low scores.

behavior 3.1.3.3 The Attitude towards exercise movement

The attitude towards exercise behavior referred to both positive and negative assessments of the students on exercise movement behavior, measured by using semantic classification metrics, which used dual polar adjectives, according to Osgood's form et al. Each answer had a score between -3 and +3. Those with more positive scores, indicated that there was a good attitude towards exercise movement behavior.

3.1.3.4 The Attitude towards food consumption

behavior

The attitude towards food consumption behavior referred to both positive and negative assessments of students' behavior on food consumption behaviors, measured by using semantic classification metrics, which used a pair of adjectives, according to Osgood's form et al.. Each answer had a score between -3 and +3. Those with more positive score indicated that there was a good attitude towards food consumption behavior.

3.1.3.5 Conformity to subjective norm in the exercise

movement

Conformity to subjective norm in the exercise movement meant that students perceived that the person who was important to them, most of them did or wanted them to do, or did not do the exercise movement behavior, measured by using the 7 point rating scale which the researcher created, based on the idea of creating a measurement model to the direct Conformity to Subjective Norm of Ajzen (Ajzen, 2002: 6). Each answer had a score from -3 to +3 and those who got higher scores were those who followed the reference group in the exercise movement rather than those with low scores.

3.1.3.6 Conformity to subjective norm to the food consumption group

Conformity to subjective norm to the food consumption group meant that students perceived that people who were important to them, most of whom had done or wanted them to do or did not do on food consumption behaviors, measured by using the 7 point rating scale which the researcher created, and based on the idea of creating a measurement model to the direct Conformity to Subjective Norm of Ajzen (Ajzen, 2002: 6). Each answer had a score from -3 to +3 and those who got higher scores were those who were more likely to refer to the food consumption group than those with low scores. 3.1.3.7 Perception of exercise movement behavior

control

Perception of exercise movement behavior control meant students' thinking in assessing the difficulty and ease of performing the exercise movement behavior, and belief that they could control how to perform the exercise movement behavior. It was measured by using 7 point rating scale, created by the researcher from the idea of creating a measurement model to the direct Conformity to Subjective Norm of Ajzen (Ajzen, 2002: 7). Each answer had a score from -3 to +3, and the higher score showed that there was a perception that then could control the exercise movement behavior more than those who with low scores.

control

Perception of food consumption behavior control referred to the students' ideas in assessing the difficulty and ease in order to do on food consumption behaviors and beliefs that could control how much food consumption behavior. It was measured by using a 7 point rating which the researcher created and based on the idea of creating a measurement model to the direct Conformity to Subjective Norm of Ajzen (Ajzen, 2002: 7), each answer had a score from -3 to +3, and those who received higher scores showed that they perceived that they could control food consumption behavior more than those who received low scores.

3.1.3.9 Intent on the exercise movement

Intent on the exercise movement referred to the intention, effort, and planning of the students to do or did not perform the exercise

movement which was consistent with the movement behavior defined in item 1. It was measured by using a 7 point rating scale which the researcher created based on the idea of creating a measure of intent to do on the behavior of Ajzen (Ajzen, 2002: 4). The scores ranged from -3 to +3, and those who got higher scores were those who were more motivated to exercise than those who received low scores.

3.1.3.10 Intention on food consumption

Intention on food consumption referred to the intention, effort and planning of the student to do or did not do on food consumption behavior which was consistent with the food consumption behavior defined in item 1. It was measured by using a 7 point rating scale which the researcher created based on the idea of creating a measure of intent in the behavior of Aizen (Ajzen, 2002: 4). The scores ranged from -3 to +3, and those who received higher scores were those who intended to consume more food than those who received low scores.

3.2 Data collection methods

The control group

The researcher collected general characteristics of the sample group, and recorded them in the application on mobile phone adiCET Nutrition, including the height and the following information was for initial values including food knowledge and weight control, dependent variables, planned behavior theory. The clinical results were body weight, waist circumference, body mass index, and other behavioral data that affected weight control. (Such as the number of times of exercise, receiving information from various media on weight control, talking, exchanging information between groups, etc.). The questionnaire was used to measure their knowledge on food and weight control. A digital scale was used to measure body weight and the participants were asked to wear thin clothes without shoes. Each measurement used the same section in the same period. A wall mounted scale was used to measure their height. A standard gauge strap was used to measure their waist circumference at the narrowest point above their hips. The data were recorded with one decimal.

After that, the researcher distributed the activity log books and explained about the data recording in groups, each group consisting of 10 members. Activities that must be recorded included the number of exercise days, or activities that must be exerted in one week, the number of days spent with friends talking about food control, information from various media in a week, the number of days going to a party, or eating out with the large group of friends in a week.

The experimental group

group, and had to participate in activities 3 times over a 3 month period. Including knowledge dissemination, Asawin market tour and supermarket tour.

Educational activities consisted of providing general knowledge about obesity, various complications, low energy foods, and concepts of eating behavior in the Science in Daily Life Course, at Suan Dusit University, Center Nonformal education, Lampang. In addition, the sample group also received a sample of food menus for weight control. The sample group was divided into a group of ten and it took about 45 minutes.

Tour Activity: "Aswin Market" (The place that sold dinner for students, tourists, local residents and was a famous and popular place in Lampang

province), together with food expert instructors, in order to recommend food which should be eaten, foods that should be avoided, and the energy of each food type. The sample groups participated in a group activity, 10 people per group, and the activity took about 45 minutes. There was an off-site activity, ready to be educated by a food expert professor. In addition, the researcher also distributed DVD media "Aswin Market Tour" to provide self-study examples.

The third activity was the "supermarket" tour (Big C) together with food expert instructors, in order to recommend foods that should be eaten, foods that should be avoided, to read food labels to study energy in each type of food. Each group consisted of 10 members, the activity took about 45 minutes. In addition, the researcher also distributed the DVD media "supermarket tour" in order to provide self-study samples. If readers were interested in more details about the intervention or media, they could contact the researcher directly.

The intervention in the experimental group was designed to change the eating behavior by increasing their self-efficacy in food control from the experimental group, planning what to eat, and monitoring every month during the study period. They also received social support from group activities. The intervention was meant to cultivate a good attitude toward food control by providing knowledge and organizing the market tours, where foods were sold to the students. Moreover, the intervention also aimed to motivate and change their behavior.

4 Data analysis

4.1 The researcher used data analysis from adiCET Nutrition mobile application. The descriptive statistics was used to analyze the data for frequency, percentage, mean, and standard deviation. 4.2 The data from the activity logbooks were statistically analyzed for frequency, percentage and mean to distribute general characteristics of the control and experimental group. The repeated measures ANOVA was applied to compare differences of the variables. The common variables were composed of weight, number of times of times of weighing, weight control history, and the total scores from the TPB questionnaire. The intention to treat techniques was used to analyze the data.

Survey on the satisfaction with the implementation of the mobile application for obesity monitoring among the samples.

1. Population and samples

The population consisted of 85 first to third-year undergraduate students in the Culinary Technology and Services Program, Suan Dusit University at Lampang Campus, who enrolled in the Science in Daily Life Course and whose waist circumferences were beyond the standards (>90 cm for men and > 80 cm for women).

The sample group was composed of 40 students whose waist circumferences exceeded the standards and who were voluntary and willing to participate in the research project. The purposive sampling method was used to select the sample group, which was divided into 20 in the control group and 20 in the experimental group. The two groups had undergone the following experimental conditions.

2. Information and data sources

For information in this study, the primary data were obtained from general information of the respondents, including their gender, age, education level, monthly income, design aesthetic information, nutritional information and exercise, and information about the operation of the system.

3 The research instruments

3.1 The research instruments

The questionnaire was divided into 4 parts as follows

Part 1: General information of the respondents, including gender, age, education level, monthly income.

Part 2: Information on the aesthetics of the application design, including color within the application, nutrition classification, and exercise with interesting images, beautiful interface design, suitable font size, and balance of color usage in the application.

Part 3: Information on nutrition and exercise, including the type of food in each meal and exercise, food information and adequate exercise which was sufficient for understanding. With food and exercise classification information that could be easily searched, searching for nutrition and exercise information, modernity of nutrition and exercise information.

Part 4: System performance, speed of response, data access and data recording were convenient and fast. Formatting within the application was easy to use. Customization of the usage of the application and satisfaction with overall usage were considered.

Measurement of user satisfaction levels with adiCET Nutrition applications, the researcher used the 5-point rating scale based on the Likert Scale (Sripaya, 2002) as follows: 5 points meant the satisfaction of users being at the highest level.

4 points meant the satisfaction of users being at a high level.

3 points meant the satisfaction of users being at a moderate level.

2 points meant the satisfaction of users being at a low level.

1 point meant the satisfaction of the user being at the lowest level.

Interpretation of the average scoring criteria for each level by calculating for the interval scale according to the formula, the formula to calculate for the width of the class was equal to 0.8, which could be interpreted as follows.

 $\frac{(Max - Min)}{Number} = \frac{5-1}{5} = 0.8$

The mean between1.00 - 1.80 least demand.The mean value between1.81 - 2.60 little demand.The mean between2.61 - 3.40 moderate demand.The mean value between3.41 - 4.20 a lot of demand.The mean between4.20 - 5.00 the most demand.

3.2 Data collection methods

3.2.1 The sample group in this experiment was required to record the data every day, for a consecutive period of 12 weeks, with the use of the user name and password. An appointment was made for them, to listen to the application usage data, and the initial data of the group, for example, weight, pressure, heart rate, etc. in each week. The sample group received additional information on correct and suitable nutrition knowledge from nutritionists, which could be used to support and promote correct food consumption behavior. A survey on the satisfaction with the implementation of mobile applications in obesity surveillance applications was conducted with the sample group.

3.2.2 For the form, description, application characteristics or applications related to nutrition of each source, there were different sources and descriptions. Most of the download rates or rating of data sources enabled them know the usage characteristics of the application, which adiCET Nutrition would have all the differences for users, starting from user's basic information recording, food and nutrition information recording, health record, exercise record, exercise advice, advice image and nutrition, health risk assessment, nutrition analysis in each meal, user notification system, application usage guidance, graph display and pictures that could be placed on social media automatically.

