

## การใช้แอปพลิเคชันฝึกความจำในการฟื้นฟูความจำของผู้สูงอายุที่มีภาวะสมองเสื่อม โดยใช้กิจกรรมตามหลักปรัชญามอนเตสซอรี

## THE USE OF MEMORY TRAINING APPLICATION FOR MEMORY REHABILITATION OF ELDERLY WITH DEMENTIA USING MONTESSORI-BASED ACTIVITIES

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### บทคัดย่อ

งานวิจัยในครั้งนี้มีวัตถุประสงค์เพื่อ 1) สร้างแอปพลิเคชันฝึกความจำเพื่อฟื้นฟูความจำของผู้สูงอายุที่มีความเสี่ยงในการเกิดภาวะสมองเสื่อมโดยใช้กิจกรรมตามหลักปรัชญามอนเตสซอรี 2) ประเมินคะแนนความจำก่อนและหลังการทดลองใช้แอปพลิเคชันฝึกความจำเพื่อฟื้นฟูความจำของผู้สูงอายุที่มีความเสี่ยงในการเกิดภาวะสมองเสื่อมโดยใช้กิจกรรมตามหลักปรัชญามอนเตสซอรี และ 3) ประเมินความพึงพอใจของผู้สูงอายุที่มีความเสี่ยงในการเกิดภาวะสมองเสื่อมต่อการใช้แอปพลิเคชันฝึกความจำเพื่อฟื้นฟูความจำของผู้สูงอายุที่มีความเสี่ยงในการเกิดภาวะสมองเสื่อมโดยใช้กิจกรรมตามหลักปรัชญามอนเตสซอรี กลุ่มตัวอย่าง คือ กลุ่มผู้สูงอายุ จำนวน 100 คน โดยการเลือกกลุ่มตัวอย่างแบบเฉพาะเจาะจง ซึ่งมีการศึกษาตั้งแต่ประถมศึกษาเป็นต้นไป สามารถช่วยเหลือตนเองได้ และได้รับการคัดกรองแบบตรวจสภาพสมองของคนไทย (TMSE) และมีผลคะแนนน้อยกว่า 23 คะแนน เครื่องมือในการวิจัย ได้แก่ แอปพลิเคชันฝึกความจำเพื่อฟื้นฟูความจำของผู้สูงอายุที่มีความเสี่ยงในการเกิดภาวะสมองเสื่อมโดยใช้กิจกรรมตามหลักปรัชญามอนเตสซอรี และเครื่องมือในการรวบรวมข้อมูล ได้แก่ แบบตรวจสภาพสมองของคนไทย (TMSE) และแบบสอบถามความพึงพอใจของผู้ใช้งานแอปพลิเคชันฝึกความจำเพื่อฟื้นฟูความจำของผู้สูงอายุที่มีความเสี่ยงในการเกิดภาวะสมองเสื่อมโดยใช้กิจกรรมตามหลักปรัชญามอนเตสซอรี ค่าสถิติที่ใช้การวิเคราะห์ข้อมูล ได้แก่ ค่าเฉลี่ยและส่วนเบี่ยงเบนมาตรฐาน ผู้วิจัยได้พัฒนาแอปพลิเคชัน “Brain Booster” บนอุปกรณ์พกพาในระบบปฏิบัติการแอนดรอยด์ ผลการวิจัยพบว่า คะแนนความจำของผู้สูงอายุที่มีความเสี่ยงในการเกิดภาวะสมองเสื่อมหลังการทดลองโดยใช้แอปพลิเคชันฝึกความจำเพื่อฟื้นฟูความจำของผู้สูงอายุที่มีความเสี่ยงในการเกิดภาวะสมองเสื่อมโดยใช้กิจกรรมตามหลักปรัชญามอนเตสซอรีสูงกว่าก่อนการทดลองอย่างมีนัยสำคัญ ที่ระดับ .01 และผลการศึกษาค่าความพึงพอใจของผู้สูงอายุที่มีต่อแอปพลิเคชันพบว่าผู้สูงอายุมีความพึงพอใจในภาพรวมอยู่ในระดับมาก คิดเป็นค่าเฉลี่ยเท่ากับ 4.44

และส่วนเบี่ยงเบนมาตรฐานเท่ากับ 0.53 นอกจากนี้จากการสังเกตพบว่าผู้สูงอายุส่วนใหญ่ได้รับความสนุกสนานในการเล่นเกมส์มองจากแอปพลิเคชัน และเนื่องจากแอปพลิเคชันถูกออกแบบให้ง่ายต่อการใช้งานและไม่ซับซ้อนจึงไม่ทำให้เกิดปัญหาการใช้งานแอปพลิเคชันของผู้สูงอายุ

