THE EFFECTIVENESS OF A TAILORED YOGA-BASED MINDFULNESS PROGRAM ON COGNITIVE FLEXIBILITY AND EMOTION REGULATION IN THAI OLDER ADULTS: A MIXED-METHODS PILOT STUDY

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THE DISSERTATION TITLED

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BY

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The effectiveness of a tailored yoga-based mindfulness program in enhancing cognitive flexibility and emotional regulation among Thai older adults was assessed in this mixed-methods pilot study. Phase 1: the experiment. Twenty-three volunteers aged 60 to 69 were allocated to a control group (n = 10) and an experimental group (n = 13), which underwent a mindful yoga program consisting of 16 sessions lasting 60 minutes each over eight weeks. The Cognitive Flexibility Inventory and the Emotion Regulation Questionnaire (Thai version) were used to assess cognitive flexibility and emotion regulation. Multivariate analysis revealed significant improvements in the experimental group's cognitive flexibility and emotion regulation through reappraisal strategies (Wilks' Lambda = .082, $F(4, 18) = 50.345$, $p < .001$). During the experiment, based on qualitative data from after-action reviews, neuroplastic changes were promoted by observational learning, repetition, and mindfulness practice. Phase 2: qualitative findings from in-depth interviews. Eight participants benefited from mindful practice in yoga poses, breathing exercises, mindfulness meditation, and group activities informed by Thai culture. Improvements in physical and mental health led to intrinsic motivation, which supported continued program participation. However, this study was limited by the small sample size and the lack of gender diversity. To improve generalizability, future studies should aim for a larger and more gender-diverse sample. Introducing this program has practical implications for enhancing older adults' mental and emotional well-being without pharmaceuticals. The results highlight the program's effectiveness and suitability for Thai older adults.

Keyword : Yoga-based mindfulness, Cognitive flexibility, Emotion regulation

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FINALLY, I DEDICATE THIS WORK TO ALL THOSE TRAVERSING THE PATH OF AGING. MAY YOU WALK IT WITH GRACE, ADAPTABILITY, EMOTIONAL RESILIENCE, AND DIGNITY.

AREEYA NILSSON

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INTRODUCTION

Background

The Thai Gerontology Research and Development Institute estimates 20% of Thais are elderly population. Research suggests Thai older adults are depressed (Sungprakorn & Tangwongchai, 2019). Life problems and social isolation can cause depression. Global issues have increased depression and anxiety in Thailand. Older adults are more susceptible to these effects due to their decreased adaptability and receptivity to new experiences (Schwaba, Luhmann, Denissen, Chung, & Bleidorn, 2018). Depression has increased in Petchburi, the central west province with the most elderly living alone. Research emphasizes that social engagement reduces depressive symptoms in older adults and also improves cognitive health (Choi et al., 2021; Huang, Liu, Liang, Wang, & Guo, 2023).

Cognitive flexibility is important for mental health and well-being, especially as individual gets older (Diamond, 2013). This cognitive skill can adapt to changes that happen as aging process (Magnusson & Brim, 2014). As people get older, the cognitive flexibility decreases, which makes it harder to adapt to new situations and environments (Buitenweg, van de Ven, Ridderinkhof, & Murre, 2018). In Wisconsin card sorting, this drop is clear, and new rules are needed. Study found that some experiences and interventions might make older adults more cognitively flexible (J. I. V. Buitenweg, R. M. van de Ven, S. Prinssen, J. M. J. Murre, & K. R. Ridderinkhof, 2017). In neurodegenerative diseases like Parkinson's and Alzheimer's, cognitive flexibility impairment is often a sign of executive dysfunction. These diseases cause synaptic dysfunction and neurogenesis (Skaper, Facci, Zusso, & Giusti, 2017; Winner & Winkler, 2015). Impaired cognitive flexibility can be indicator of executive dysfunction (Lange et al., 2016; Uddin, 2021). Social activities and cognitive stimulation may slow the progression of Alzheimer's disease and dementia and improve cognitive reserve (K. A. Treiber et al., 2011).

To regulate emotions, individual needs to be able to think flexibly (Malooly, Genet, & Siemer, 2013). Poor emotion regulation is related to depression and anxiety. (Joormann & Gotlib, 2010; Loevaas et al., 2018). Individuals with high levels of anxiety often show cognitive inflexibility (Wilson, Nusbaum, Whitney, & Hinson, 2017). This inflexibility can hinder thinking, response, or staying focused (L. Morris & Mansell, 2018; Zou, Li, Hofmann, & Liu, 2020). So, managing negative thoughts, feelings, and experiences is a part of mental health (J. Gross & John, 2003). Cognitive reappraisal and expressive suppression are two common ways to deal with emotions. Study found that those with high expressive suppression strategy scores are more likely to be in psychological distress (D. A. Preece, Becerra, Robinson, & Gross, 2020).

Certain interventions, such as cognitive behavioral therapy or CBT, can effectively improve cognitive function and manage emotions. (Hofmann, Asnaani, Vonk, Sawyer, & Fang, 2012). Mindfulness meditation intervention can also manage emotions, and promote self-awareness (Goldin & Gross, 2010). Mindfulness meditation in a four-day study can improve cognitive processing, attention, thinking and mood (Zeidan, Johnson, Diamond, David, & Goolkasian, 2010)

Yoga is form of exercise. It can promote cognitive function and emotion regulation, also improve mood and mental health. Exercise boosts Brain-derived neurotrophic factor (BDNF), neurogenesis, neuronal activity, and neurotransmitter function (Cotman & Berchtold, 2002). In depression, yoga increases BDNF (Naveen et al., 2016), and changes brain structure, including hippocampus cortical thickness and gray matter and amygdala gray matter (Gothe, Khan, Hayes, Erlenbach, & Damoiseaux, 2019; van Aalst, Ceccarini, Demyttenaere, Sunaert, & Van Laere, 2020). Studies suggest yoga may prevent depression recurrence and boost mood (Gong, Ni, Shen, Wu, & Jiang, 2015). Malhotra et al. (2023) study found that yoga reduced depression, anxiety, and stress in older adults after 6 weeks.

Yoga, as group-based program in older adults can be considered as a safe, moderate, and social intervention. Yoga is the ideal practice for body, mind, emotions, and peace of mind (Taimni, 1961), but there is no study how it affects cognitive flexibility

in executive function and emotion regulation, especially in older Thai adults. So, the goal of this study is to introduce a yoga-based mindfulness practice to this group to promote flexibility in their thinking and better at regulating their emotions.

Mindfulness meditation improves cognitive flexibility and emotion control, but Westerners have studied it most, leaving Thai older adults demographic unaware. Due to significant developmental changes in emotional, cognitive, and social domains, adolescent emotion regulation has been extensively studied from early to modern times (Silk, Steinberg, & Morris, 2003; Zagaria et al., 2023). Thai older adults' emotion regulation with mind-body exercises is understudied. Meditation and mindfulness have been studied more, but theoretical and empirical gaps remain. There is a theoretical gap in how different meditation traditions affect cognitive flexibility because only concentrative meditation does (B. Müller, A. Gerasimova, & S. Ritter, 2016).

Kabat-Zinn (1990) states that mindfulness is being aware of the present moment without judging it. Langerian mindfulness (Pirson, Langer, Bodner, & Zilcha-Mano, 2012) has been shown to lower depression and anxiety (Pagnini et al., 2019). However, their efficacy across cultures is unknown. This highlights the need to study mindfulness-based practices in Thailand, especially in relation to neuroplasticity (FitzGerald & Folan-Curran, 2002), and observational learning (Bandura, 1977). Current study on cognitive interventions for older adults recommends to focus on diverse, engaging, and socially interactive group-based activities tailored to individual needs (J. I. V. Buitenweg et al., 2017). This study examines mindfulness therapies that use neuroplasticity and observational learning to improve cognitive and emotional health in aging adults to fill these gaps.

Research questions

1. How does the effectiveness of a yoga-based mindfulness program in enhancing cognitive flexibility and emotion regulation vary among Thai older adults?

2. How do Thai older adults experience and perceive learning new skills and acquiring knowledge through the program activities, as guided by neuroplasticity model

of mindfulness and observational learning, contribute to their overall learning processes and outcomes?

3. How do Thai older adults perceive and experience the yoga-based mindfulness program, and what parts of specific components of the program are perceived to be most beneficial and culturally suitable for Thai older adults?

Objectives of the study

1. To assess the preliminary effectiveness of a yoga-based mindfulness program aimed at enhancing cognitive flexibility and emotion regulation among Thai older adults.

2. To explore how Thai older adults can enhance their learning processes through yoga-based mindfulness activities, applying the neuroplasticity model of mindfulness through repetition in practice, alongside the observational learning by observing and modeling behaviors demonstrated by yoga teacher.

3. To gain insights of the program's impact and to determine the most suitable components in postures, breathing exercises, session stage, program duration, and frequency for Thai older adults to inform program development or improvement.

Significance of the study

Theoretical significance

This study contributed how mindfulness-based intervention affects older adults' cognitive flexibility and emotion regulation. It examined how neuroplasticity and observational learning could improve cognitive and emotional abilities in old age. Studying yoga-based mindfulness enhanced Kabat-Zinn and Langer's understanding of mindfulness.