4. Data analysis

4.1 The descriptive statistics was used to analyze the data to describe the variables, such as, frequency, percentage, mean, and standard deviation.

4.2 The paired t-test was used to analyze the inference data in an attempt to compare the mean differences before and after the implementation or the application.

Chapter 4

Results

Results of the development of the mobile application in promoting obesity surveillance in food consumption according to nutritional principles

1. Review of the program requirements from the literature review and the functions of the program

Body weight and BMI are used to assess the progress and results of weight loss. They indicate whether the methods or eating habits in practice are efficient and effective to reach the goals. As a consequence, an effective weight loss approach should be based on the eating and exercise planning in order to attain the goals quickly and safely. The functions of this application should be as follows:

- Function of calculating of food calories
- Function of calculating calories of activity or exercise
- Function of calculating the BMI to determine which category your is classified into
- Function that suggests proper exercise
- Function showing the amount of calories consumed each day
- Function telling how many calories you eat in each meal
- Function telling the amount of calories of activity or exercise each day

Function summarizing the total calories of eating and activities or exercise to calculate the weight loss on a daily basis

2. Design and writing the program with computer languages

2.1 Data dictionary

Database design was a way to create a database, in the form of data relationships. Database design features are way to manage various data in the form of data tables. Data storage included food information, selected food information, user profile information, activity information, information of selected activities, processing data, health information, data storage in Java programming language, tools used in Android Version 3.3.1 development, data storage with Sql lite Version 3.26.0.



Table Name: member			
Attribute	Description	Attribute Domain	Туре
MB_ID	User ID	Value 0-9	int
MB_Email	User email	No more than 45 characters	Varchar(45)
MB_Name	User name	No more than 50 characters	Varchar(50)
MB_Password	User password	No more than 12 characters	Char(12)
MB_Birthday	User's birth date	Numerical value	Data/time
MB_Gender	User gender	No more than 1 character	Char(1)
MB_Age	The age of users	Value 0-9	int(11)
MB_Weight	The weight of the user	Decimal number	Decimal(10,2)
MB_height	The height of the user	Decimal number	Decimal(10,2)
Username	User main name	No more than 55 characters	Varchar(55)
Primary Key: M	IB_ID		
Foreign Key: -	I Pland	PRIC	1151

Table 4.1 Membership information

Table 4.1 showed the member information table, consisting of features displays user attributes. The description section showed the details of the user, with Attribute Domain and Type as an indication of the type of data.

Description	Attribute Domain	Туре
Food code	Value 0-9	Int
The name of the food	No more than 40 characters	Varchar(40)
Calories of food	Value 0-9	int(11)
Food size	No more than 40 characters	Varchar(40)
Food size	Value 0-9	int(40)
Food size	No more than 40 characters	Varchar (40)
Type of food	No more than 30 characters	Varchar (30)
Picture of food type	No more than 100	Varchar (100)
	Description Food code The name of the food Calories of food Food size Food size Food size Type of food Picture of food type	DescriptionAttribute DomainFood codeValue 0-9The name of the foodNo more than 40 charactersCalories of foodValue 0-9Food sizeNo more than 40 charactersFood sizeValue 0-9Food sizeValue 0-9Food sizeValue 0-9Food sizeNo more than 40 charactersFood sizeNo more than 30 charactersType of foodNo more than 30 charactersPicture of food typeNo more than 100

Table 4.2 Food information

Table 4.2 showed food data table consisting of attributes that showed food characteristics. The description showed food details, with Attribute Domain and Type as an indication of the type of data.

RAJABHA
Table Name: foodselect			
Attribute	Description	Attribute Domain	Туре
Fs_id	Code of food that the user chooses	Value 0-9	Int
Fs_name	The name of the foodNo more than 40that the user choosescharacters		Varchar(40)
Fs_cal	Calories of food that users choose		
Fs_unit	The amount of food that users choose		3
Fs_sunit	The unit of food that the user chooses	No more than 50 characters	Varchar(50)
Username	Name of the user	No more than 50 characters	Varchar(50)
Fs_meal	The meal of the user selected	No more than 50 characters	Varchar(50)
Primary Key: fs_	id		>
Foreign Key: Use	ername Reference to: memb	per 3	

Table 4.3 Food selection information

Table 4.3 showed food selection data, consisting of attributes that showed the characteristics of the food selection in each meal of the user. The description section showed the details of the food that was selected in each meal, with an Attribute Domain and Type that indicated the type of data.

Table 4.4 Member/user detai	s
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Table Name: memberdetail			
Attribute	Description	Attribute Domain	Туре
MD_id	Code of recording	Value 0-9	Int
MD_weight	Record the weight of the user	No more than 10 characters	Varchar(10)
MD_date	Record the current date of the user	Numerical value	Date/time
MD_status	Save user status	No more than 10 characters	Varchar(10)
MB_id	Name of the user	No more than 50 characters	Varchar(50)
username	Name of the user	No more than 50 characters	Varchar(50)
Primary Key: md_id	NEA		/
Foreign Key: Userna	me Reference to: memb	er B	

Table 4.4 showed member information details, consisting of the attributes displaying the features of the basic user information of users. The Description section displays the details of the user's basic information, with an Attribute Domain and Type as an indication of the type of data.

RAJABHA

Table Name: activityrecommend			
Attribute	Description	Attribute Domain	Туре
AR_id	Code of activity	Value 0-9	Int
AR_name	Name of activity	No more than 40 characters	Varchar(40)
AR_cal	Calories of activity	Value 0-9	Int(11)
AR_unit	Number of activities	Value 0-9	Int(11)
AR_sunit	Units of activity	No more than 40 characters	Varchar(40)
AR_cata	Types of activities	No more than 30 characters	Varchar(30)
AR_image	Picture of activity type	No more than 100 characters	Varchar(100)
Primary Key: sr_id			
Foreign Key: -	SEA	NO E	

Table 4.5 Recommended a	activity	information
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Table 4.5 showed the data of the activity recommendation, consisting of attributes showing the features of the recommended exercise activities. The Description section showed details of recommended exercise activities, with Attribute Domain and Type that indicated the type of data.

RAJABHAT

Table 4.6 Data on	activity detail
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Table Name: activitydetail			
Attribute	Description	Attribute Domain	Туре
AD_id	Code of activity that the user chooses.	Value 0-9	Int
AD_name	The name of the activityNo more than 40Valuethat the user choosescharacters		Varchar(40)
AD_cal	Calories of activities thatValue 0-9Inusers choose		Int(11)
AD_unit	Number of activities that users choose	Value 0-9	Int(11)
AD_sunit	The unit of activity that the user chooses	No more than 50 characters	Varchar(50)
MB_id	Name of the user	No more than 50 characters	Varchar(50)
username	Name of the user	No more than 50 characters	Varchar(50)
Primary Key: ss_id	SACIO	JISE	
Foreign Key: User	name Reference to: member	13.95	E

Table 4.6 showing information activity details consisted of features showing the attributes of the selected exercise activity details. The Description section showed the details of the selected exercise activity, with Attribute Domain and Type that indicated the type of data.

Table Name: estimatedata				
Attribute Description		Attribute Domain	Туре	
SD_id	Code of calculations	Value 0-9	Int	
SD_num	number of times	No more than 40 characters	Varchar(40)	
SD_sum	Calculation results	No more than 40 characters	Varchar(40)	
SD_sug1	Instructions for breakfast	No more than 150 characters	Varchar(150)	
SD_sug2	Instructions for lunch	No more than 150 characters	Varchar(150)	
SD_sug3	Instructions for dinner	No more than 150 characters	Varchar(150)	
SD_data	Date of calculation	Numerical value	Date/time	
Username	Name of the user	No more than 50 characters	Varchar(50)	
MB_id	Name of the user	No more than 50 characters	Varchar(50)	
Primary Key: SD_id				
Foreign Key: Userna	Foreign Key: Username Reference to: MB_id			

Table 4.7	' Data	on	suggested	activities
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Based on Table 4.7, the suggestion data table consisted of attributes that displaying the data estimation features. The description section showed details of data estimation, with Attribute Domain and Type that indicated the type of data.

Table 4.8 Health data	of	users
-----------------------	----	-------

Table Name: Heal	th		
Attribute	Description	Attribute Domain	Туре
HD_id	Health information code	Value 0-9	integer
HD_num	The number of times	No more than 40	Varchar(40)
	that health records were	characters	
	recorded	JIn.	
HD_Bloodslevel	Blood glucose level data	No more than 50	Varchar(50)
		characters	
HD_Fatlevel	Blood fat data	No more than 50	Varchar(50)
12	Triglyceride level data	characters	$\langle \rangle$
HD_LDL	(LDL)	No more than 50	Varchar(50)
	Data of Low-density	characters	
	lipoprotein (LDL)		2
HD_HDL	(HDL)	No more than 50	Varchar(50)
-	Data of High-density	characters	
	lipoprotein (HDL).	133	
HD_Liver	Liver enzyme function	No more than 50	Varchar(50)
111	ZAG	characters	H
HD_kindey	No more than 50	No more than 50	Varchar(50)
12	characters	characters	\mathbb{K}
HD_Heartrate	Heart rate	No more than 50	Varchar(50)
1		characters	
HD_Bpressure	Blood pressure level	No more than 50	Varchar(50)
	N D	characters	
HD_data	Recording time	Numerical value	Date/time
MB_id	Name of the user	No more than 50	Varchar(50)
		characters	
Username	Name of the user	No more than 50	Varchar(50)
		characters	
Primary Key: H_id			
Foreign Key: User	name Reference to: MB_id		

Table 4.8 showed health information, consisting of attributes showing the characteristics of user health information section. The description displayed the details of the user's health information, with an Attribute Domain and Type that indicated the type of data.