**คำสำคัญ:** ภาวะสมองเสื่อม; ผู้สูงอายุ; เทคโนโลยี; หลักปรัชญามอนเตสซอรี; แอปพลิเคชัน

### Abstract

This research aimed 1) to establish a memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities, 2) to investigate the memory scores before and after the trial of the mentioned memory training application for memory rehabilitation of elderly with dementia, and 3) to examine the satisfaction of elderly with dementia towards the mentioned memory training application for rehabilitating their memory. The sample group consisted of 100 elderly who were selected using purposive sampling method. They were required to have education from elementary school onwards, and be able to help themselves. Moreover, they had to be screened by implementing the Thai Mental State Examination (TMSE) and the result scores must be less than 23 points. The research instrument for treatment was the memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities, whereas the research instruments for collecting data were TMSE and a satisfaction questionnaire on the use of the memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities. The data were statistically analyzed for mean and standard deviation. The researchers developed an application called "Brain Booster" on the Android operating system. The findings showed that after using the memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities, the memory score of the elderly with dementia was significantly higher than before the experiment at the .01 level. Moreover, the overall satisfaction of the participating elderly was at a high level, with the mean of 4.44 and the standard deviation of 0.53. In addition, it was observed that most of the elderly had fun playing the brain training games from the application. Besides, the application was designed to be easy to use and uncomplicated, so it did not cause problems in using the application for the elderly.

**Keywords:** Dementia; Elderly; Technology; Montessori Philosophy; Application

### Introduction

According to The Office of the National Economics and Social Development Council, Thailand was expected to be a complete aged society in 2021. The 60-year-old populations were approximately 11.3 million representing 16.7 percent of the total population in 2021 [1]. An increase in number of elderly populations result in the problem of high medical expenses for various chronic diseases. One of the top five chronic diseases in the elderly is dementia which is a very dangerous disease for the elderly. Based on the severity of dementia, two methods for treating dementia have been found. First, there is the use of drugs to slow down the disease progression. However, this method has been found to have adverse drug reaction in patients [2]. The other

method is promoting and caring patients by using memory training activities. This method has been found to be an effective therapy for patients with early-stage dementia who can be screened.

From the literature review concerning memory-boosting activities in patients with dementia, it is found that there are several limitations of activities that have been used for dementia patients including language and communication differences, education and past experience differences, and cultural diversity. These limitations are the factors that cause the patient's memory rehabilitation activities to be unsuccessful.

However, the use of the Montessori-based activities is a very interesting concept. The Montessori philosophy is a concept based on non-competitive and cooperative activities. At first, it was developed and used by Dr. Maria Montessori with children to build a strong self-image, high levels of intellectual and social competence, and the confidence to face difficulties. The concept emphasizes on the importance of the individual potential, and also develops a holistic balance of physical, emotional, mental, social, intellectual and spiritual aspects. An important aspect of this philosophy is that participants are eager to experiment and choose activities based on their interests, which can lead to effective individual development [3]. The activities established from this concept are not very complicated. They are also easy to follow. They can reduce language, educational and cultural limitations. Most importantly, they are consistent and suitable for Thai elderly people. This claim came from Nanthachai's research on the effectiveness of memory training with activities according to the Montessori philosophy in the elderly with early dementia. She used daily activities that were in line with the Montessori philosophy to rehabilitate memory of elderly, such as making flower garlands, molding, cleaning, knitting, and making origami. She found that these basic activities helped prevent and delay dementia of the elderly [4]. The principle of organizing activities according to this concept starts from simple activities to more difficult and complicated ones. The activities focus on the connection of the various senses of perception, learning, and recognition of the elderly. Montessori-based activities are divided into 3 aspects of skill development, including life experience, sensory and academic aspects. It is also able to enhance brain performances that could protect and restore memories of the elderly with dementia. The activities provided are related to the elderly's daily life activities. They are not complicated, so that they will clearly affect patients' implicit memory [5].

According to previous research studies [4, 6], the Montessori philosophy was employed to create activities to rehabilitate memory of the patient or the elderly. Those activities were mostly daily activities; however, this research study aimed to establish a memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities through mobile channels. The researchers created activities based on the Montessori philosophy in the form of an application called "Brain Booster" that could be played using smartphones. The daily activities including cooking, arranging medicines, and shopping were done via smartphones. It was convenient and useful for patients with time and distance constraints as well as useful for medical personnel as there had been a shortage of medical personnel. This tool could help reduce the initial burden of medical personnel which was directly beneficial to the elderly and early-stage patients with dementia who could restore their memory. Furthermore, it could help train the memory of the elderly which resulted in the reduction of the burden for caregivers, families, medical personnel as well as the elderly and patients with dementia to have a better quality of life.