Operational significance

This study made a learning program for Thai older adults operationally beneficial. It improved mental, cognitive, and physical health as a non-pharmaceutical alternative. Its personalized framework, based on participants' needs and limits, contributed it more practical and acceptable. Group-based approaches promoted

social connection and engagement for healthy aging. Possible program beneficiaries are as follows:

Yoga/ meditation practitioners

The program can be presented as an alternative to physical and mental health. Cognitive flexibility and emotion management are the program goals. Yoga-based mindfulness approach improves cognitive performance, mental health to reduce stress and anxiety, and physical health to optimize balance and flexibility.

Older adults

Rural young-old healthy older adults without mild cognitive impairment (MCI) or mental health issues benefit from this study. These participants learn lifelong practice to enhance cognitive flexibility and emotion management through yoga-based mindfulness program.

Scope of the study

To evaluate the preliminary effectiveness of a yoga-based mindfulness program on cognitive flexibility and emotion control in Thai older adults. Experiment group participants discussed how program activities, neuroplasticity model of mindfulness, and observational learning improve learning. The insights were combined with in-depth interview data in phase 2.

1. **Research participants**

Phase 1 and during the experiment: This study focused on Thai older adults in the 'young-old' stage of Petchburi province, Thailand, the majority of whom are aged 60–69. Petchburi's 2021 registration statistics show 53,033 people in this demographic, a large portion of the province's older adult population. Thai older adults in the 'young-old' stage in the sub-district of Petchburi, Thailand, aged 60–69, who have retired from full-time jobs were selected for this study. 23 people were sampled. The Mental Health Department of Thailand's cognitive impairment assessment tools and the Thai translation of the Cognitive Flexibility Inventory identified these participants. A Cognitive Flexibility Inventory score of 20–100 is required for sample selection. 13 participants were in the experimental group and 10 in the control group.

Phase 2: Thai older adults in the 'young-old' age group (60–69 years) from Petchburi Province who participated in the yoga-based mindfulness intervention. Participants from Phase 1 were selected for Phase 2 based on Cognitive Flexibility Inventory scores. Eight participants were chosen, four with top CFI scores and four with bottom CFI scores. Purposive sampling was used to get findings at the views and experiences of the participants. Semi-structured, in-depth interviews had been conducted to find out how well the program worked and how well it fit their needs.

2. Study contents and variables

Phase 1 Contents: Participants reflected on their yoga learning experiences during Phase 1. The neuroplasticity model of mindfulness and observational learning were informed questions.

Phase 1 Variables: The independent variable was yoga-based mindfulness. Cognitive flexibility and emotion regulation were dependent variables.

Phase 2 Contents: The two main areas of Phase 2 were: (1) Program impact on health and well-being, and (2) Key components and participant preferences.

Definition of terms

Pilot study

Pilot studies examine how possible, acceptable, and accessible it is to carry out a research intervention. Because it has a small sample size and is exploratory, this study design can help improve research methods, measurement tools, and intervention content before a full-scale study (Kunselman, 2024). A tailored yoga-based mindfulness program for Thai older adults was investigated in this study. In non-hypothesis-driven pilot studies, inferential statistics remained valuable to estimate effect size. The major objectives justified the sample size, and hypothesis-testing examined initial intervention outcomes.

Tailored-intervention

Tailored-interventions are planned to improve professional practice based on prospectively identified determinants (Baker et al., 2015). Besides professional practice, tailored interventions are used in public health and community-based

programs (Rimer et al., 1999). The target group's needs or characteristics are used to design these interventions, with content and delivery tailored to improve relevance and effectiveness. A “tailored” program for Thai older adults in this study was defined as a structured, responsive intervention for physical safety, psychological comfort, and health condition alignment, the program has multiple layers of customization and personalization including health screening, expert validation, try-out group feedback, and group levels based on physical ability; classified group A for participants with physical limitations; mobility-limited condition and group B for participants in generally good health; strong condition.

Older adults

Department of older persons, Ministry of social development and Human security, Thailand defines 'young-old' as 60–69-year-olds retired from full-time work.

Yoga

APA dictionary of psychology states 'yoga' comes from Sanskrit for 'union' or 'yoke'. Practical instruction aims to unite the human and universal spirits. Yoga releases tension and redirects energy (prana) by regulating breathing and adapting bodily postures (asanas), resulting in self-control, physical and mental relaxation, and deep contemplation.

Mindfulness and mindfulness meditation

Kabat-Zin (1990) defined mindfulness as sustaining attention on the present moment and being aware of what's going on inside individual. It is the state of being aware of owns thoughts, feelings, and physical sensations without judging them. Mindfulness meditation is an ancient Buddhist practice that aims to bring about lasting happiness and relief from pain. Mindfulness meditation can help individual to pay attention better by focusing on breathing (Kabat-Zinn, 1990; Wolkin, 2015).

Langerian Mindfulness means being open to new experiences and being able to change. To be more present, one needs to pay attention to new differences and accept uncertainty. Being mindless means being inflexible, not paying enough attention to what's going on right now (Langer, 1989, 1992) and having trouble adjusting to new situations (Langer, 1992; Pagnini, Bercovitz, & Philips, 2018).

Cognitive Flexibility

The Cognitive Flexibility Inventory (CFI) defines this as the ability to switch between cognitive frameworks or mental approaches in response to environmental stimuli (Dennis & Vander Wal, 2010).

Emotion regulation

An Emotion Regulation Questionnaire (ERQ) developer, J. J. Gross (1998), defined emotion regulation as managing emotional experiences and expressions. Management of emotions is the focus of emotion regulation. It transcends psychology subfields and unites fields.

CHAPTER 2
LITERATURE REVIEWS

In the study, a yoga-based mindfulness program was developed to improve cognitive flexibility and emotion regulation in older adults, explore how learning new skills and acquiring knowledge through yoga-based mindfulness activities can enhance learning processes, and gain insights into the program's impact to refine programs tailored to Thai older adults. Relevant evidence, studies, and reviews are as follows:

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    1.2 Situation of older adults
    1.3 Intervention and Active Aging theory
    1.4 Related studies
2. Cognitive flexibility
    2.1 Definition and concept
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1. Older adults

1.1 Definition and concept

1.1.1. Defining old age: Societies define old age differently. According to Gorman (1999), aging is a biological reality of progressive decline, but its social interpretation varies between developed and developing contexts. Age, usually 60 or 65, is the main indicator of old age in developed nations, along with retirement age. Instead of numerical age, many developing countries define old age by social roles or physical abilities (Ajeh, Ndenkeh, Nji, Adedimeji, & Yumo, 2019).

1.1.2. Biological perspective on aging: WHO (2024) states that sustained molecular and cellular damage causes gradual declines in physical and mental capacity and increased disease risk. Changes are not uniform or age-dependent. Retirement, moving, and losing social connections; friends are also part of aging.

1.1.3. Common health conditions: Multi-chronic conditions are common in older adults. Hearing loss, vision problems, back and neck pain, osteoarthritis, depression, and dementia are examples. Frailty, incontinence, and delirium, often caused by multiple factors, are also at risk (WHO, 2024).

1.2 Situation and Challenges of Older Adults

Globally, the elderly population is growing rapidly. The WHO predicts that by 2030, one in six people will be 60 or older, up from 1 billion in 2020 to 1.4 billion. This number is expected to double to 2.1 billion by 2050, with 426 million over-80s. The demographic changes effect healthcare, the economy, and society.
In Thailand, from 2021, there were 12,116,199 older adults. Thailand is now one of the countries where the population is getting older very fast. "Young-old" (60–69 years) makes up 56.5% of older adults, "Middle-old" (70–79 years) 29.1%, and "Very old" (80+ years) 14.4%.

Challenges in cognition and emotion:

Older adults who have cognitive decline lose a lot of their independence and mental health. Neurodegenerative diseases like Parkinson's and Alzheimer's early decline executive functions like attention, memory, and adaptability (Lange et al., 2016; Willis, et al., 2022).

Cognitive issues in Thailand are compounded by emotional and social issues. A national study found that low social participation and high stress caused depression in one-third of retired Thai hospital employees. The Department of Thai Mental Health reported over 22,000 outpatient mental health visits in 2022, with depression and anxiety being the most common (Sungprakorn & Tangwongchai, 2019).

The rapidly aging Petchburi province is especially affected. The highest percentage of elderly people living alone (12.4% in 2020) and depression rates rise from 1% to 5% between 2021 and 2022. Social isolation and low engagement significantly increase depression risk in older adults (Huang et al., 2023; Choi et al., 2021). Solitude and lack of emotional support create a vulnerable environment that accelerates emotional and cognitive decline.

1.3 Interventions and Active Aging concept

The challenges with Thai older adults, such as physical health deterioration, cognitive decline, emotional vulnerability, and social isolation require effective and sustainable interventions. Active aging framework is suitable to address these issues. This aspect is guided by World Health Organization. It emphasizes health, participation, and security to improve quality of life in aging period.

Older adults need to have full potential in physical, social, and mental aspects and have the proper care and protection. Being "active" is beyond being physically active or working. It emphasizes further in social participation, economic, cultural, spiritual, and community activities. This approach includes older adults who are retired, sick, or disabled and can still help their families, communities, and society. The goal of the active aging framework is to help elderly live longer and healthier lives. “Health” definition by World Health Organization’s holistic is in line with this concept which is including; physical, mental, and social well-being. World Health Organization argues that programs that foster emotion resilience and social connection are very important as much as those that help older adults get better physically (World Health, 2002).

This research study found that the yoga-based mindfulness program helps individuals stay active as they age. Older adults can feel better, think more clearly, be more emotionally strong, and connect with others through physical movement, mindfulness practices, community support, and cultural values.