1.2 Project details

1.2.1 Map of the application, planning and tracking

weight loss



Figure 4.1 Application structure

Figure 4.1 showed the application structure starting from logging in to the system (1) and then divided it into the main Home screen, (2). This section would divide the sub-categories into Food, Activity recording, Weight history, Meal History. Each category was divided into sub-details as shown in Figure 3.15 and registration section, (3). Divided into sub-categories, including 3.1 BMI calculations.





1.2.2 Map of application, planning and tracking weight loss

1.2.3 Showed Details of the application structure

No.	Application page	Description
1	intro	Showing basic body mass index information Page
2	Index	All menu page
3	Register	Member registration page
4	BMI	Showing Body mass index information page
5	Health	Health record page
6	Food	Each meal record page
7	Activity	Save the activity menu page
8	Summary	Summary of the amount of energy used page
9	Suggestion	Food information and activity Suggestion page

 Table 4.9 Details of the application structure

Table 4.9 showed the details of the application structure, with the following application page: intro, Index, Register, BMI, Health Food, Activity, Summary, Suggestion, and with explanations as show in the table



1.2.4 User Interface Design

1.2.4.1 The basic body mass index information



Figure 4.3 Basic body mass index information page

1.2.4.1 This page displayed the basic body mass index information of users, consisting of basic advice, energy that should be received on a daily basis, classified by gender, i.e. 1,600 - 2,000 kcal for females and 2,000 -2,500 kcal for males divided into percentage of recommended daily dose, such as total fat 3 grams, equivalent to 5%, protein 0.8 g, etc.

page

1.2.4.2 All menus on the Home page



1.2.4.2 This page showed all the menus of the

application in the Home page. This figure illustrated all the menu icons on basic information, information on health, exercise and food for each meal, energy summary, and suggestions.

.

	Information
	Name
	Height Cm. Weight Kg.
/	Birthday Blood G
15	Waistline Cm. Gender
15	E-mail
	Save Data
	Calculator BMI
Z	
Figure 4.5 Me	mbership registration page

1.2.4.3 Subscription registration page

1.2.4.3 This page was for filling in the information of users who had not used the system before. They were required to fill out the information as specified by the system. For instance, new users were required to complete all fields, such as name, surname of the user, height, weight, date of birth, blood group, waist circumference, gender, and email. Once completed, click the button "Save data" to save data onto the system.

1.2.4.4 The body mass index information page

Body Mass Index of you! 24.3 !!! Kilogram/SquareMeter The criteria for the Asian populations Underweight 18.5 - 22.99 Overweight 23 Pre-obese 23 - 24.99 (At risk) Obese Class 1 25 - < 29.99</p> Obese Class 2 > 30 Evertice Class 2 > 30

Calculator BMI

Figure 4.6 The body mass index data page

1.2.4.4 This page showed the results of the body

mass index calculation of users who had previously recorded various information, including the body mass index details base on the criteria of the World Health Organization (1998).

1.2.4.5 Health record page

	() Health		
	Blood sugar level	mg/dL	
	Triglycerides	mg/dL	
	HDL	mg/dL	
/	LDL	mg/dL	
10	SGOT	mg/dL	9
- [2]	Renal function	mg/dL	1921
131	Heart rate	T/min	11:51
18/	Blood pressure	_mm.Hg	115-1
	SaveData		
2	👩 adicet		5
Figures 4.7 He	alth record page	BE	
E	J. Jako	The second	NIS

1.2.4.5 This page showed the details of the health information, which had to be specified in order to store the information for the first time. Users were required to specify their own health information, such as, blood sugar levels, blood lipid levels (HDL, LDL, triglycerides), liver enzyme activity, renal enzyme activity, heart rate, and blood pressure level.





and the amount of calories that the user consumed in each meal of the day, and then recorded the information of each meal. Users would know the amounts of calories consumed in each meal of the day.

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1.2.4.7 Activity menu recording page

1.2.4.7 This page displayed the activity menu

information. Users selected the activity and filled in the time period used for doing that activity, then recorded the data of each day activity. User could select various activity menus and fill in the amounts of time to do the activity, and then recorded the activity information.

	Summary	of energy	
	DD / MM / YY	02/11/60	
	Summary of en	ergy 2,250 _{Kilocal}	
	carbohydrates _ Fat _ Protein _	750 1,250 250	
	Summary of me	etabolism 400 Kilocal	-
1	Q. Su	ggestion	
CHIE	👩 a	dicet	E L
TANK		- All	
Figure 4.10 S	ummary page of us	ed energy	$\langle \mathbf{x} \rangle$
	RAIA	2.4.8 This page	showed the sum

of energy

information on the amount of energy each day, which was separated into a summary of the amount of energy from all the nutrients received for each day and a summary on the energy metabolism of the body. Users would receive a summary of the amount of energy each day in terms of nutrients received and metabolism.

This page showed the summary

1.2.4.9 The food information and recommended

Suggestion Q: Food : Breakfast Lunch Dinner salad or fruit Chicken breast or pollea egg Fresh milk or orange juice mixed vegetable stire-fried fruit drinking water Activity Walk about 45 Min about 30 Min Run Ride bicycle about 30 Min adicet Figure 4.11 Recommended food and activities page 1.2.4.9 This page showed food information and

activities recommended to users as in Figure 4.11. Users could choose meals according to the instructions. At the same time, they could choose the recommended sports activities according to their preferences and suitability.

activities page

3 Testing and editing the programs

For the process of testing the application to look for this defects, the developer divided the testing process into 2 steps, as follows:

3.1 Unit Testing: In this Unit Testing, the researcher focused on checking accuracy and finding errors that occurred within each function by using the White-Box Testing method, which was a test method that the developer saw appropriate, because the constructed application was divided into sub-units which was not complicated, This test method tested the functionality of the application and how it worked, in order for the application to work correctly, and to find errors. It was a test that the developer had done along with the development of the application.

3.2 Integration Testing was the second step of the application testing. The test in this step take place after every unit of the sub-unit has been tested, by combining all the functions of the application together, in order to test the total functionality together. The developer focused on testing accuracy, and finding connection errors. For data transmission between each related function, the developer used the User Interface Testing for testing at this stage. By testing in the top-down manner, the developer tested each menu selection of the user interface until all items were selected, to ensure that errors were not found in compatibility of each function of the application.

Results of weight control programs that focused on changing eating habits in overweight or obese students

1. Results of weight measurement, height measurement, waist circumference and BMI calculation before-after obesity monitoring program

Table 4.10 Results of weight measurement, height measurement, waist

circumference and BMI calculation before and after participating

in the obesity monitoring program

	Experimental group	control group		
Sample attributes	(n=20)	(n=20)	p - value	
	Sal TIL D			
Female (percent)	18 (90.0)	18 (90.0)	1.00	
Age ± SD	19.75±0.81	19.17±0.81	0.72	
Year (percent)) ((直)) (181	0.007	
1 st year	9 (45.0)	7 (35.0)		
2 nd year	6 (30.0)	10 (50.0)		
3 rd year	5 (25.0)	3 (15.0)	5	
Monthly expenses (percent)	120 PD	2/11	0.089	
<5,000 bath	12 (60.0)	9 (45.0)		
>5,000 bath	8 (40.0)	11 (55.0)	_	
Used to try to control body	16 (80.0)	16 (80.0)	1.00	
weight (percent)	R H	$\mathbb{N}^{\mathbb{Z}}$		
How to control body weight		114	/	
that has been used (percent)]]\$]		
- food control	17 (85.0)	18 (90.0)	0.21	
- Exercise	13 (65.0)	8 (40.0)	0.041	
Body mass index (kg / square				
meter)				
Before	27.38±0.62	26.02±0.58	0.19	
After	27.02±0.62	26.18±0.65	0.17	

Table 4.10 Results of weight measurement, height measurement, waistcircumference and BMI calculation before and after participating

Complete Attailed on	Experimental group	control group	
Sample attributes	(n=20)	(n=20)	p - value
Body weight (kg)		17	
Before	71.17±2.27	63.97±3.12	0.12
After	70.14±2.14	64.87±2.52	0.15
Waist circumference (in		1.112	1
centimeters).			
Before	87.35±5.54	88.34±5.08	0.38
After	87.04±3.87	88.85±4.11	0.41
Height (meters)	1.60±0.08	1.58±0.09	0.26
The number of weighing /	1.39±0.81	1.94±0.91	0.01
week 5	Mater 1	\mathbb{R}	5/
Preferred body weight (kg)	53.12±11.11	55.82±10.57	0.31
		YP	

in the obesity monitoring program (Continued)

Table 4.10 showed all 40 samples participating in the research until completion of the project. Most of the participants were female (90.0%), with an average age of 19.46 years. From Table 4.10, the average weight of the experimental group before and after participating in the program were 71.17 ± 2.27 and 70.14 ± 2.14 kg, and 63.97 ± 3.12 and 64.87 ± 2.52 kg for the control group. The body mass index (BMI) of the experimental group was 27.38 ± 0.62 and 27.02 ± 0.62 kg / sq.m, and 26.02 ± 0.58 and 26.18 ± 0.65 kg / m² ± 4.11 cm. for the control group. Weighing

frequency of the control group was 1.94 ± 0.91 times / week) which was more frequent than the experimental group (1.39 ± 0.81) times / week with a statistical significance of that of p <0.05. There were more freshmen in the control group than sophomore students. However, this might not affect the research results. Differences in class years might not directly affect weight control behavior because the two class years were in relatively similar learning environment and stress level. Furthermore, they were all in the same types of environment.

For results from the table 4.10 showed that the control and the experimental groups were not significantly different in their body weight, waist circumference and body mass index (BMI) in every period of the study (Table 4.10). After three months of intervention, the body weight, waist circumference, and body mass index of the experimental decreased, which would not be different from the control group, as shown in Figure 4.13 and 4.13. The experimental and the control groups were not significantly different, but the number of times to study, the data related to weight control from various media of the control group was significantly higher than that of the experimental group (p < 0.05) at 3 months, which might increase the food knowledge scores and weight control of the control group (Table 4.11). It was still less than that of the experimental group who received the intervention program. The experimental group had the average number of times going to parties or eating out with a large group of friends than the control group with statistical significance (p <0.05) from 0.59 \pm 0.62 day / week and 1.56 \pm 1.48 days / week. It might be possible that there was a return of undesirable behavior (relapse) over time, because the effects of the intervention were weakened, or the samples in the experimental group were reckless that the weight loss method was used together, making them careful of their conduct.