## Objectives

1. To establish a memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities
2. To investigate the memory scores before and after the use of the memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities
3. To examine the satisfaction of the elderly with dementia towards the memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities

## Methods

This research was a participatory action research with the one group pretest-posttest design. The sample group in this research consisted of 100 elderly people who were selected using purposive sampling method. The criteria were that they could be either male or female who had education from elementary school onwards, owned Android smartphones, and were able to help themselves. They needed to be willing to cooperate until the end of the research project with the research team. Moreover, they had to be screened by implementing the Thai Mental State Examination (TMSE) and the result scores must be less than 23 points which were considered as having dementia. All processes of the research including surveying, collecting data and testing the instrument were conducted from January until December 2022. The research process was explained as follows.

1. Documents, which were a secondary source, concerning dementia symptoms, the Montessori philosophy, and the use of technology to develop applications were reviewed.

2. Official letters were sent from Chiang Mai Rajabhat University to the mayors of Nong Phueng, Yang Noeng and Saraphi subdistrict municipalities for permission to conduct a study with the sample group. After that, a meeting was convened for the mayors and heads of the elderly association of the three municipalities in order to clarify the purposes of the research and to request their collaboration for data collection.

3. The population of this research was 6,985 elderly people, whose age was 60 years and over, living in Nong Phueng, Yang Noeng and Saraphi subdistrict municipalities, Chiang Mai province. The purposive sampling method was applied to select the sample group of 100 male and female elderly people. They were required to complete the Thai Mental State Examination (TMSE). TMSE is a kind of assessment used in Thailand to screen cognitive impairment and dementia. The assessment consists of 30 items and is divided into six parts including orientation, registration, attention, calculation, language, and recall. The assessment should be performed by medical professional as they have a specific expertise. The suggested threshold to identify cognitive impairment is 23 out of 30 [7]. The TMSE scores of the participants must be less than 23 points, so they were classified as the elderly with dementia. Additionally, the assessment of dementia in this research was performed by medical professional.

4. The researchers conducted the focus group discussion with the sample. The topics including the routine activities, the favorite hobbies, kinds of favorite games, the health problems, physical constraints, the computer knowledge, the frequency of mobile use, and opinions about traditional games and digital games were discussed to elicit the data as the primary data which meet the needs of the elderly. It was concluded

that there were some aspects that the researchers should concern for designing the user interface of the digital games including the high-definition color contrast, avoiding small images and instructions, using sounds with tones of lower frequency, providing information through some mechanism, and avoiding situations which required a higher level of attention.

5. All obtained primary and secondary data were used to design memory training games, based on the Montessori philosophy, which were consistent with the patients' context. The games were divided into three aspects including life experience and movement, sensory and movement, and academic and movement.

6. The Montessori philosophy was used as a basis to design games. Three games were created to match participants' life styles and needs. The games were related to the participants' daily lives including cooking, arranging medicines, and shopping. Each game was divided into three levels: easy, moderate, and difficult. The levels of the games depended on the complexity of the processes in the games. The contents in the games were checked by three medical personnel. The mean of the content accuracy assessment by experts was 4.4.

7. The verified data was used to create a storyboard. It described the form of the application, which divided the activities into three main aspects including life experience and movement, sensory and movement, and academic and movement. The operation at this stage was under close consultation of medical personnel.

8. The application was developed by using System Development Life Cycle (SDLC) along with the design of the working process of the system.

9. The finished application was checked by three technical experts to inspect the quality of the application. It was found that the overall technical suitability of the application was at the highest level, with the mean of 4.57.

10. After implementing the application to the target group, their memory performance was measured again by using the Thai Mental State Examination (TMSE). The screening and assessment were only carried out by medical personnel.

11. The memory scores before and after the use of the memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities were compared.

12. The researchers calculated the statistical value using mean and standard deviation.

13. The researchers examined the satisfaction of the participants towards the use of the memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities.

## Results

### **1. The result of establishing the memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities**

The result of establishing the memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities was shown as follows.

The application could be downloaded from Google Play. After the installation was complete, the system displayed the Brain Booster icon screen shown in Figure 1.



Figure 1 The Brain Booster application icon.