1.4 Related studies

As we age, cognitive functions normally decline. This decline affects executive function, especially cognitive flexibility as one of a key executive function. To Understand cognitive decline in older adults is crucial for developing strategies to improve cognitive health and to maintain independence, hence enhancing cognitive flexibility is much needed because it can improve cognitive function and also slow cognitive decline in aging.

Executive dysfunction is a transition between normal aging and dementia (Guarino, Forte, Giovannoli, & Casagrande, 2019). Mild Cognitive Impairment (MCI) , which causes declining cognitive function, attention, and memory in older adults (Ataollahi Eshkoor, Chan, & Ng, 2015), can possible benefit from cognitive interventions (Clément, Gauthier, & Belleville, 2012). In Parkinson's disease (PD), one of the most common neurodegenerative disorders in older adults (Willis et al., 2022) as well as executive dysfunction, cognitive flexibility is a major issue (Lange et al., 2016). Thus, older adults at risk of neurodegenerative diseases are likely to benefit from cognitive flexibility.

The surprising improvement in older adults' emotional well-being and ability to regulate emotions despite cognitive decline and neural function changes needs to be investigated. Older adults with higher fluid cognitive abilities can better regulate their emotions, leading to more adaptive outcomes and goal achievement (Opitz, Lee, Gross, & Urry, 2014).

Older adults tend to engage more with emotional stimuli, which contribute them in processing and memorizing emotions, especially the intense emotions and when the cognitive abilities are in higher level (Growney & English, 2022). Further, a systematic review stated that in this demographic, excessive rumination is strongly

linked to depression and anxiety (Ramirez Ruiz, Quinn, & Ferreira, 2019). Therefore, excessive rumination link is a gap highlighting the need for effective emotion regulation strategies.

2. Cognitive flexibility

2.1 Definition and concept

Cognitive flexibility is the ability to adapt goal-directed behavior to changing situational demands and is part of executive functions. To adapt to changing environmental stimuli (Gilbert & Burgess, 2008), cognitive flexibility directs switching between mental frameworks or cognitive sets (Dennis & Vander Wal, 2010). It's also the ability to adapt and switch between cognitive processes, including the mental capacity to switch concepts depending on the situation (Scott, 1962; Uddin, 2021). Critical to mental health and well-being, especially in later adulthood, cognitive flexibility helps reduce aging-related cognitive decline (Burke et al., 2019; Uddin, 2021).

Cognitive and behavioral flexibility include adaptive behavior changes in response to changing environmental conditions (Uddin, 2021). Based on conceptual frameworks, Johnco, Wuthrich, and Rapee (2013) emphasize that cognitive flexibility suggests different learning approaches and implies immediate integration of cognitive techniques. These methods are considered problem-solving steps.
In order to solve problems, make decisions, and adapt to different situations, cognitive flexibility is necessary.

According to Dennis and Vander Wal (2010), key elements of the idea include:

1) Perceptual adaptability: cognitive flexibility allows someone to see multiple explanations for life and human behavior. This diversity of viewpoints broadens understanding.

2) Problem-solving: the ability to see multiple solutions to difficult situations is crucial. High cognitive flexibility helps people brainstorm and consider different solutions.

3) Control: cognitive flexibility includes the tendency to see difficult situations as manageable. Believers in their ability to influence outcomes feel empowered and resilient in the face of adversity.

2.2 Measurement

Neuropsychological tests like the Wisconsin Card Sorting Test (WCST) (Grant & Berg, 1948) and the Stroop color-word Test (Golden, Golden, & Golden, 1978). assess cognitive flexibility. Self-report measures like the Cognitive Flexibility Scale (CFS) (Martin & Rubin, 1995) and CFI) (Dennis & Vander Wal, 2010) are also used. CFS involves changing thought and behavior, while CFI involves creating alternatives (Hohl & Dolcos, 2024).

The Cognitive Flexibility Scale (CFS) asks participants to rate 12 statements about flexible behaviors, such as "I can find workable solutions to seemingly unsolvable problems." Participants rate their agreement with statements about psychological inflexibility or experiential avoidance, such as "My painful memories prevent me from having a fulfilling life" on the Acceptance and Action Questionnaire (AAQ/AAQ-II) (Hohl & Dolcos, 2024).

Dennis and Vander Wal's Cognitive Flexibility Inventory (CFI) emphasizes that people with higher cognitive flexibility are more likely to adapt to difficult life experiences. Besides the initial 50-item Cognitive Flexibility Inventory (CFI), which evaluates perception of difficult situations as controllable, the ability to perceive multiple alternative explanations for life events and human behavior, and the ability to generate multiple alternative solutions to difficult situations, Refined version with 20 items was created later. Alternatives and Control, the two final CFI subscales, assess cognitive flexibility like the 50-item version.

Due to its ability to generate alternatives and relevance in applied psychology and real-world scenarios, this study used the abbreviated Cognitive Flexibility Inventory (CFI). Although neuropsychological tests are valid, self-report measures like the CFI are better for monitoring cognitive behavioral interventions. The CFI can be used for anxiety and mental health issues in older adults, despite its focus

on depression (Dennis & Vander Wal, 2010; Johnco et al., 2013). CFI assesses two cognitive flexibility factors:

1. Alternatives the adaptive ability to accept multiple explanations for life events and create multiple solutions to difficult problems. Samples: “I am good at sizing up situations.; I consider multiple options before making a decision”

2. Control an internal locus of control, or seeing difficult situations as somewhat manageable. Sample: "I have a hard time making decisions in difficult situations; I feel like I'm losing control."

Psychometric properties of the 20-item CFI included high test-retest reliability for the full score (r =.81), Alternatives subscale (r =.75), and Control subscale (r =.77; Dennis & Vander Wal, 2010). The Alternatives subscale (α =.91), Control subscale (α =.86), and full score (α =.90) had good to excellent Cronbach's alpha (Dennis & Vander Wal, 2010). Through their associations with other cognitive flexibility, depressive symptomatology, and coping measures, the CFI and its two subscales demonstrated convergent construct validity (Dennis & Vander Wal, 2010).

For this study, the researcher requested permission from Chulalongkorn University's Faculty of Psychology to use the Thai Cognitive Flexibility Inventory (CFI) (Rangsitsathian, 2019). Item 15 was removed from this translated version due to its low corrected item-total correlation. The CFI in Thai has strong internal consistency, with a Cronbach's alpha (α) coefficient of 0.873.

According to scoring and interpretation (Johnco et al., 2013), cognitively flexible people react adaptively to difficult life experiences, while cognitively inflexible people react pathologically. A clinical group (anxiety and depression) has significantly lower CFI total and subscale scores than a non-clinical sample. CFI scores have a total and two subscales. Higher scores indicate more cognitive flexibility, ranging from 20 to 140. According to the developer, there are no CFI total or subscale cutoff scores for high, moderate, and low flexibility. Use percentile cutoffs to determine research high and low flexibility scores. CBT should target clinically significant inflexibility at

percentiles below 25. According to CBT, cognitive inflexibility causes and maintains depression and anxiety. Both subscales measure important cognitive flexibility aspects:

1. Alternatives: assessing the ability to see multiple explanations for life events and human behavior and to find multiple solutions to difficult problems. Range 13-91. Numbers 1, 3, 5, 6, 8, 10, 12, 13, 14, 16, 18, 19, 20

2. Control: assessing the tendency to control difficult situations. Range 7–49. Total 7 items. Item 2, 4, 7, 9, 11, & 17 reverse scores

2.3 Interventions to enhance cognitive flexibility

Cognitive flexibility interventions in non-invasive ways are still being studied. The interventions' effects on cognitive function have been extensively studied. Reasoning and processing speed in older adults can be maintained with cognitive training (Rebok et al., 2014). Additionally, social support can protect against cognitive decline in old age (Sims et al., 2014). Exercise is considered as intervention to enhance cognition. This is because exercise can increase neural activity, neurotransmitter function, neurogenesis and brain-derived neurotrophic factor (BDNF), promoting brain plasticity and cognitive function (Cotman & Berchtold, 2002). Individuals who are active physically also have better executive functions, according to Uddin (2021). Despite age or health, exercise can foster brain function (Stillman, Esteban-Cornejo, Brown, Bender, & Erickson, 2020).

Research on cognitive flexibility interventions for older adults is growing. According to research, casual games and short activities can improve cognitive flexibility. Casual or short mathematical or memory games are most enjoyable to older adults. These activities increase compliance and beliefs about cognitive enhancement, improving cognitive flexibility (J. Buitenweg, R. van de Ven, S. Prinssen, J. Murre, & K. Ridderinkhof, 2017). Mindfulness meditation can enhance cognitive flexibility. This is because mindfulness practice boosts attention and cognitive flexibility (Moore & Malinowski, 2009). In addition, vagus nerve stimulation (VNS) can enhance cognitive flexibility, ANS flexibility enhancement has been studied to support this. (De Smet et al., 2023; Driskill, Childs, Itmer, Rajput, & Kroener, 2022).

In the combined intervention, Lin et al. (2021) showed that resonance frequency breathing (RFB) promoted autonomic nervous system flexibility. This study may not mention cognitive flexibility, but the RFB resembles a yoga breathing technique. Using the cognitive benefits of yogic breathing techniques, especially slow ones, may provide benefits similar to vagal nerve stimulation without surgery or medication (Pal, 2018). Yogic breathing exercises, or pranayama, can be used in combination with mindfulness meditation to improve attentional control skills, these skills are essential for cognitive flexibility (Moore & Malinowski, 2009). Yoga components include yogic breathing, yogic poses, and mindfulness meditation, this integration is shown to induce neuroplasticity.