2.2 Score results from the knowledge questionnaire and weight control before - after participating in the obesity surveillance program

 Table 4.11 Score results from the knowledge questionnaire on knowledge and

 weight control before and after participating the obesity surveillance

The variables studied	Before giving knowledge Mean ± SE ¹		3 months later Mean ± SE ¹	
	Experimental group	control group	Experimental group	control group
Knowledge, Food and weight control	9.84±0.28	9.92±0.39	13.12±0.23	12.19±0.25

7946

program

From Table 4.11, after three months of intervention, it was found that the experimental group had statistically higher knowledge about food and weight control than the control group (p <0.01). The average scores before and after. The intervention program in the experimental group were 9.84 ± 0.28 , 13.12 ± 0.23 and 9.92 ± 0.39 , 12.19 ± 0.25 in the control group.

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Table 4.12 Effects of weight control program on food knowledge and variables

based on the TPB scores in the control group (N = 20)

and experimental group (N = 20)

	Before giving l	knowledge	3 months		
The variables studied	Average ± SE ¹		Average ± SE ¹		
	Experimental	control	Experimental	control	
	group	group	group	group	
TPB score Behavior	3.58±0.49	4.92±0.59	12.12 ± 0.45^2	2.19±0.78	
(score range: 0 - 21)		601	1421	0	
The intention (score	2.19±0.42	2.39±0.51	7.16 ± 0.49^2	0.48±0.59	
range: -9 - 9).			112	-	
Self-efficacy(Score	2.38±0.48	1.68±0.55	3.48 ± 0.52^2	-0.26±0.51	
range: -9 - 9)	NIK		(/)		
Attitudes (score range: -	4.27±0.50	4.98±0.62	6.17±0.61	4.72±0.54	
9 - 9).	NE?		2		
Individual norms (score	3.15 ± 0.41^3	1.59±0.52	4.75 ± 0.89^{2}	-0.25±0.87	
range: -9 - 9)	281 A	2112	Z		

1: The average value when adjusted with common variables \pm standard error values 2: p <0.01 when comparing between the experimental group and the control group 3: p <0.05 when comparing between the experimental group and the control group

Knowledge, eating habit and variables based on the TPB theory

From Table 4.11, after three months of intervention, it was found that the experimental group had more knowledge about food and weight control than the control group (p <0.01) (Table 4.11). It was also found that the experimental group had statistically higher diet control behavior, intention to control weight and perceived

self-efficacy in weight control than the control group. It was noteworthy that in mechanical increases in all three trials, the variable scores increased significantly after the intervention ended (at three months).

The intervention did not affect the attitude towards weight control. The experimental group felt that weight loss was a norm rather than what the control group felt before and after the intervention. (Table 4.11)

2.3 The results of the theoretical framework and the plan before participating in the obesity monitoring program.



 Table 4.13 Correlation coefficients according to the theoretical framework and the plan before participating the Obesity Monitoring

 Program.

	The correlation coefficients of the variables studied.				
Variable	1 2 3 4 5 6 7 8 9 10				
According to framework of the theory of planned behavior					
1. Attitude towards exercise movements					
2. Conformity to reference group in the exercise movement	.221** -				
3. Perception of exercise movement behavior control	.459** .417** -				
4. Intent in the exercise movement	.492** .485** .811** -				
5. Exercise movement behavior	.342** .121 .426** .390** -				
6. Attitude towards food consumption	.255** .194** .311** .270** .224** -				
7. Conformity to reference group to the food consumption group	.222** 1.00** .417** .485** .124 .197** -				
8. Perception of food consumption behavior control	.381** .470** .591** .586** .334** .335** .470** -				
9. Intention on food consumption	.345** .497** .516** .634** .310** .280** .497** .820** -				
10. Food consumption behavior	.215** .313 .335** .291** .450** .281** .135 .424** .372** -				
* p < .01	NV NV				
	RALLANIA				
	ABHI				

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From Table 4.13, when considering the relationships between variables according to the planned behavior theory framework before participating in the obesity surveillance program, the relationships could be explained as follows:

1.1 The intention of exercise movement was positively correlated with the variables according to the plan that was Conformity to Subjective Norm and perception of behavior control with statistically significant at .05 level. The relationships were ranked from high to low as perception, control of exercise movement (r = .811, p <.01), attitude toward exercise movement behavior (r = .492, p <.01), and Conformity to Subjective Norm in the exercise movement (r = .485, p <.01).

1.2 The Exercise Movement behavior was most positively correlated with perception of control of exercise behavior (r = .426, p < .01) and there was no correlation with Conformity to Subjective Norm in the exercise movement.

1.3 The intention of food consumption was positively correlated with the variables according to the plan that was Conformity to Subjective Norm attitude and perception of behavior control with statistical significance at the level of .05 in all 3 variables. The relationships were ranked from high to low as perception of food consumption behavior control (r = .820, p < .01), conformity to Subjective Norm according to food consumption (r = .497, p < .01) and attitude towards food consumption behavior (r = .280, p < .01).

1.4 Food consumption behaviors were positively correlated with perception of the most food consumption behaviors control (r = .424, p <.01) and were not associated with Conformity to Subjective Norm according to food consumption.

1.5 The intention of exercise movement was positively correlated with food consumption intention at the statistical significance level of .05 (r = .634, p <.01).

1.6 There was a positive correlation between exercise behavior and food consumption behavior at the level of .05 (r = .450, p < .01)



 Table 4.14 Correlation coefficients according to the theoretical framework and the plan after participating in the Obesity Monitoring

 Program.

	The correlation coefficients of the variables studied.
Variable	1 2 3 4 5 6 7 8 9 10
According to framework of the planned behavior theory	
1. Attitude towards exercise movements	
2. Conformity to Subjective Norm in the exercise movement	.224** -
3. Perception of exercise movement behavior control	.463** .419** -
4. Intention on the exercise movement	.490** .487** .813** -
5. Exercise movement behavior	.345** .124 .428** .391** -
6. Attitude towards food consumption	.257** .198** .314** .271** .226** -
7. Conformity to Subjective Norm to the food consumption group	.224** 1.00** .419** .487** .124 .198** -
8. Perception of food consumption behavior control	.383** .471** .593** .587** .336** .335** .471** -
9. Intention on food consumption	.348** .499** .519** .637** .311** .281** .499** .822** -
10. Food consumption behavior	.217** .315 .337** .292** .452** .282** .135 .426** .374** -
** p < .01	= $//S/$

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From Table 4.14, when considering the relationships between the variables according to framework of planned behavior theory, the relationships could be explained as follows.

1.1 The intention of exercise movement was positively correlated with the variables according to the planned behavior theory i.e. Attitude of Conformity to Subjective Norm, and perception of behavior control with statistical significance at the 0.05 level in all 3 variables. The relationships were ranked from high to low as perception of exercise movement behavior control (r = .813, p < .01), attitude toward exercise movement behavior (r = .490, p < .01), and attitude of exercise movement behavior (r = .487, p < .01). It was indicative that, if the participants received that exercise movement was easy and controllable, and felt positive toward the movement as well as a desire for them to form the movement habit, they become intentional and put more efforts and plans on their exercise movement.

1.2 Exercise movement behavior was positively correlated with perception of the most exercise movement behavior control (r = .428, p < .01) and there was no correlation with Conformity to Subjective Norm in the exercise movement. It was shown that the students who perceived that movement behavior was a simple thing, and believed that they could control their behavior more, they would put more intention, effort, and plan to do more activity movements, A more positive feeling of movement behavior would generate more movement behavior.

1.3 The intention of food consumption was positively correlated with the variables according to the planned behavior theory. i.e. attitude of Conformity to Subjective Norm, and perception of behavior control with statistical significance at the level of .05 in all 3 variables. The relationships were ranked from high to low as

perception of food consumption behavior control (r = .822, p < .01), Conformity to Subjective Norm to food consumption (r = .499, p < .01), and attitude towards food consumption behaviors (r = .281, p < .01). It was indicative that, if the students perceived that eating behavior was easy and controllable and that individuals important to them carried out the behavior and wanted them to do likewise, and that they felt positive toward the behavior, they would be more committed and try and plan to carry out the behavior.

1.4 Food consumption behaviors were most positively correlated with perception of food consumption behavior control (r = .426, p <.01), and there was no correlation with Conformity to Subjective Norm to food consumption. It was shown that the student perceived that their eating habits were easy and believed that they were able to control their habits. Their intention, efforts and plan to carry out the habits would be high. Furthermore, they felt positive about the habits and their execution would follow suit.

1.5 The intention of exercise movement was positively correlated with the intention of food consumption with statistical significance at the .05 level (r = .637, p <.01). It was indicated that students with high intention, effort, and planning to do exercise movement would have high intention, effort, and plan to do high dietary habits as well.

1.6 The exercise movement behavior was positively correlated with food consumption behaviors with statistical significance at .05 level (r = .452, p < .01), indicating that students with high exercise behavior would have high dietary habits as well.

Survey of satisfaction in implementing the mobile application for obesity surveillance of the samples

The results of the user satisfaction survey on the adiCET Nutrition application on Android operating systems allowed the users to answer queries, had gender differences and education levels. There were 18 females, or 90%, and two males, or 10% of the respondents. There were ten freshmen, or 50%, six sophomores, or 30% and Tour juniors, or 20%. The analysis results on their satisfaction were summarized in table 4.15

Table 4.15 Results of users'	satisfaction with the adiCET	Nutrition application

de.