There were three different games to be played including The Egg Game, The Medicine Preparation Game, and The Shopping Game as shown in Figure 2.



Figure 2 Three games of the Brain Booster application.

The Egg Game had three levels of difficulty from easy, moderate, to difficult. In the easy level, the missions were to boil a soft-boiled egg, a medium-boiled egg and a hard-boiled egg. Moderate-level missions were to fry star, heart, and flower shaped fried eggs. For difficult level, the missions were to make shrimp, minced pork and minced meat omelets respectively, as shown in Figure 3.



Figure 3 The Egg Game.



Figure 4 The Medicine Preparation Game.

Figure 4 demonstrated the second game, The Medicine Preparation Game, which also had three levels of difficulty. The users were required to arrange pills according to the prescribed color and number of tablets in the easy level. In the moderate level, the mission was to arrange the pills according to the shapes of the shadows given. Finally, in the difficult level, the users were required to arrange pills according to the shapes of the shadows and the prescribed number of pills.

The last game in Figure 5 was The Shopping Game. The users were required to buy things at a price of tens, hundreds, and thousands in the easy, moderate, and difficult levels respectively.



Figure 5 The Shopping Game.



Comparing the mean scores by gender based on kinds of games, it was found that the average score of elderly women (85.23) was overall higher than elderly men (69.71) in The Egg Game. It could be hypothesized that women would cook more than men and that greater disparities in cooking frequency were associated with the lower scores of The Egg Game in men. For The Medicine Preparation Game, and The Shopping Game, there was no significant difference between gender. The mean score of elderly men was 86.08 and the mean score of elderly women was 89.12 in The Medicine Preparation Game. Also, the mean score was 87.25 for men and 86.74 for women in The Shopping Game. This was because the system design and development were based on a focus group discussion which provided firsthand information that met the needs of the elderly both male and female. Furthermore, the elderly often engaged in these types of activities as part of their daily routine. As a result, they had the same search score.

## **2. The memory scores of the elderly assessed by using TMSE before and after the implementation of the memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities**

**Table 1** The comparison between the memory scores of the elderly assessed by using TMSE before and after the use of the memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities.

<b>Memory scores</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>t</b>
Before experiment	100	17.23	2.214	-35.448**
After experiment	100	23.07	2.268	

\*\*significant at the .01 level.

From Table 1, the mean of memory score before experiment was 17.23 and the standard deviation was 2.214, whereas the mean of memory score after experiment was 23.07 and the standard deviation was 2.268. Thus, it could be concluded that the memory score of elderly with dementia after the use of the memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities significantly higher than before the experiment at the .01 level.

## **3. The satisfaction of the elderly with dementia towards the memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities**

After the application was implemented, the researchers investigated the satisfaction of 100 elderly who participated in the study towards the use of the memory training application. The satisfaction result was summarized in Table 2.



**Table 2** The satisfaction of the elderly with dementia towards the memory training application.

Statements	Satisfaction levels		
	Mean	S.D.	Meaning
<b>1. Design and layout of users' screen</b>			
1.1 The design of the application screen is pleasant to use.	4.68	0.47	highest
1.2 The design of the application screen makes it easy to use.	4.04	0.49	high
1.3 The design of the application screen focuses on convenient exchange of information between users.	4.40	0.49	high
1.4 The design of the application screen allows easy access to all menu.	4.54	0.50	highest
1.5 Fonts and pictures in the application are appropriate.	4.66	0.48	highest
1.6 The background colors and font colors are easy to read.	4.44	0.50	high
Total	4.46	0.49	high
<b>2. Language</b>			
2.1 The language used in the application is correct.	4.40	0.47	high
2.2 The language used in the application is easy to understand.	4.40	0.49	high
2.3 The language used in the application is appropriate for the users.	4.54	0.55	highest
Total	4.44	0.50	high
<b>3. The operation of the application</b>			
3.1 The application works properly.	4.36	0.48	high
3.2 The processing of data of the application is fast.	4.44	0.65	high
3.3 The application file size is appropriate.	4.44	0.71	high
3.4 The application is easy to use and not complicated.	4.04	0.53	high
Total	4.32	0.60	high
<b>4. Others</b>			
4.1 It is a useful application.	4.44	0.48	high
4.2 The application can be actually used.	4.56	0.50	highest
4.3 The application is different from other applications.	4.62	0.49	highest
Total	4.54	0.49	highest
<b>Total satisfaction</b>	<b>4.44</b>	<b>0.53</b>	<b>high</b>