Therefore, this comprehensive mindfulness practice, which involves both body and mind, may be a non-invasive way to improve cognitive flexibility, a vital cognitive function. Evidence-based studies show that yoga interventions improve cognitive function compared to control groups (Gothe et al., 2019). Additionally, cognitive flexibility may improve emotion regulation, particularly anxiety management. Anxiety-related cognitive rigidity can impair emotion regulation. Improved cognitive flexibility can help people adapt to difficult situations, reducing anxiety's impact on emotion regulation.

2.4 Related studies

As executive function is impacted by aging. Age can reduce cognitive flexibility, memory, and attention. Numerous research supports this conclusion. In older adults with mild cognitive impairment, the autonomic nervous system (ANS) training can help to slow dementia progression, according to Lin et al. (2021). Increasing ANS flexibility through resonance frequency breathing (RFB) training can also enhance cognitive training's effects on cognitive function. Research found that RFB improves ANS flexibility through paced breathing.

Another study examined how cognitive stimulation affects Alzheimer's disease patients' cognitive and functional decline (K. Treiber et al., 2011). According to the study, cognitive stimulation can slow cognitive decline in Alzheimer's disease by

increasing cognitive reserve. Thinking, reading, crossword puzzles, volunteering, traveling, and playing cards are cognitive activities. These activities boost thinking, memory, and attention, which can increase brain reserve capacity. Cognitive stimulation improves cognitive health later in life by slowing cognitive decline. The former study mentions ANS flexibility and uses resonance frequency breathing training, similar to yogic breathing techniques that affect neuroplasticity, the autonomic nervous system, and vagal nerves (Jerath, Edry, Barnes, & Jerath, 2006; Samiran Mondal, 2024). However, even the study does not explicitly mention cognitive flexibility, vagal nerves still play a crucial role in synaptic plasticity (Keute & Gharabaghi, 2021), and study shows that vagal nerve stimulation enhances cognitive flexibility (Borges, Knops, Laborde, Klatt, & Raab, 2020). Yoga, as a mindful practice, can stimulate cognitive functions by promoting concentrated attention and controlled breathing. Brain networks that support cognitive flexibility are Frontoparietal, midcingulo-insular, and frontostriatal, they support along the lifespan by adapting thoughts and behaviors (Uddin, 2021).

In summary, executive functioning in older adults needs cognitive flexibility to adapted to age-related challenges and diversity in life situations. Furthermore, validated measurement research on Thai older adults is not often studied. To fill in this gap, the yoga-based mindfulness program's target outcome and the Cognitive Flexibility Inventory (CFI) in Thai version are used to examine participants' adaptive thinking abilities in a culturally relevant and psychometrically approach.

3. Emotion regulation

3.1 Definition and concept

It is defined as to manage emotional experiences and expressions, according to J. J. Gross (1998). Focusing on emotion regulation distinguishes it from coping, mood regulation, defense mechanisms, and affect regulation. Psychology's emotion regulation spans subfields. Emotion regulation is the ability to control emotions, according to APA. Reframing situations, redirecting emotions toward positive outcomes, and using specific behaviors to manage emotional states are all part of explicit emotion

regulation. Implicit emotion regulation adjusts emotional intensity and duration without conscious monitoring. Across the lifespan, emotion regulation improves. Commonly called emotional regulation.

According to D. A. Preece et al. (2020), emotion regulation involves using various methods to control emotion intensity, duration, and expression. The following are two popular ways to manage emotions:

1. Antecedent-focused cognitive reappraisal involves changing one's thoughts about a situation to change its emotional impact. The meaning of an event is often reinterpreted. It boosts mental health.

2. Expressive suppression inhibits outward emotional expression and is response-focused. Those using this method usually hide their emotions. Alexithymia and psychological distress increase with this strategy.

Emotion regulation process model: (a) Situation selection: Choosing environments or situations that may affect emotions. Changes in the environment can affect emotional responses. To regulate emotions, focus on or away from specific stimuli. Changing thoughts or beliefs about a situation to regulate emotions. Modifying physiological, behavioral, or expressive responses to manage emotions (J. J. Gross, 2015).

3.2 Measurements

Emotion regulation can be assessed through various measurements such as the Emotional Dysregulation Questionnaire (Hair, Black, Babin, & Anderson), and the forms of Emotion Regulation Questionnaire (ERQ), in standard and in abbreviation. However, the difficulties in Emotion Regulation Scale are not fully captured emotional dysregulation, as a result, the Emotional Dysregulation Questionnaire (EDQ) has been created. Many psychological disorders are relevant to emotional dysregulation. In assessing emotional dysregulation, the Emotional Dysregulation Questionnaire has several benefits over the DERS, this is because of its comparable length and assessing improvement of emotional dysregulation, it can more accurately identify individuals'

emotion regulation deficits in clinical practice (Gill, Warburton, Sweller, Beath, & Humburg, 2021).

A brief emotion regulation assessment tool is ERQ-S (D. Preece, Petrova, Mehta, & Gross, 2023). The six items assess the cognitive reappraisal and expressive suppression strategies in shortened version. ERQ-S is a concise ERQ version that still maintains validity and reliability, not to include a fact of saving time for clinical use and research study.

The regular Emotion Regulation Questionnaire (ERQ). Based on its strong psychometric properties in Thailand, where a translated version is available, this study will use this version. The ERQ evaluates two main emotion regulation strategies.

1. "I control my emotions by changing the way I think about the situation I'm in." is one of six cognitive review items.

2. "When I am feeling negative emotions, I make sure not to express them." is one of four expressive suppression items.
In general community samples, ERQ has strong psychometric properties (D. A. Preece et al., 2020).

The two common strategies are presented in the 10 items. The 6-item is measured cognitive reappraisal scores represent good to excellent internal consistency (α =.89-.90). The expressive suppression strategy is scored over 4 items exhibit good to excellent internal consistency reliability (α =.76-.80). According to the reviews, cognitive reappraisal scores are negatively correlated with psychological distress and alexithymia, while expressive suppression scores are positively correlated with psychological distress and alexithymia.

These results confirm previous student sample findings, proving the ERQ's robustness across diverse community populations. The researcher requested permission from Chulalongkorn University's Faculty of Psychology to use the Thai version of the ERQ, translated from the original work, and assessed its validity and reliability. The initial pilot study obtained internal reliability scores of α = 0.84 for cognitive reappraisal and α = 0.50 for expressive suppression. The internal reliability of

expressive suppression has been improved to α = 0.72. The Thai version has acceptable internal reliability for cognitive reappraisal and expressive suppression, despite initial lower reliability. As a collectivistic culture, Thailand may interpret emotional regulation strategies differently than Western individualistic cultures (Srisa-ard, 2021).

Scores include ERQ and two subscale scores for scoring and interpretation. Total score ranges from 10 to 70, with higher subscale mean scores indicating more emotion control.

The higher of the score indicates the more often that emotion regulation strategy is used. Emotion regulation by cognitive reappraisal strategy have more affective, cognitive, and social consequences compared to expressive suppression strategy. The emotion regulation questionnaire has two key subscales:

1. Cognitive reappraisal: it involves changing one's ideas about a situation to change its emotional impact. Total at 6 items (1, 3, 5, 7, 9 and 10)

2. Expressive suppression involves repressing emotions. Total at 4 items (2,4,6 and 9)

3.3 Interventions to enhance emotion regulation

Older adults can improve emotion regulation with yoga, mindfulness, and emotion-focused therapy. Emotion-focused therapy helps elderly hypertensives manage emotions and stabilize blood pressure (Witten, Coetzer, Rowlands, & Turnbull, 2023). In older adults with chronic health conditions and couple relationships, mindfulness interventions improve emotion regulation.

Emotion regulation can be more challenging in aging, especially for older adults with chronic health conditions, according to 44 studies (Moye, 2023). Cognitive reappraisal, a positive key emotion regulation strategy, can be enhanced by mindfulness meditation (Garland, Hanley, Farb, & Froeliger, 2015). One study investigated how state mindfulness can affect cognitive reappraisal by randomly assignment the participants into mindfulness, suppression, or mind wandering induction training conditions.

Path analysis showed that state mindfulness, the immediate awareness of one's thoughts, feelings, bodily sensations, and surroundings during a specific activity, indirectly affected reappraisal. Mindfulness meditation may improve emotion regulation by increasing cognitive reappraisal. The study suggests that mindfulness meditation may improve cognitive reappraisal and emotion regulation.

Yoga enhances bidirectional brain-body communication and stress regulation in older adults, promoting cognitive and emotional health (Voss, Cerna, & Gothe, 2023). As a significant strategy in regulating emotion, cognitive reappraisal is vital to cognitive flexibility. Emotion downregulation in individual with less cognitive flexibility skill impacts amygdala and prefrontal activity, the reappraisal condition negatively correlates prefrontal activity, cognitive flexibility and even working memory capacity (Zähringer, Falquez, Schubert, Nees, & Barnow, 2018).

3.4 Related studies

Brain regions like ventral anterior cingulate cortex and lateral prefrontal cortex integrate value-based decision-making and reinforcement learning to regulate emotions. Ventral anterior cingulate, ventromedial, lateral, and parietal prefrontal cortices are involved. Internal models guide behavior and encode value in frontoparietal regions for model-based emotion regulation. When prediction error adjustments fail, this process requires working memory and is essential for quick regulation. The amygdala, ventral striatum, and brain stem nuclei also regulate emotions and motivation at deep brain levels (Etkin, Büchel, & Gross, 2015).