Francis list	Evaluation results		
Evaluation list	Ī	SD	Level
The beauty of the design	AVI,		0
1. Colors within the application	4.27	0.58	Good
2. There was a classification of nutrition and	4.33	0.48	Good
exercise with interesting images.))ZE		
3. Beautiful interface design	4.40	0.50	Good
4. The font size was appropriate.	4.20	0.61	Good
5. The balance of colors used in Apple	4.18	0.52	Good
applications.	200	VA	3/
The average	4.28	7/A	Good
The average	4.31	27	Good
		~/	1
RALADI	TAI		
IJAB.	11		

Evoluation list	I	Evaluation results		
Evaluation list	\$\overline{x}\$	SD	Level	
Information on nutrition and exercise	2			
1. Types of food in each meal and exercise	4.30	0.65	Good	
2. Food and exercise information is sufficient to	4.20	0.55	Good	
understand	20	1		
3. There was a classification of food and exercise	4.43	0.50	Good	
information that can be easily searched.	1	N.C.		
4. Finding nutrition and exercise information	4.25	0.60	Good	
5. Modernity of nutrition and exercise	4.32	0.48	Good	
information	4/1/1			
The average	4.31		Good	
The system works	NZ	\square		
1. Speed of response to work	4.30	0.65	Good	
2. able to access information, and record data	4.43	0.63	Good	
easily and quickly.	19E	\leq	\geq	
3. Formatting within applications that are easy to	4.40	0.50	Good	
use	11 R		27	
4. Customizing the use of the application	4.37	0.62	Good	
5. Satisfaction with the overall use	4.20	0.56	Good	
The average		4.34	Good	
Mean of overall performance of the application		4.31	Good	

Table 4.15 Results of users' satisfaction with the adiCET Nutrition application (Continued)

Table 4.15 showed the results on the satisfaction with the implementation of the mobile application by the participants in terms of its design beauty, information on nutrition and exercise and system performance. It was found that the overall mean was 4.31, at a good level. For the system performance, the overall mean was 4.34, at a good level. The satisfaction on quick data access and record was at the highest level, at 4.43, followed by the internal formats at 4.40, the application customization at 4.37, and speed of response at 4.30. The overall satisfaction with the implementation of the application was at a good level, at 4.20 and the satisfaction with nutrition and exercise information was 4.31. The satisfaction with the categorization of food and exercise information was at the highest level, at 4.34, followed by the information at 4.32 and a speed search for the information at 4.25. The overall satisfaction with the sufficiency of the information was at 4.20, at a good level. The satisfaction with the design beauty was at 4.28. The satisfaction with the beauty of the interface was at 4.40, followed by interesting categorization of the information at 4.33, and coloration at 4.27. The font size was suitable with the mean of 4.20. The balance of coloration in the application was at a good level, with the mean of 4.18.


Chapter 5

Conclusion, Discussion and Recommendation

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Conclusion

The objectives of this research were to construct the mobile application to promote obesity monitoring in order to consume food correctly according to nutritional principles, to study the effects of weight control programs that focused on changing eating habits in overweight or obese students, and to survey satisfaction with the mobile application for monitoring obesity of the sample group, the researcher conducted a training session for the sample group participating in this project by deliberating the usage of various information in the application program. The sample group consisted of 40 students in the culinary Technology and Services, Suan Dusit University, Lampang Non-Formal Education Center, who enrolled in the Science in Daily Life course. The purposive sampling method was used select the sample group whose waist circumference exceeded the standard (male> 90 cm and women> 80 cm). The sample group was required to record every day periodically for 12 consecutive weeks with their user names, and passwords assigned to them by the researcher. They were made an appointment to listen to the application usage data and to record their basic information, such as, weight, blood pressure, heart rate, etc. in each week. The sample group also received additional information and various knowledge on correct and suitable nutrition from nutritionists, which could be used to support the correct

eating habits. The data were collected before and after the experiment, using measurements of weight changes, waist circumference, BMI, and surveying the satisfaction of using adiCET Nutrition applications. The descriptive statistics were used to analyze the data for percentage and the paired t-test was used to analyze the inferential data in order to compare the differences of mean before and after the experiment.

The study results revealed that after implementing the application, it was found that their body weight, BMI and waist circumferences decreased substantially. The comparison of their body weights, BMI and waist circumferences before and after using the application for 12 weeks revealed that they reduced at a satisfactory level. This was because the users gained knowledge on methods of weight loss, changes in their eating habits and exercise, appropriate exercise, and setting their weight loss goals from using the application. They also recorded their behavior in an attempt to find out their problems, collectively analyze their weight loss problems, and plan their collective eating and exercise, resulting in achieving their goals of losing weight.

For the study of the effects of the weight control programs that focused on changing dietary behaviors of the overweight or obese students, it was an experiment at study with a control group. The samples were 40 volunteers with a body mass index greater than or equal to 23 kilograms / square meter. They were divided into experimental and control groups of equal number. The experimental groups participated in 3 activities in 3 months. The activities consisted of knowledge provision, group discussion, media distribution for self-learning, food menu

distribution and group activities by organizing Asawin Market tour, and a supermarket. The assessment was on changes in knowledge of food and weight control, variables according to Theory of Planned Behavior (TPB), waist circumference, body weight, and body mass index within the 3-months period. The group participating in the weight control program (experimental group) had the higher scores on food control behaviors, food control intentions, perception, weight control ability, and belief in social norms, in food control than those of the control group. There was a reduction in waist circumference, body weight, and body mass index of the experimental group compared to the control group. Therefore, the weight control program that focused on modifying eating habits of the overweight or obese students could promote knowledge, intention, awareness, ability to control weight and good behavior, in food control, reduced waist circumference, body weight, and body mass index within 3 months. Even though it did not reach the statistically significant level, the program could not prevent the recovery of weight, waist circumference, and body mass index in the long term after the intervention stopped for three months.

For user' satisfaction evaluation results with adiCET Nutrition application, the satisfaction with the aesthetic aspects of the design was at a good level. The information on nutrition and exercise was satisfactory at a good level, and the system performance was also at a good level. On the Android operating system, it was found that user' satisfaction with the application on aesthetic design, nutrition and exercise information, and system performance was all at a good level. This was because, the application focused on design and beautiful colors, with interesting information on food, nutrition, and specific exercises. Furthermore, categorization of the information was suitable and in line with their needs and the system operations were user-friendly. The result was that the satisfaction with the efficiency of the application, on average, was at a good level.

Taus III

Discussion

The main objective of this research study was to develop a mobile application in promoting the monitoring obesity, so that food consumption could be in accordance with the nutritional principles. The features of the adiCET Nutrition application, were to record the data on basis information of users, food and nutrition, health, exercise, exercise advice, health and nutrition advice, user data analysis by experts on Health and nutrition, health risk assessment, nutrition analysis for each meal, user notification system, instructions for using the application, and display of the results in graphs and images that could be automatically upload onto social media. The application corresponded to the features from those of smartphones that were used to treat people who truly wanted to lose weight. The main focus of this study was on self-examination, self-monitoring of food consumption, and self-exercise in order to lose weight. The purpose of this study was the collection and acceptance, and possible results of the weight control by itself by checking the data transmission through the application on smartphones, in comparison with those on websites and note records. Therefore, MMM applications could be an acceptable tool and could affect weight loss by a full RCT test, which could be guaranteed by research studies (Carter MC. 2013).

In Thailand, the most users, based on references of articles that suggested the use of applications, application details, download rates from websites in year 2018 included www.thaiware.com, www.samsung.com, www.kapook.com, and www.fwd .co.th, which were organized to download mobile applications in various formats with details, with different information, including a variety of applications or applications related to nutrition of each source, with different sources and details. In most cases, the download rate, or rating, the source of information, made sense of the application's usage. The number one and most popular and downloadable was the "LoseIt" application; its function being an application to calculate calories about health care, weight control, weight loss, or diet. It was a useful way to control energy and calculate the energy in each meal that was eaten, and determined the energy that should be received each day, in order to be able to reduce weight according to the established target. The next application was "Calories Diary". It was an application that has features that users could save information about eating each meal, and had the data to compare the amount of energy to exercise, calculated the energy of each food type for each meal, and compared that energy from the food received, how much to consume by any type of exercise, with the application dividing the activity characteristics into small, medium, quite large, and large. Users considered what kind of activity would help to burn the amount of energy that they received appropriately. In addition, the applications called "Food I eat", "Caloric Counter", "Check Calories", "and BMI Calculator" also had similar features, namely, using tools to help control energy and calculate each food energy in each meal, when having more and more frequent application behavior, including diet and exercise, to control weight, thus, affecting the amount of fat accumulated in the body, which could be reduced to normal. With the M Diet Helper application, it was a different application, with the use of a warning about the reduction obesity and management of each meal plan for the user automatically and easily. The application, "60 DAY Best of Me", had a difference in self-change. The New life in 60 days reduced belly and diseases with 5 trainers who would guide on health care, exercise, energy metabolism and muscle building in various parts. The introduction of 3 healthy food menus and a 60-day evaluation function. Jeon, Park and Faan (2013) developed an application for Smartphones in order to use the clinical management plan with obesity, to develop and evaluate the use of smartphone clinic applications, as a guideline for obesity management by monitoring developments in this study. It could be useful for weight management, because it could provide high-quality health information. Based on this study, the results showed that the sample using adiCET Nutrition application, the comparison of average difference, body weight, body mass index, and waist circumference of the sample, before and after using the application, it was found that after using the application according to the usage instructions and appointments for each week for 12 weeks, the body weight, body mass index and waist circumference of the samples, the reduction was statistically significant at the 0.05 level. This was because the samples using the application received knowledge and how to use the adiCET Nutrition application, according to the researcher which was in line with the research social control, and considering weight loss from mobile use for teenagers (Smart project). This study could explain the reasons, theory, design and weight control for teenagers who used it, via technology media and mobile phones, by a total of 404 overweight or obese people. They were students from the three Southern California universities, where all participants who were selected to participate in all activities were in their final year. The participants took a regular exercise-related activity, changed their eating habits that resulted from using communication technology in the telephone system, and could result in weight loss behaviors among adolescents, who participated in activities (Patrick et al., 2014). Other studies with self-monitoring of daily meals could successfully reduce weight with mobile phone technology. The researchers evaluated the use of smartphones applications for food consumption, by self-monitoring and weight loss, in comparison with traditional diet counseling, and how to get counseling. The participants tracked their and weight loss, and compared them with other participants who lost weight within 8 weeks. The participants used the Lose It application to record various aspects of information related to their own food consumption on smartphones. From these studies, the results could be summarized that smartphones applications could be used as a means of selfexamination for food consumption that was possible for people who wanted to lose weight (Wharton CM., 2014).