According to Table 2, the overall satisfaction of the elderly with dementia towards the memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities was at a high level, with the mean of 4.44 and the standard deviation of 0.53. When each item was taken to consideration, it was found that the elderly with dementia had the highest satisfaction with the others aspect, with the mean of 4.54 and the standard deviation of 0.49. It was followed by the design and layout of users' screen aspect, with the mean of 4.46 and the standard deviation of 0.49; the language aspect, with the mean of 4.44 and the

standard deviation of 0.50, and the operation of the application aspect, with the mean of 4.32 and the standard deviation of 0.60 respectively. Additionally, from the suggestions, the majority of the participants were satisfied with the games in the application because they were related to their daily activities. The application was also easy to use and uncomplicated. Besides, some suggested that there should be more games related to their daily lives, such as other kinds of cooking games apart from egg game.

## Conclusions and Discussion

In this research, the memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities was established. It was discovered that the memory score of the elderly with dementia after the use of the memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities was significantly higher than before the experiment at the .01 level. Moreover, the overall satisfaction of the elderly with dementia towards the memory training application was at a high level, with the mean of 4.44 and the standard deviation of 0.53.

The memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities was established and derived from the collaboration among all concerned parties in designing the activities based on the Montessori Philosophy principle including medical personnels, local organizations, village health volunteers, elderly people, and researchers. The collaboration of all parties could strengthen the power of community participation. The importance of promoting brain health in the elderly was emphasized as an incentive to raise awareness of the importance of the elderly in the community to have the good memory performance. According to the elderly's memory score after using the memory training application, it could be claimed that this tool could benefit the elderly's brains. This resulted in slowing down the deterioration of the brain which could be regarded as the starting point of promoting the health of the elderly to be more effective. The result was in line with Nanthachai that the average memory scores of the experimental groups were significantly higher than the controlled group after using the Montessori Philosophy-based activities to train their brains [4]. Furthermore, the participants or the elderly with dementia in this research were satisfied with the memory training application for rehabilitating their memory. According to the satisfaction questionnaire, it could be concluded that the elderly were satisfied with all aspects of the application including design and layout of the application, language used in the application, the operation of the application, and so forth. They also had a positive attitude toward the games in the application as well. In terms of application design and development, the concept of selecting pictures and colors had been incorporated into the application design. With increased age, there are a loss of contrast sensitivity, a reduction in the range of visual accommodation, difficulties with dark adaptation, and declines in color sensitivity. These vision changes could make it more challenging for elderly individuals to perceive the details on a screen. Consequently, the application was designed by using short, concise, and easy-to-understand texts to suit the age range of the users. Besides, the color composition and size of pictures also played a part in reducing the visual constraints of elderly people, capturing the users' attention which corresponded with Kamsuwan and Thongngao that media in graphic form could help people to have better knowledge and understanding faster and more clearly than communication in the form of texts alone [8]. Furthermore, the research result of Trithossadech confirmed that graphical presentations were very

useful in conveying information [9]. Human perceived visual information better than written or verbal information, including color and beauty, which could make users or readers more interested and remembered.

Additionally, activities were design in the form of a game application that was consistent with the principle of Montessori Philosophy. The activities emphasized and developed a holistic balance of the elderly from simple activities to more difficult and complex ones. This led to the three aspects of skill development including life experience, sensory and academic aspects. It brought about the establishment of activities that the elderly could perform in order to exercise their brain as well as to protect and restore their memory. This was consistent with Kanagawa et al. that the caring of the elderly to prevent dementia should include an early assessment of dementia symptoms, recruitment of public health volunteers, and the establishment of specific care activities for elderly with dementia [10]. The use of Montessori-based activities in the form of game application was able to raise awareness of the importance of the elderly in the community and the activities could be accomplished because the community was satisfied with helping taking care of the elderly.

### **Suggestions**

#### **General suggestion**

The “Brain Booster” application is a memory training application for memory rehabilitation of elderly with dementia using Montessori-based activities. This application has been implemented within the area of Saraphi district, Chiang Mai province. It should be supported and developed further. Furthermore, it should be disseminated and publicized to other elderly groups in the upper northern region that has a similar context. They can further use the application to promote brain health care of the elderly in order to delay the onset of dementia, which leads to a sustainable quality of life development model for the elderly.

#### **Suggestions for further study**

1. A function to collect user information should be added in the application in order to be processed into the big data, so that the information obtained from the system can be used to improve the public health system in the form of information as part of the determination of guidelines or policies in public health of the government
2. The application should be inserted with the function that can connect to relevant public health departments.
3. The application should be developed on smartphones that are compatible with the IOS operating system.

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