The supramarginal gyrus and superior parietal lobule are activated during yoga emotion regulation (Wadden et al., 2018). Superior parietal cortex is essential for working memory manipulation, according to research. 2009 (Koenigs, Barbey, Postle, & Grafman, 2009). Rapid model-based emotion regulation requires working memory. Emotion regulation tasks require working memory to build and use internal models that guide behavior and encode value (Etkin et al., 2015).

Research links working memory, cognitive flexibility, and emotion regulation. As executive functions and reappraisal share a brain network, a negative correlation

between working memory capacity and cognitive flexibility when down-regulating negative emotions suggests a dynamic interaction between these cognitive functions (Zaehringer, Falquez, Schubert, Nees, & Barnow, 2018). Cognitive flexibility's role in emotional regulation and clarity has been studied, including both understanding and actual capacity. A questionnaire to 151 participants. Self-reported cognitive flexibility mediates the effect of emotional clarity on emotional regulation, with a goal unaffected by meditation (Soomin Kim & Hyun, 2018).

Emotion regulation helps older adults manage negative emotions and maintain psychological resilience, according to the literature. Standardized emotion regulation tools have been rarely used in Thai older adults, especially to evaluate yoga-based mindfulness programs. To address this, the researcher operationalized emotion regulation using the Thai Emotion Regulation Questionnaire (ERQ) to assess participants' emotion regulation strategies in line with the intervention's goal of self-awareness and adaptive coping.

4. Concepts, theories, and related literature for developing a yoga-based mindfulness program

4.1 Yoga

4.1.1 Definition and concept

Yoga is an Indian mind-body practice. Though not a psychological theory, yoga promotes mindfulness, stress reduction, and emotional well-being. Yoga is mindful and improves physical health, mental clarity, and spiritual growth. Body awareness, breathwork, and mindfulness-intentioned exercises improve cognition, emotion, and behavior (Brems, 2020). Yoga is unique in that it combines physical postures (Asana), breathing exercises (Pranayama), and meditative exercises with relaxation.

4.1.2 Related studies

According to this study, each yoga component's effect on neuroplasticity, the brain's ability to change structure and function, can be explained.

Integration of physical postures, breathing exercises, and meditation improves brain structure, cognition, and emotional balance.

1. Asana, physical postures, have been shown to improve neuroplasticity. Research shows that brain plasticity from exercise improves cognitive function and wellbeing (Mandolesi et al., 2018). Emotions affect cognition through prefrontal and limbic circuitry, according to this study. Physical activity improves cognitive function and emotional well-being by changing brain structure and function. Yogic positions. As with physical exercise, yoga postures benefit the brain and nervous system. Static (Mountain pose, Tree pose) and dynamic (Cat-cow pose, Warrior 1 and 2 in gentle flow movement) yoga postures benefit the brain and nervous system. Regularly activating nerves in yoga poses helps the somatic nervous system. Balance poses and flow sequences help proprioceptors, which register body position and movement, stay healthy. Helps offset age-related nerve message transmission to muscles decline. With a mental focus, restorative poses like Child pose and Corpse pose and gentle inverted poses like Cat-cow and Bridge pose can put the nervous system into the "rest and digest" state, relaxing and quieting the mind (Zolotow & Bell, 2017). This idea can help people calm down and regulate their emotions. (Appendix E classifies and illustrates yoga poses).

2. Pranayama, or breathing exercises, affect neuroplasticity and emotion regulation. Pranayama helps the breathing neural system become neuroplastic. Since pranayama involves difficult breathing, the cerebellum, which controls autonomic functions like breathing and heart rate, is heavily involved. Pranayama activates the limbic system, which controls emotions, memories, and arousal, affecting breath regulation, emotional balance, and memory recall. Pranayama stimulates the vagal nerves, which affect the limbic system, thalamic nucleus, frontal cerebral cortex, and temporoparietal cortex, regulating emotions and cognition. The largest cranial nerves, the vagal nerves, are essential to the parasympathetic nervous system (Fuller & Mitchell, 2017; S. Mondal, 2024; Penzenstadler, Torkar, & Martinez Montes, 2021). Recently, yogic breathing was examined on CSF dynamics. Encircling the brain and spinal cord

with CSF protects and nourishes the CNS. Deep abdominal breathing significantly increased CSF flow power and velocity, suggesting that breathing techniques may affect CSF dynamics and Alzheimer's disease (Yildiz et al., 2021).

3. Neuroplasticity and emotion regulation are linked to meditation and relaxation. According to research, yoga and meditation improve mental clarity, stress reduction, and emotional well-being, resulting in inner peace and tranquility (Taimni, 1961). Meditation improves cognition and reduces age-related brain degeneration (Lardone et al., 2018). Meditation is essential to yoga's neuroplasticity and emotion regulation. It causes brain plasticity in regions involved in attention, self-processing, somatosensation, and stress regulation. Meditation has been linked to increased orbitofrontal cortex (OFC) gray matter volume (GM), which regulates emotions (Chantal Villemure, Ceko, Cotton, & Bushnell, 2015).

Yoga increases gray matter (GM) levels in the hippocampus and insular (van Aalst et al., 2020; C. Villemure, Čeko, Cotton, & Bushnell, 2015). Gray matter synaptic plasticity, including long-term potentiation (LTP), and hippocampus neurogenesis are interconnected processes that improve memory formation and flexibility (Stuchlik, 2014). Besides the OFC, the insular is linked to comfortable emotions and the amygdala (Gehrlach et al., 2019; Livneh et al., 2020). Studies also show that yoga increases Brain-Derived Neurotrophic Factor (BDNF) (Naveen et al., 2016), which is essential for neurogenesis (Numakawa & Odaka, 2021), and GABA neurotransmitter ((Streeter et al., 2018). GABA controls synaptic plasticity and adult neurogenesis (Mishra & Seth, 2022). Therefore, neurogenesis and synaptic plasticity are crucial to cognitive flexibility. (Anacker & Hen, 2017; Britten et al., 2020). As a mindfulness practice, yoga improves attentional control and may change neural networks and synaptic connections, which are essential to neuroplasticity. Cognitive flexibility may improve, allowing people to shift their attention and respond more adaptably (Malinowski, 2013). Thus, by increasing gray matter, BDNF, and GABA, yoga may improve emotion regulation and cognitive flexibility. These details relate to the neuroplasticity model of mindfulness, discussed in the following section.

Studies in Thailand have shown that yoga improves older adults' physical and mental health. A quasi-experimental pretest–posttest study used Buddhist psychology and yoga to support elderly holistic balance (Nimsakul, 2019). The intervention group received a 3-day, 2-night yoga-Buddhist mindfulness program. Thirty participants were divided into experimental and control groups. Both after the intervention and at one-month follow-up, the experimental group showed significant improvements in physical, emotional, and social balance. Culturally tailored yoga programs with Buddhist psychological frameworks promote healthy aging, according to this study.

Overall, extensive studies show that apart from emotional well-being benefit, yoga also contributes to many brain-structural benefits. Thus, the yoga-based mindfulness program can definitely promise the effectiveness in enhancing both cognition and emotional health.

4.2 Mindfulness and meditation

4.2.1 Definition and concept

Mindfulness

Kabat-Zinn (1990) defined mindfulness as awareness of present-moment thoughts, feelings, also physical sensations with acceptance and no judgment (Wolkin, 2015). Researchers argue that mindfulness has several components that improve mental health. Thus, attentional skills and nonjudgmental attitudes toward experiences are relevant concepts. (1) focusing on the present. (2) stated intention, attention, and attitude as core principles. (3) as aware, describing, acting without judgment or reactivity 4. Mindfulness meditation improves attention, body awareness, emotion regulation, and self-perception. (5) focusing on the present and adopting equanimity We propose six neurocognitive mechanisms: attention, emotion regulation, pro-sociality, nonattachment, and decentering. Across these perspectives, mindfulness practices emphasize attentional skills (Wolkin, 2015).

Langerian mindfulness is defined by mindfulness and mindlessness (Langer, 1992), according to the study, Wong, Ang, Yong, and Tan (2023) defined mindfulness as being mindful, this means noticing new differences in experiences or

situations. Uncertainties must be accepted. By accepting the unknown, people are more open to new information and more engaged in the present. Mindlessness relies on categories or past experiences. Mindlessness is characterized by cognitive inflexibility, minimal information processing, and limited context awareness (Langer, 1989). Mindless people cannot adapt to changing circumstances (Langer, 1992; F. Pagnini, Katherine E. Bercovitz, & Deborah Phillips, 2018).

According to these literature reviews, they are representing different aspects of "mindfulness," despite sharing the same term. Regarding study of Pagnini et al. (2019), Kabat-Zinn focused on metacognitive processes, being aware in moment-to-moment, and acceptance, while Langerian mindfulness emphasizes the flexibility, curiosity, creatively, and external stimuli, novelty seeking (Hart, Ivtzan, & hart, 2013).

Meditation

Matko and Sedlmeier (2019) states meditation as a practice in multi facets, with spiritual, psychological, physiological, and also cultural aspects, calling attention in variability and complexity. Meditation definitions had been reviewed differently in the extensive studies. Meditation practice is considered as a family of self-regulation that train awareness and attention in order to improve voluntary control over mental processes, improving wellness and specific abilities such as calm, concentration and clarity according to Walsh and Shapiro (2006). In terms of attentional focus, West (2016) defines meditation as focusing on one object, concept, sound, image, or experience to gain deeper spiritual, existential, or psychological insight. Deshmukh (2006) takes a more philosophical approach, describing meditation as the art of being serene and alert in the present moment rather than constantly striving for change or self-improvement.