The researcher developed a mobile application (adiCET Nutrition app.) to gathered information and details of all parts that could be useful and available to teenagers who were obese or those who wanted to use health-related care about nutrition. Users would be able to use the application in practice, and the results could cause behavioral changes in obese adolescents and obesity monitoring as well. Their nutrition could be appropriate to their age and the information was easily accessible via modern technology. This application should be used to promote suitable eating habits among teenagers and adolescents because the sample group was able to reduce their body weight after implementing the application. Obese adolescents could reduce the risks or dangers from obesity-related diseases. It was recommended that application be further improved for better and higher efficiency and effectiveness. The study findings confirmed those of Pagoto, Schneider & Jojic (2013) in that mobile applications were able to assist patients in reducing their body weight. Mobile application are a useful tool with the aims of defining weight loss features as well as strategies relating to weight control behavior in order to specify the qualifications for weight loss could play a small role in changing weight control behavior. An investigation to increase a motivating behavior to reduce stress and to completely solve this problem might be a wrong projection about applications. In general, added methods to enhance the usefulness of applications should be created in an attempt to create inspiration in losing body weight.

This investigation explored the results of the weight control programs that focused on changing eating behavior of overweight or obese students. The program would significantly affect their food control intention, perception on self-efficacy, belief that their weight control was socially acceptable, and food control behavior. Moreover, their BMI and waist circumference were reduced within three months, but not at a statistically significant level. Nonetheless, it was revealed that weekly weight records affected weight loss and behavioral changes of obese participants. Manosaksaree (2016) revealed that the knowledge on eating habits and exercise of the experimental group was higher than that exercise of both group were not different and weight loss of the two group was not different either

Jantima (2017) conducted an investigation with 30 pot-bellied men aged 45 – 55 years for a period of 12 weeks. A one-group assessment and measurement was conducted before and after the experiment. It was found that their average weight loss was 2.3 kg and their BMI reduced 0.87 kg/m². Furthermore, their knowledge on the pot-bellied syndrome and self-efficacy increased significantly. Prapasil (2013) reported that the scores on self-organization behavior of the experimental group were higher than those of the control group. After 12 weeks of participating in the program, BMI and risks on cardio-vascular disease of the experimental group were significantly lower than those of the control group. Waist circumferences of the women were significantly lower than those of the control group. However, those oh the men were not significantly lower than those of the control group. It was also revealed that those having completely undergone weight control programs (eating low-caloried food during the 18 months of the study) had their weight reduced 10% but the weight might return 2/3 of the lost weight within one year. Total weight would return within five years (Anderson et. Al., 1999; Waleekhachonloet et. Al., 2007)

There were limitations of this research. Despite being an experimental research with purposive control group, the experimental and control group were not homogenous in all aspects. Weighing frequency of the control group was higher than that of the experimental group and group members were mostly sophomores. Frequency of weighing indicated awareness on weight change and might affect weight control results (Linde et. Al., 2005). Additionally, normative scores of weight

control of the experimental group were significantly higher than those of the control group from the beginning. Other external factors that might affect the study results included frequency of exercise, information on weight control from other media and exchange of information between the two groups. However, their cooperation were sought after from the beginning of the study and they were required to record the frequencies of their exercise, additional information, exchange of information and types of food they ate. It was found that these factors did not make or made little difference between the groups.

The weight control programs in this research focused on changes of eating habits in the forms of recommendations and follow up. Group activities were used in conjunction with self-study as well as developing recommendation most suitable for daily-life activities or the sample group. Such a practice enabled all the samples to participate in the study project until the end and there were no reports on undesirable results from food control from the sample group. This investigation incorporated the Theory of Planned Behavior (TPB) developed by Ajzen (1991), which was an extension of the theory of Reasoned Action (TRA) by Fishbein & Ajzen (1975). TPB model originated from important knowledge processes to access the purchase intention. The model explained the complexity of the relationship between human behavior and relevant factors. It was indicated that human behavior was caused by intention and the intention was directly affected by the three factors: attitude, conformity to a reference group and perception on behavioral control. The three factors directly affected the intention of an individual in expressing his behavior. If an individual believed in his competence to carry out a particular behavior at a high level, it was likely that he would pay attention to and try to become successful in that behavior. In this investigation, the weight control programs was able to increase the knowledge and intention to control food of the sample group and perceive their competence in food control as well as social support. Nevertheless, it was not sufficient to change their weight control behavior on a daily basis. It is thus recommended to further studies on weight loss.

For the survey results on satisfaction of the sample group with the implementation of the application regarding its aesthetic design, information about nutrition and exercise and the system performance, it was revealed that the overall satisfaction was at a high level. This study finding was in line with that of Boonyaman (2016) in that the satisfaction levels with the implementation of the multi-channel application for weight loss were at the high and highest levels. In this investigation, the satisfaction was overall at the high level. This was because the application was beautifully designed and colored with interesting information on food, nutrition and exercise. The information categorization and displays were suitable, user-friendly and in accordance with users' needs, resulting in the mean of its efficiency at the high level.

Recommendation from the study results

1. A Responsive Design application should be constructed to be used on both iOS and Android mobile devices in order to promote the development of teaching and learning in various media applications. 2. The results of this study could be used as a guideline for mobile applications to monitor obesity conditions for health care, nutrition, exercise and weight loss. However, more diverse information features in each and need to be created.

3. Weight control programs focusing on changing eating habits in overweight or obese students should increase knowledge, intention to control food, self-efficacy, social support, and better diet control behaviors. Nevertheless, it is not sufficient to change weight control behavior in the daily life. Thus, more studies on maintaining weights should be conducted.



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Appendix A

Application adicet Nutritution

1. showing basic body mass index data

		W/ . Cr	
	Hon	ne	
/			
13	Basic A	Basic Advice	
12	Energy that should	Energy that should be received each day	
0	Ť	Å	0
	Female	Male	
	1,600 - 2,000 Kilocalories	2,000 - 2,500 Kilocalories	
H	Percentage of daily n	Percentage of recommended daily nutrients	
13	All fat	3 g.	2
10	All carbohydrates Sugar	6 g. 3 g.	
	<u>ST/</u>		
	a 🖉	dicet	

2. pages showing all menus



3. pages of subscription records



	Name	
/	Height Cm. Weight Kg	
12	Birthday Blood G	2-
	Waistline Cm. Gender	
100	E-mail	\sim
0	Save Data	~
HI	Calculator BMI	SH
12		2
	adi cet	
	AJABHN	

4. pages showing body mass index data

Calculator BMI

24	.3 !!!	
Kilogram	/SquareMeter	
The criteria for th	ne Asian populations	2
Underweight	< 18.5	6
Normal weight	18.5 - 22.99	1
Overweight	≥ 23	
Pre-obese	23 – 24.99 (At risk)	12
Obese Class 1	25 - < 29.99	E
Obese Class 2	> 30	3
	EAC Kilogram The criteria for th Underweight Normal weight Overweight Pre-obese Obese Class 1 Obese Class 2	Z4.3 !!!Kilogram/SquareMeterThe criteria for the Asian populationsUnderweight < 18.5 Underweight $< 18.5 - 22.99$ Overweight ≥ 23 Pre-obese $23 - 24.99$ (At risk)Obese Class 1 $25 - < 29.99$ Obese Class 2 > 30



5. health records page

	Health			
	Blood sugar level _	mg/dL		
	Triglycerides _	mg/dL		
1	HDL _	mg/dL	$\langle \rangle$	
15	LDL	mg/dL	/	
0	SGOT	mg/dL	0	
	Renal function	mg/dL		
Q	Heart rate	T/min	$\left \right\rangle$	
HI	Blood pressure	mm.Hg	E	
12	SaveDa	ta	3/	
adicet				
· JABHN				

6. pages save each meal



7. pages of activity menu notes

	Activity	
	SWIMMING Search	
-TI-		A LE
10	period Min	19
CH	metabolism Kilocal	γT
IA	SaveData	ERSI
1	adicet	
	RAJABHNI	



	Summary of energy		
	DD / MM / YY 02/11/60		
/.	Summary of energy 2,250 _{Kilocal}		
12	carbohydrates 750		
	Fat 1,250		
0	Protein 250	1	
CH	Summary of metabolism <u>400</u> Kilocal		
12	Ö: Suggestion	/	
12			
	adicet		
	AJABHA		


9. pages showing food information and recommended activities

Appendix B

Activity record for weight loss



Food menu	items	for	weight	loss
-----------	-------	-----	--------	------

Week	Day]	Food items	s / quantities		obstacles
		Morning	lunch	afternoon	evening	
1	Monday					
	Tuesday					
	Wednesday					
	Thursday					
	Friday	5010	51167	5		
	Saturday	120	TIME	SIL		
	Sunday	11.		2678	1	



Schedule of exercise activity by walking fast 2011 - 20

Ľ

Month	Week	date	Brisk walking (minutes)	Maximum pulse during exercise (times / min)	Respiration rate (times / min)	obstacles
	T	1	SAX	Mitcho	5/15	5/
	2	3	MAS		VIS	
	10	4			VIS	/
		6	1		1151	

Record

 NR.	ž	$\langle \rangle$	
 1	JABHI		
		5	

Month	week	Data	Weight (kg)	height (meters)	BMI	waist (cm)
	1	1				
		2				
		3				
		4				
		5	15151	IIn		
		6	1 A La	~~~ //////////////////////////////////	11	
	6	1	0	A	A.V	
			Rec	cord	(E)	<u>\</u>
	1.2			<u> </u>		<u></u>
					<i></i>	
	01		INKS		// //	0
- 1	~ 1	-	(MV) C	Pnit	1/1	1.01
	- 11	- 1	-15/		11	
	- 11	-		N WE	9.1	
- 1		2	2511	6 1135	\leq	
- 1	01		26110	6/135	2	\geq
1	TI		FAVAN S	PAS	\leq	H
	-		2 multi	111.23	511	Fal
- 1	2	\\ /	1812-	D. SIK		21
	Z	11			$\langle H \rangle$	5
	10	211.	FIT		115	4/
	1	1			112	- /
	1	4			121	/
	1	7			N	
		1.			~/	
			KAL	ALLA		
			NIJA	BHI		

Weight data table (kg), height (meters), BMI, waist (cm)

Appendix C

TPB diet questionnaire

Question 1-3: Assessment of food control behavior

1. During the past 1 month, how many days do you control your diet each day to control the total weight? (0 - 7)

everyday	almost everyday	Mostly	About half a month	Several days but less than half a month.	A few days	1 day	never
----------	--------------------	--------	--------------------------	--	---------------	-------	-------

3. Let you evaluate how often you control your diet each day in order to control how much weight (0 - 7)

5

2

0

3

Best control Not control at all

Question 4-6: Assessing food control intentions (-3-3)

7

4. You intend to control food each day in order to control weight.

6

- 5. You want to control food each day in order to control weight.
- 6. You try to find a way to control food, which is suitable for you to control weight.

Article 4-6: There are answers to choose from:

True			Uncortain		Not true	
Much	Moderate	Little bit	Uncertain	Little bit	Moderate	Much

Question 7-9: Assessment of self-efficacy in food control (-3-3)

7. How much do you think is possible that you can control the food on a daily basis, if you intend to do it?

Most likelyVery possibleQuite possibleModerate possibleSom possible	le Very ble little Impossible possible
--	--

8. How much do you believe you can force yourself to eat on a daily basis?

1

Most Much Quite a lot Moderate Some V	Verv little	Con't
	, or y meete	Callt
enforceabl enforceabl enforceabl enforceabl e	enforceabl	enforceabl
e e e e e	e	e at all

NUA

9. Even if you intend to control the food on a daily basis, you will not succeed because there are many things to disturb.

	True	-45	Uncortain	105	Not true	- 1
Much	Moderate	Little bit	Uncertain	Little bit	Moderate	Much

Question 10-12: Attitudes in food control (-3-3)

N

10. Controlling food each day to control weight is for you

	Useful	PINE	Uncortain	AND	Useless	
Much	Moderate	Little bit	Uncertain	Little bit	Moderate	Much

11. Control of food on a daily basis to control weight is for you

Good			100.0110		Badly	
Much	Moderate	Little bit	mere	Little bit	Moderate	Much

12. Control of food each day in order to control weight is for you.

1/AR

Important		Uncortain	Not important			
Much	Moderate	Little bit	Uncertain	Little bit	Moderate	Much

Question 13-15: Assessing the behavior of people about food control (-3-3)

13. Everyone thinks that you should control your diet in order to control weight.

14. Most people that you are intimate want you control food in order to control weight.

15. If anyone is like you (Shape, weight, age, environment, and everything like you), he would try to control food in order to control weight.

Article 13-15: There are answers to choose from:

True			Lucantain	Not true			
Much	Moderate	Little bit	Uncertain	Little bit	Moderate	Much	



Instruction : Please mark $\sqrt{}$ in the box that matches the student's actions in the past 12 weeks, how often do the students do the following activities.

Activities of daily life	Never	Do	Do	Do	Do	Do	Do	Do
		1	2	3	4	5	6days	every
	1	day	days	days	days	days		day
1. Doing exercise at	5	e15	1111	7-				
least 30 minutes a day.	55	0.2	1 2 2	1.17	12			
2. Doing activities that	115				.15			
make the body feel	11	1	AX		10	2 1		
tired, or have sweat,	1/1	()	8 1	1	1.	123		
such as doing	$\langle \chi \rangle$		二))	11	1	1		
housework, running	1.1	Y				1:2	1 4	
with friends, short	11			112		11:	21	
walks instead of using	611			111	1	. 11	2-1	
a car.	111	$\gamma =$		KU /	11			0
3. Staying with for a	111	1		1	1	1	1	
long time, such as	1115		1		11 /		-	1.
watching TV / VCD,	111	22	and The	11	1/1	-	19	1
playing games.	19	5	2101	720		1		1
4. Doing housework	TA	2/1	1	VCL.F		1		
until sweating, such as	38	11	B	12	-	1		
sweeping the house,	05	11	35			2		
mopping the floor.	ev	11/	ab.	113	2		12	
5. Watching TV / VCD	120	10		191	1		H	
for 2 consecutive hours	192	Cal	11-2	26	11			1
or more.	200	Sar Cli	is.	2111	0	S //	S	
6. Playing sports with	AN	<	V	21	0	M	021	
friends during school	PH	H	t	12	14	111	151	
breaks.						11.	~/	
7. Doing activities in	2	4		2		15	- /	
the kitchen		1			//	27	/	
8. Sit and read books	1				1.	2		
for 2 hours or more						5/		
9. playing games for 2	P	1		1		/		
consecutive hours or	SV/	T_{1}	DI	AL	~/			
more		11	D	1.				
10. Eating food while								
watching TV / VCD.								
11. Short walks instead								
of using a car.								

In the past 12 weeks, students have played sports or any of the following activities at least 30 minutes a day (choose more than one). Students mark $\sqrt{}$ in the box that matches the type of sport or activity that the students have done.



Appendix D

Data collection form on food knowledge and weight control of the participants **Notice**: Please Mark / in the space that matches your feedback as possible. (Answer: There are two options, yes and no.)

- 1. The main cause of weight gain, caused by the imbalance between the energy received and the energy used.
- 2. Overweight or obese conditions increase the risk of many types of complications such as high blood pressure, diabetes, high blood cholesterol.
- 3. The important thing for you to control weight in the long term is to adjust the behavior.
- 4. The goal of losing weight over a 3 month period is to reduce weight by 10 percent of the initial body weight.
- 5. The same amount of carbohydrate food, found that the energy obtained from glutinous rice> steamed rice> blanched white rice noodles> Kanom Jeen
- 6. In the same amount of food, fish is a low-energy food compared to chicken or pork or beef.
- 7. Low energy fruit group, including watermelon, cantaloupe, rose apple and truffle.
- 8. Energy from sweets is mostly energy from carbohydrates and fats.
- 9. The fullness of vegetable dishes will help control weight more than being filled with rice or flour foods.
- 10. Controlling food by reducing the amount of food that is still receiving 5 full nutrients will result in better results for the body than bad results.
- 11. Eating dinner should be eaten at least 2 hours before bedtime.
- 12. Drinking alcohol which stimulates appetite and alcohol also gives energy close to fat, so it should be avoided.
- 13. Avoiding breakfast regularly until habitually decreases the normal metabolic rate from 1-5% which may result in weight gain of 4 kilograms in 1 year, even if not eating more food, so we should eat breakfast.
- 14. Dieting is the most appropriate weight loss method.
- 15. When losing weight as needed, there is no need to control the diet again.

Appendix E

Evaluation list Evaluation results 5 1 4 3 2 The beauty of the design 1. Color within the application 2. There were categories of nutrition and exercise with interesting images. 3. Beautiful interface design 4. The font size was appropriate. 5. Balance of colors used in the application. Information on nutrition and exercise 1. Types of food in each meal and exercise 2. Food and exercise information was sufficient to understand. 3. There was a classification of food and exercise information that could be easily searched. 4. Finding nutrition and exercise information 5. Modernization of information on nutrition and exercise. System operation 1. Working response speed 2. Could access information and saved data quickly and easily. 3. Formatting within the application was easy to use. 4.Customizing the use of applications 5. Satisfaction with the overall use.

User satisfaction questionnaire for adiCET Nutrition application

Appendix F

Rights Protection Documents Participants in the research project





Participant Information Sheet

 Title: Mobile Application for Obesity Surveillance

 Researcher name: Atthapong Chumkiew
 Position: Lecturer

 Place to contact the researcher

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 (Home) 85 Soi 1, Nakuem Road, Sop Tui Subdistrict, Mueang District, Lampang Province

Mobile Phone: 064-437-6771 E-mail: Atthapongck@gmail.com

This study has a specific purpose: To study the effects of weight control programs that focus on changing eating habits in overweight or obese students Culinary Technology and Service Branch Suan Dusit University Lampang Non-Formal Education Center To lose weight Weight loss behavior Body mass index And waist circumference Therefore, the research results will benefit. Following the results of the research into guidelines for developing weight loss programs for teenagers who are overweight in other areas Or in other populations And obtain guidelines for solving overweight problems for teenagers with empirical evidence And is a systematic weight loss activity that will result in further reduction of risk factors that may occur to overweight teenagers in the long term. This research is a two-group quasi-experimental research. The experimental group and the control group were compared before and after the experiment. And between the experimental group and the control group in the sample group selection for use in this research The sample group is divided into 2 groups, 40 people, 20 control groups and 20 experimental groups. Cooking and service technology students. Suan Dusit University Lampang Center for Non-Centered Education in Science in Daily Life By being a 1-3 year old student selected as a group Specific samples (purposive sampling), which are students whose waist circumference exceeds the standard (male> 90 cm and women> 80 cm) voluntarily and willing to

participate in the research project can communicate verbally, understand Thai. Can read and write Research tools

The tools used in this research consisted:

Control group

The researcher collected general characteristics of the sample group and recorded it in the application on the mobile phone. AdiCET Nutrition is the height and the following information for the default. Knowledge of food and weight control Variables according to plan behavior theory And clinical results are body weight, length, waist circumference, body mass index, and other behavioral data that affect weight control (such as the number of exercise times Receiving information from various media In weight control Talking, exchanging information between groups, etc.) Measurement of food knowledge and weight control using self-selected questionnaires To measure body weight Use digital weighing scales By requiring research participants to wear thin clothes And not wearing shoes Each measure must use the same section at the same time. The height is measured by a wall mounted height meter. The waist length data is measured using the narrowest point that is above the hip with a standard gauge line. Weight data recording Height and waist circumference using 1 decimal point

After that, the researcher distributed the activity logbook And explaining about the recording of data as a group of 10 people per group. Number of days to exercise or activities that require exertion in a week The number of days that a conversation with a friend about food control Including studying information from various media in a week Number of days to go to a party Or go to eat with a large group of friends in a week

Experimental group

The experimental group was treated the same as the control group. And must participate in the activity 3 times in 3 months period. Activities include Educating Low market tour and supermarket tour

Education activities Consists of providing general knowledge about obesity Various complications, low energy foods And the concept of eating behavior in the daily science course hours at Suan Dusit University Lampang Center for Non-Centered Education. In addition, the sample group also received a sample menu for weight control. Educating is done by dividing the sample into groups of 10 people each and takes about 45 minutes.