Neuroscience states meditation as a complex neural practice that alters brain function and chemistry, the practice impacts both behavior and cognition (Jaseja, 2009). Dunne (2018) displays meditation in a context of socio-culture, focusing on the communal framework, structured guidance and multi-generational nature. This

meditation perspective includes practice instructions and community-based progress measurements.

4.2.2 Related studies

All types of meditation are possible to promote creativity, but only concentrative meditation improves cognitive flexibility. Different meditation styles' effects on creativity were examined. Performing the experiment outside of a lab sought external validity. Two experienced meditation groups practiced mindfulness or concentrative meditation. Cognitive flexibility and creativity were measured before and after meditation. Meditation improves creative performance regardless of style. Only concentrative meditation increased cognitive flexibility. Concentrative meditation may improve the ability to switch between ideas and think of multiple solutions by training the mind to focus and redirect attention, according to the study. This meditation may also help break thinking patterns and generate new ideas (B. C. N. Müller, A. Gerasimova, & S. M. Ritter, 2016). This research suggests that mindfulness practices affect cognitive flexibility differently.

Focusing on mindfulness meditation, cognitive flexibility, and attentional functions, the study compared experienced meditators to non-meditators. Meditation improved mindfulness, attention, and cognitive flexibility. Meditators reported higher mindfulness and better attentional performance than non-meditators across all instruments. Mindfulness was strongly correlated with attention (Moore & Malinowski, 2009). This study shows how mindfulness, attentional functions, and cognitive flexibility are linked, supporting their integration as key components of cognitive flexibility. Mindfulness and emotion regulation are linked. In older adults, dispositional mindfulness meditation, the ability to focus on the present moment, was examined on emotional perception and processing. It found that mindfulness reduced reactivity in emotional brain regions like the orbitofrontal cortex and amygdala. Being mindful reduced reactivity in these areas during emotional tasks in older adults, suggesting that mindfulness training may improve emotional regulation. During emotional perception tasks, functional imaging was used to study brain activity in the prefrontal cortices,

mPFC, orbitofrontal cortex, and amygdala. Mindfulness in older adults may be linked to optimized neural circuitry for emotion perception (Rolley, 2012). As studies have shown, the medial prefrontal cortex (mPFC) is linked to cognitive flexibility, and mindfulness training may improve emotional regulation. Patients with depression and chronic stress have lower mPFC activity due to cognitive flexibility deficits (Jett, Bulin, Hatherall, McCartney, & Morilak, 2017).

In summary, while yoga and mindfulness have been shown to have physical and emotional benefits, few studies have examined their cognitive effects, particularly on cognitive flexibility and emotion regulation. Gentle yoga for older adults, mindfulness, and learning programs are also lacking in culturally relevant integration. The researcher developed a yoga-based mindfulness program with breathwork, physical postures, and mindfulness in Buddhist and Langerian practices in response. Learning theory and behavioral adaptation guided the program. The tailored intervention addressed Thai older adults' needs and yielded cognitive and emotional outcomes.

4.3 Learning concepts

This yoga-based mindfulness program aligns with observational learning and neuroplasticity model of mindfulness to improve cognitive flexibility and emotion regulation. In the initial phase, the program used observational learning to teach physical yoga postures by observation and imitating.

4.3.1 Neuroplasticity model of mindfulness

This study's theoretical framework is the neuroplasticity model of mindfulness. It proposes that mindfulness can affect brain structure and function using neuroplasticity. Neuroplasticity can result from mindfulness practices, which are essential to this yoga-based mindfulness program to improve cognitive flexibility and emotional regulation. Under neuroplasticity, this practice involves paying attention to body and breathing sensations, thoughts, and emotions:

Role of neuroplasticity

Frontal lobe regulates real-time metacognitive attention, according to Cayoun (2005). To help make decisions and act, this function supports executive processes, including reactive behavior inhibition. The parietal lobe also helps allocate

attention and monitor and sense bodily sensations. In particular, the somatosensory cortex represents most body parts. Studies of mindfulness training's neurophysiology aim to identify brain pathway changes linked to behavioral changes, or neuroplasticity. According to the study, neuroplasticity is the ability of neurons to adapt to novel environments (Fitzgerald, Folan-Curran, Richardson, & Tibbitts, 2002).

Hebbian principle and neuroplasticity model

In Hebbian learning theory, synaptic terminals adjust to neural activity and strengthen neuronal connections with each learning experience. Reorganizing the brain is neuroplasticity. It uses two main methods. 1) Neuronal regeneration, collateral sprouting; synaptic plasticity, neurogenesis. Neurogenesis creates new neurons, while synaptic plasticity strengthens or weakens neuronal connections through Long Term Potentiation and Long Term Depression. 2) Equipotentiality, vicariation, and diaschisis. The functional aspect involves synaptic strength and efficiency changes, which can cause structural changes. Structures may change dendritic spine morphology, form new synaptic connections, or prune existing ones. These interconnected relationships underpin the neuroplasticity model (Cayoun, 2005; R. G. M. Morris, 1999; Puderbaugh & Emmady, 2024).

Synaptic Plasticity

The physiological basis for learning and memory is synaptic plasticity, which occurs when specific neuronal activity changes synaptic transmission efficacy (Tabata & Kano, 2009). This refers to synapses' ability to change strength or efficiency over time. Neurotransmitter receptor number and sensitivity, dendritic spine size, and shape change during synaptic plasticity. Dendritic spine dynamics and synaptic strength depend on glutamate, the neurotransmitter of synaptic plasticity (Glasgow, McPhedrain, Madranges, Kennedy, & Ruthazer, 2019). As a cofactor, glutamate decarboxylase converts precursor glutamate into GABA in the cytoplasm of presynaptic neurons (Jewett & Sharma, 2024), the brain and spinal cord's main inhibitory neurotransmitter. Glutamate decarboxylase is essential to the conversion of

glutamate to GABA. Glutamate and GABA interact in neurotransmission and neuronal function in this conversion pathway.

Practicing mindfulness like mindful yoga practice can improve GABA neurotransmission. Yoga appears to increase brain GABA and vagal nerve stimulation to improve GABA-mediated cortical-inhibitory tone (Mehta & Gangadhar, 2019). Yoga can increase GABA levels by 27% (Streeter et al., 2018). Small protrusions from neuron dendrites are dendritic spines. Activity changes dendritic spines, which are essential for synaptic plasticity and memory storage. Synaptic activity and plasticity can cause them to grow, shrink, or disappear. These dendritic spine morphology changes are linked to synaptic plasticity and essential for sending and processing information. Electrical stimulation changes dendritic spine structure and function, potentiating synaptic connections and developing new ones. Stimulated presynaptic neurons send signals to postsynaptic neurons across synapses. Electrical stimulation caused long-term potentiation (LTP), which increases neuron responsiveness to electrical signals propagating along the dendritic tree. It improves neuronal communication. For memory formation and synaptic plasticity, dendritic spines undergo structural and functional changes associated with long-term potentiation (LTP) after electrical stimulation. LTP improves electrical signal transmission by strengthening neuronal synapses. In contrast, long-term depression (LTD) causes inactive dendritic spines to shrink and lose synaptic partners. After electrical stimulation, dendritic spines rapidly absorb calcium ions, swelling the spine head. This process improves spine stimulation by facilitating neurotransmitter flow to spine head receptors. After that, new dendritic spines may strengthen neuron connections. Changes in spine strength and the creation of new ones tighten neural network connections, promoting learning and memory (Segal, 2023).

Synaptic plasticity and Cognitive flexibility

Plasticity in synapses greatly affects cognitive flexibility. Cognitive flexibility requires synaptic plasticity, changes in brain cell connections. Study found that brain cell components like GluA1 affect mice's thinking and learning. (Britten et al., 2020). Radiation reduces cognitive flexibility and synaptic transmission in rats' prefrontal

cortex, suggesting a link between synaptic plasticity and cognitive flexibility (Guntupalli et al., 2023). These findings demonstrate that synaptic plasticity greatly impacts cognitive flexibility.

Synaptic plasticity and Emotion regulation

Amygdala synaptic plasticity regulates emotions. This affects how the amygdala, prefrontal cortex, and hippocampus regulate emotions and behavior. Balanced amygdala plasticity controls emotions. However, synaptic plasticity abnormalities may cause anxiety or sadness (Ge, Cai, & Pan, 2022).

Neurogenesis

New neurons are produced by the adult hippocampus and olfactory bulb, with the hippocampus being the primary focus due to its functional importance in mammals, including humans. New neurons can enhance learning, memory, and emotion (Baptista & Andrade, 2018; Kempermann, Song, & Gage, 2015). Overactive hypothalamic-pituitary-adrenal axis (HPA) and high glucocorticoids affect stress-induced neurogenesis (Kempermann et al., 2015). Hippocampal dentate gyrus neurogenesis is affected by brain-derived neurotrophic factor (BDNF) (Waterhouse et al., 2012) that enhances GABAergic transmission to differentiate and mature adult-born neurons (Numakawa & Odaka, 2021). Yoga and meditation reduce cortisol and increase BDNF (Naveen et al., 2016), which may affect the HPA axis (Pandey, Singh, Devesh, & Haider, 2016).

Neurogenesis in the adult hippocampus

Adult hippocampal neurogenesis is often studied in neurogenic zones because of its role in memory and affective behaviors (Kempermann et al., 2015). Based on activity, this process may contribute to hippocampus plasticity throughout life in humans. This phenomenon can be stated in four phases, the adult hippocampal neurogenesis produces new granule cells in the dentate gyrus, whose axons form the mossy fiber tract, a neural pathway connecting the dentate gyrus to the CA3 region, which helps memory and learning by connecting and communicating newly formed nerve cells with other cells. Four phases make up neurodevelopment are as follows;

1. Precursor cells expand and can become neurons. Neurogenesis starts.

2. Early Survival: Neurons kill many newly generated cells after the cell cycle. During this time, refine the neuronal population.

3. After mitosis, surviving neurons mature through functional integration, axonal and dendritic growth, and synaptogenesis. This phase establishes neural connections.

4. Functional integration and synaptic plasticity adapt in late maturation. New neurons' synaptic plasticity aids memory and network integration.

Neurogenesis, cognitive flexibility, stress, anxiety and depression

Neurogenesis impacts cognitive flexibility, stress, depression, and anxiety, referring to Anacker and Hen (2017). According to research, adult hippocampal neurogenesis improves memory and cognitive flexibility. New brain cells enable thinking transitions, improving cognitive flexibility. Neurogenesis may remove old links, allowing new associations and cognitive flexibility. According to several studies, neurogenesis is necessary for learning to reverse a rule, emphasizing its importance in cognitive flexibility. The prefrontal cortex and hippocampus help us switch tasks and thoughts. Neurogenesis speeds up learning, thinking, and adaptability. Stress affects adult neurogenesis. For weeks, chronic stress like social failure or unexpected events lowers brain cell production. Learning and memory depend on neurogenesis, so chronic stress may alter it and affect hippocampus processing and transmission to the amygdala and hypothalamus. This is important for neuroendocrine and anxiety regulation.

Neurogenesis, cognitive flexibility, stress, anxiety and depression

Baptista and Andrade (2018) found that adult-born hippocampus neurons regulate emotions and that new neuron integration modulates emotions. The neurogenic niche of the hippocampus forms new neurons. A study on Hippocampal neurogenesis emphasizes cognitive flexibility and emotion modulation. Pattern separation using emotional signals helps the hippocampus distinguish similar emotions (Leal, Tighe, Jones, & Yassa, 2014). Study found that basolateral amygdala

injury inhibits neurogenesis, preventing new neurons from responding to fear-conditioning trials (Kirby et al., 2013). This suggests that the hippocampal formation receives emotional input.

Multiple studies (Anacker & Hen, 2017; Baptista & Andrade, 2018; Clelland et al., 2009; Deng, Aimone, & Gage, 2010; Egeland, Zunszain, & Pariante, 2015; Frankland, Köhler, & Josselyn, 2013; Sahay et al., 2011) suggest that cognition and emotion can explain how adult-born hippocampal granule cells regulate stress adult neurogenesis declines, disrupting pattern separation and retaining old memories in the hippocampus.

1. Reduced cognitive flexibility increases interference and preserves outdated memories. Recalling past stressful events can cause chronic stress even when they are gone. Immature granule cells might erase fear memories in rats.

2. Low neurogenesis reduces pattern separation, making the organism respond similarly to similar stimuli. In stressful situations, all contexts are threatening, so lack of discrimination can help avoidance. Due to negative past experiences, chronic stress increases stress responses to harmless new encounters.

Past negative emotions affect how they react to new stimuli, giving them a broad stress-related emotional context. Stress may be modulated by adult-born neurons' HPA axis regulation and emotion encoding. Proper neurogenesis allows optimal emotional states, but prolonged stress suppression can worsen anxiety and depression.

Gray matter, synaptic plasticity, and neurogenesis

Cognitive, emotional, and behavioral flexibility depend on gray matter, synaptic plasticity, and neurogenesis. Brain communication and information processing require gray matter, neuronal cell bodies, dendrites, and glial cells. Synaptic plasticity allows synapses to change strength over time, allowing memory formation and flexibility. In the hippocampus, neurogenesis affects pattern separation and memory resolution. LTP, neurogenesis, and synaptic plasticity improve learning and memory by

retaining, erasing, and encoding memory They improve behavioral flexibility by facilitating adaptation (Stuchlik, 2014).

Yoga is related with the increment in Hippocampus gray matter, prefrontal cortical activity, and default mode network connectivity. Yoga may affect the insula, which controls emotions and cognition (Homma & Phillips, 2022; van Aalst et al., 2020). Gray matter, synaptic plasticity, and neurogenesis affect cognition and emotion. Modifying these processes may improve cognitive and emotional health with yoga. Similar to mindfulness, neuroplasticity helps the brain rebuild neural connections and adapt to new situations. Mindfulness improves attentional control and can change neuroplastic brain networks and synaptic connections. These changes can improve cognitive flexibility, allowing people to focus and adapt (Malinowski, 2013).

In conclusion, the literature reviews suggests that yoga-based mindfulness activities are possible to improve cognitive flexibility and emotion regulation. These improvements show the brain's amazing adaptability and reorganization to experience, supporting neuroplasticity. These advances result from neuroplasticity's synaptic plasticity and neurogenesis mechanisms.

4.3.2 Observational learning

Observational learning suggests we can learn new behaviors from others (Bandura, 1977). Learners must observe to master skills and practices, according to this theory. Learning and development are greatly influenced by observation and imitation. The Bandura theory expands on direct environmental interaction as learning. Imitating and observing others is another way to learn. Behavior modification using the observational method involves observing others, mentally rehearsing appropriate behavior, and then implementing it. Not just copying movements, imitation requires attention, retention, reproduction, and motivation. Five basic learning steps: Learning requires observation, attention, retention, reproduction, and motivation. According to Bates (2019), Bandura believed that learners must (1) observe the behavior, (2) remember it, (3) be able to reproduce it, and (4) want to

reproduce it. Observational learning requires observation and imitation. Mirroring others' actions is a key in observational learning.

In learning processes, observational learning is vital; to observe and internalize model actions. This method goes beyond imitation to understand each action's purpose and technique (Bandura, 1986). Bandura argued learning requires models. From these models, learners learn the steps. This is crucial when verbal education fails to convey posture or skill nuances (Bandura, 1977). Imitation always begins with observation and includes attention, retention, reproduction, and motivation. Participants watch the model, copy its actions, and have motivation to improve (Bandura, 1986).

For a comprehensive theoretical framework, Schmalzl, Powers, and Henje Blom (2015) discuss yoga-based practices (YBP)'s under neurophysiological and neurocognitive mechanisms. Fundamental processes in learning can be shown as follows:

1. Practice and repetition: learning involves remembering instructions and choosing appropriate actions to practice movements and sequences. This is helped by brain working memory and motor habit learning. The method requires metacognition. Conscious and intentional mental and behavioral monitoring (Teasdale, 1999). Most contemplative practices, including Yoga-based practices, involve "stepping back" to observe thoughts and feelings. This distinguishes YBP from treadmill running with music. Although Yoga-based practices and metacognition have not been studied, mindfulness-based practice literature is relevant and applicable.

2. Self-awareness and observation: learning requires understanding one own thoughts and actions. Examining thoughts and feelings in yoga improves self-awareness and self-regulation. It involves interoception aspects. Interoceptive awareness involves conscious awareness of heart rate, respiration, and emotional autonomic nervous system responses (Cameron, 2001). Interoceptive awareness is beneficial and multifaceted. Damasio's somatic markers theory (A. R. Damasio, 1996), states that many cognitive, emotional, and interpersonal processes require this aspect.

Perceiving affective and autonomic states and engaging with the world requires interoceptive awareness (Antonio R Damasio, 1999). Interoceptive, proprioceptive, kinesthetic, tactile, and spatial information are integrated during bodily sensation processing to form one's sense of self (Ehrsson, 2007; Haselager, Broens, & Gonzalez, 2012; Ionta, Gassert, & Blanke, 2011). Understanding internal states is essential for learning. Individual identity, emotions, and cognition depend on this awareness, it shows how cognitive, emotional, and physical factors aid learning and skill acquisition.

3. Body awareness and motor processes in YBP depend on the basal ganglia (BG). Somatosensory input and motor, emotional, autonomic, and cognitive pain responses are processed by the BG. Input from cortex and thalamus, output to frontal and prefrontal regions. Frontal lobe cortico-striatal inputs greatly affect YBP and BG function. Premotor cortex, supplementary motor area, and prefrontal cortex are essential for motor planning and coordination. Cortico-striatal loops in the BG aid executive function, procedural learning, and working memory. The BG and cerebellum can improve motor, cognitive, and emotional neurocircuitry during YBP.

All these data suggest observational learning in yoga-based mindfulness practice is potential to guide learning and cognition. Observing and imitating behaviors and making positive brain changes help participants learn yoga. Mental processes like attention, retention, reproduction, and motivation are intrinsically rewarding. Positive reinforcement boosts older adults' natural practice motivation. Poses and breathing exercises improve mental and emotional health. Yoga requires repetitive practice, working memory, and motor habits. Metacognitive awareness changes emotional and cognitive processes by improving self-regulation and interoception.