Tour activities "Knight Market" (Place to sell dinner for students General tourists, local residents and famous and popular sources in Lampang province), together with food expert instructors to recommend foods to eat Foods to Avoid Energy of each type of food. Samples are joined as a group of 10 people each. The activity takes about 45 minutes. There are activities outside the premises. Ready to provide knowledge by food expert instructors The researcher also distributed the DVD media "Knight Market Tour" to provide self-study examples.

The third activity is tour. "Supermarket" (Big C) Together with a food expert professor to recommend foods that should be eaten. Foods to Avoid Reading food labels to study energy in each food type Like to join the activity as a group of 10 people per group, the activity takes about 45 minutes If the reader is interested in more details about interventions or media, please contact the researcher directly.

Interventions in the experimental group were designed to change the eating behavior. By increasing the awareness of self-efficacy in dietary control from the experimental group eating plan And follow-up every month during the study period It also increases the support from the society by organizing group activities. Intervention also aims to create a positive attitude towards food control. By providing knowledge and organizing activities for the Knight Market Tour which sells cooked food and tour supermarket which is the main source of food for students All interventions aim to achieve intention and behavior modification.

Confidential information collection

Information obtained from this study Will be kept secret by various information Will use the numeric code Which will be well preserved Only researchers and advisors can access this information. Information dissemination may be published in books, medical journals and nurses. Such dissemination will be done for academic benefit. And will be published in the overview only The information published is information that is not anonymous. And sources of information Those who have been informed cannot link to the information provider.

This research, you have the right to participate in a voluntary research program that has no compulsion or can refuse to participate in the research project. Without any impact on you and when participating in the research project, you have the right to leave the research project without needing to clarify the reason if you are not comfortable And if you have any questions I am willing to provide information to you willingly. "If you are not treated according to this information, you can file a complaint at: Human Research Ethics Subcommittee Research and Development Institute Chiang Mai Rajabhat University

Thank you for your cooperation. Atthapong Chumkiew Sign..... Sign..... (Dr. Natthiya Tantranon) (Atthapong Chumkiew) Thesis Advisor Principal researcher CHIANG RAJAB



Informed Consent Form

DateYear.....

Number Research volunteers

I, who signed the end of this book Requesting consent to participate in the research project

. . . .

Research project: Mobile Application for Obesity Surveillance

Researcher name: Atthapong Chumkiew Position: Lecturer

Place to contact the researcher

(Office)	Faculty of Public Administration Western University
(Home)	85 Soi 1, Nakuem Road, Sop Tui Subdistrict, Mueang District,
	Lampang Province Mobile Phone: 064-437-6771
	E-mail: Atthapongck@gmail.com

I have received details about the origin and purpose of research. Detailed steps That must be treated or treated Risk / danger And the benefits which will arise from this research by reading the details in the document explaining the volunteer research throughout And received explanations from the researchers until they understood very well

I therefore voluntarily participated in this research project. As specified in the research volunteer clarification document with my consent Attended the training for 12 weeks, explained by the researcher, the purpose of the research, the research methods, the potential disadvantages of research. Including the benefits that will be obtained from thorough research And have a good understanding which the researcher answered all the questions that were suspiciously willing Not concealing hidden Until I was satisfied and joined this project voluntarily And I have the right to terminate the participation in the research Without being affected by the service And does not need to clarify the reasons for canceling the participation in the project The researcher assures that the

information relating to me will be kept confidential and will only present the results of the research. However, I authorize the researcher to disclose the information to the relevant departments as appropriate. Which can only be done if necessary for academic reasons In addition, the researcher assures that if any harm caused by such research I will receive care and help without any charges at all. If in doubt Can contact the person responsible for this research project is Atthapong Chumkiew Can be obtained at telephone number 0644376771 with a consultant, Dr. Natthiya Tantranon, can contact at 053885871 on official days and hours. I have the right to withdraw from the research at any time as desired. Without having to report the reason for withdrawing from that research will not affect in any way to me all

I received a guarantee that The researcher will treat me according to the information provided in the research volunteer clarification documents and any information. Related to me The researcher will keep it confidential. By presenting the research data as an overview only There is no information in the report that will lead to my identification.

If I have not been treated exactly as specified in the research volunteer clarification document I can file a complaint at: Human Research Ethics Subcommittee Research and Development Institute Chiang Mai Rajabhat University

I have signed it as an important witness before the witness. However, I received a copy of the data sheet for research volunteers. And a copy of the consent letter to participate in the research of the volunteer research

Sign..... (Dr. Natthiya Tantranon) Thesis Advisor Sign.....) (.....) Research volunteers

Sign.....

Sign.....

(Mr.Atthapong Chumkiew) researcher (.....) attestor

Appendix G

Research document certification from

Ethics Committee University





เอกสารรับรองจริยธรรมการวิจัยในมนุษย์ คณะกรรมการพิจารณาจริยธรรมการวิจัยในมนุษย์ด้านวิทยาศาสตร์สุขภาพ ศูนย์ความเป็นเลิศด้านนวัตกรรมสาธารณสุขศาสตร์และสิ่งแวดล้อมชุมชน คณะวิทยาศาสตร์และเทคโนโลยี มหาวิทยาลัยราชภัฏเชียงใหม่

เลขที่รับ 004/62

เลขที่อนุมัติ EC 62/004

ชื่อโครงการวิจัย:	โปรแกรมประยุกต์บนมือถือในการเฝ้าระวังสภาวะโรคอ้วน
Project title:	Mobile Application for Obesity Surveillance
ผู้วิจัยหลัก:	นายอรรถพงษ์ ชุ่มเขียว
Principal investigator:	Mr. Atthapong Chumkeaw
สังกัดหน่วยงาน:	วิทยาลัยพัฒนาเศรษฐกิจและเทคโนโลยีชุมชนแห่งเอเชีย มหาวิทยาลัยราชภัฏเชียงใหม่
Affiliation:	Asian Development College for Community Economy and Technology, Chiang Mai Rajabhat University
วิธีการทบทวน (Reviewed M	ethod): การพิจารณาแบบเร่งรัด (Expedited review)
เอกสารรับรอง	1. แบบเสนอโครงการวิจัย
Document reviewed:	 2. เอกสารชี้แจงผู้เข้าร่วมการวิจัย
	 หนังสือแสดงความสมัครใจในการเข้าร่วมการวิจัย
	 เครื่องมือที่ใช้ในการเก็บข้อมูล
	5. ประวัติผัวิจัย

คณะกรรมการพิจารณาจริยธรรมการวิจัยในมนุษย์ด้านวิทยาศาสตร์สุขภาพ ศูนย์ความเป็นเลิศด้านนวัตกรรมสาธารณสุข ศาสตร์และสิ่งแวดล้อมชุมชน คณะวิทยาศาสตร์และเทคโนโลยี มหาวิทยาลัยราชภัฏเชียงใหม่ พิจารณาแล้วเห็นว่า โครงการวิจัย ดังกล่าวข้างต้นมีประโยชน์ต่อสังคม และไม่ก่อให้เกิดความเสียหายหรืออันตรายใด ๆ ต่อกลุ่มตัวอย่าง และองค์กรที่เกี่ยวข้อง กับการวิจัย จึงขอรับรองว่าโครงการวิจัยนี้ได้รับการรับรองการพิจารณาจริยธรรมโครงการวิจัย ตามแนวทางหลักจริยธรรมการวิจัย ในคนที่เป็นมาตรฐานสากล

วันที่รับรองการพิจารณาจริยธรรม:	1	เมษายน	2562
วันหมดอายุ:	31	มีนาคม	2563

ลงนาม.....

(ผู้ช่วยศาสตราจารย์ ดร.สามารถ ใจเตี้ย) ประธาน คณะกรรมการพิจารณาจริยธรรมการวิจัยในมนุษย์ด้านวิทยาศาสตร์สุขภาพ ศูนย์ความเป็นเลิศด้านนวัตกรรมสาธารณสุขศาสตร์และสิ่งแวดล้อมชุมชน คณะวิทยาศาสตร์และเทคโนโลยี มหาวิทยาลัยราชภัฏเชียงใหม่

CURRICULUM VITAE

Personal Profile	Mr. Atthapong Chumkiew		
Date of birth	08 December 1979		
Education and certi	fication		
1998	B.Sc. (Computer technology) Payap University		
2008	Master of Science (Computer Science) Chiang Mai University		
Work Experience			
2004 - 2008	Secretary of the Department of Parasitology		
0	Faculty of Medicine Chiang Mai University		
2008 - 2010	Computer Technical Officer Policy and Planning		
	Division Chiang Mai Rajabhat University		
2010 - 2016	Lecturer, Lampang Educational Center, Suan Dusit University		
2016 - Presen	t Lecturer, Western University		

Research

- Chumkiew, A., Thongboonnak, K., Chuensumran, U., Tantranont, N., (2019). Mobile Application Development for Health Monitoring and Obesity Management. The 9th National and International Conference on Humanities and Social Sciences (NICHSS 1/2019) on 25 - 26 March 2019 at Phranakhon Rajabhat University, Bangkok, Thailand.
- Chumkiew, A., Thongboonnak, K., Chuensumran, U., Tantranont, N., (2019). The results of a weight control program focused on changing eating habits in overweight or obese students. *Nursing Journal*.