Cognitive flexibility, emotion regulation, and learning can be affected by the basal ganglia (BG), which controls motor planning and learning. It regulates cortical emotional responses and learning and emotion. Synaptic plasticity and neurogenesis in the cerebellum and BG affect motor learning. The BG, which coordinates motions and executive functioning for motor planning, learning, and cognitive tasks like working memory, is also stressed in yoga. Cognitive flexibility and mood management involve

working memory. A working-memory prefrontal model links cognitive flexibility, research shows. Working memory facilitates context-dependent task switching and selection, according to neural mechanisms and Wisconsin card task tests (Abrossimoff, Pitti, & Gaussier, 2020). The cerebellum and basal ganglia (BG) collaborate during yoga. Research links cerebellum to cognitive flexibility (Baumann & Mattingley, 2022) and emotion regulation (Shin et al., 2024). BG is linked to cognitive flexibility, emotion control, and learning in many studies (van Schouwenburg et al., 2014). The basal ganglia controls cortical oscillations and neuronal responses to emotional inputs, influencing learning and emotional responses to different stimuli (Pierce & Péron, 2020). The embryonic basal ganglia release GABA. As GABA is necessary for neurogenesis and synaptic plasticity (Mishra & Seth, 2022; Rubenstein & Campbell, 2013). Synaptic plasticity and neurogenesis in the cerebellum affect motor learning (Manto & Jissendi-Tchofo, 2012; Tabata & Kano, 2009).

In conclusion, yoga-based mindfulness programs that incorporate observational learning, neurophysiological, and neurocognitive mechanisms support the neuroplasticity model of mindfulness and improve learning, skill acquisition, cognitive flexibility, and emotion regulation.

4.4 Yoga-based mindfulness program

This program covers yogic poses (asanas), breathing exercises (pranayama), and mindfulness meditation practices. These methods improved cognitive flexibility and emotion regulation. The current research study improved cognitive flexibility and emotion regulation by applying concept of brain-based learning experience design by Caine and Caine, 1991, 2003 (Saleh, 2012), the overall program design is outlined as follows:

1. Create a sensory yoga studio with music, singing bowls, aromatherapy, and candles. Meditation and breathing exercises are focus on breathing, body movements, and sensory experiences to increase sensory awareness. Immersion improves focus, deep breathing, and singing bowl theta wave activity (Seong Kim & Choi, 2021), making it ideal for learning (Shaikh et al., 2023).

2. Relaxed alertness: Pranayama improves mood. A friendly, supportive environment reduces stress and promotes emotion regulation. Self-compassion is fostered by pair sharing/ practicing. To relax, focus, arouse, entrain central autonomic networks, reduce anxiety, and improve memory, deep breathing is applied (Noble & Hochman, 2019). Further, to facilitate alpha brain waves by specific yoga breathing (Barnwal & Kulshrestha, 2011). Alpha brainwave plays a crucial role in neuronal networks and neuroplasticity mechanism (Shaikh et al., 2023). In addition, study found that alpha brainwaves can improve emotion and cognition (Wolff, Zink, Stock, & Beste, 2017), this results in learning activities that is calm and also focus.

3. Active processing: to have reflection sessions (after-action review) after each practice session to consolidate learning, building cognitive flexibility, and promoting emotion regulation. This was to encourage participants to consider other perspectives and problem-solving methods. Participants learned to adjust challenging yoga poses with varieties of props or supports requires having skill of cognitive flexibility. Reflection sessions facilitated participants mindfulness, and how to apply it creatively. Sharing how participants adapted poses with props can spark collaboration and problem-solving. By encouraging experimentation and open-mindedness, participants in yoga practice developed cognitive flexibility for success inside and outside the studio. Focus on meditation and its real-world effects to develop critical thinking and problem-solving.

Conceptual framework

Several key elements strongly supported this framework:

1. The program acknowledged neuroplasticity, the brain's ability to adapt and learn regardless of age, to support this demographic. Figure 2 depicts active aging framework program integration.

2. Yoga sessions had been designed in specific aspect by emphasizing thinking exercises to foster cognitive flexibility during practice sessions.

3. Integration of different mindfulness meditation approaches in order to bolster cognitive flexibility and emotion regulation.

4. Yoga poses and breathing exercises were specifically selected from the extensive reviews to support cognition, emotion, and physical health of older adults.

5. This framework aided program design and evaluation, and learning processes. Program components improve cognitive function, emotion regulation, and overall well-being. Figure 1 depicts the conceptual framework, which divides the study design into two phases serving differently but related purposes. A yoga-based mindfulness program was assessed in phase 1. This phase aimed to enhance cognitive flexibility and emotional regulation in older adults. Participants' learning processes were investigated based on After-action reviews feedback collecting throughout the experiment. Phase 2 consisted of the post-experiment in experiences and perspectives of participants as qualitative in-depth interviews. This phase supported the quantitative data in evaluation of program effectiveness. The final step was the program validation to confirm program applicability and credibility. Qualitative data after the program intervention fostered experimental design and helps researchers understand how the program affects participants' mental health and learning processes.

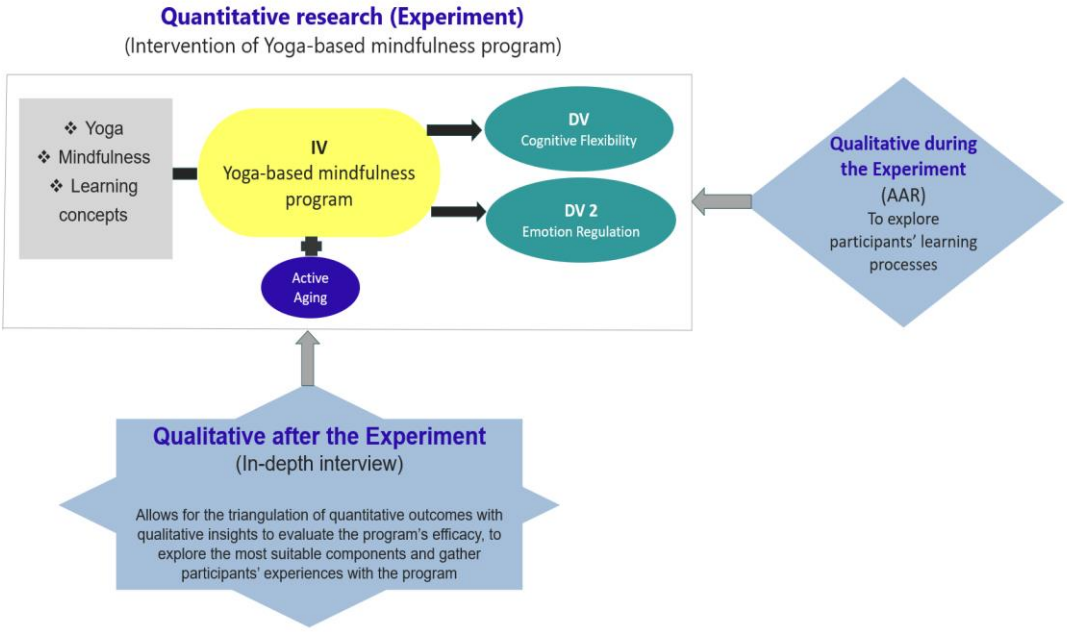

Figure 1 Conceptual framework

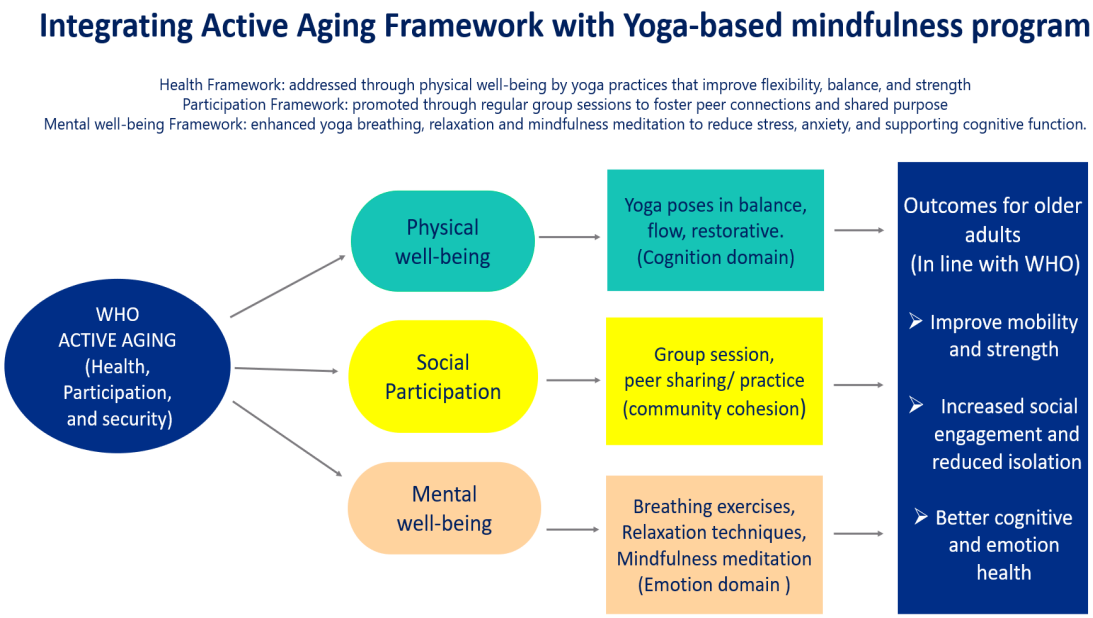

Figure 2 Active Aging framework and Yoga-based mindfulness program

Operational definition

Cognitive flexibility

This skill described older adults' adaptability. This elderly group self-reported the Thai Cognitive Flexibility Inventory (CFI). CFI has 20 items with a 7-point scale from "strongly disagree" to "strongly agree." It tests cognitive flexibility in two areas: "Alternate," the ability to see multiple alternative explanations for life events and human behavior, and generate multiple solutions to difficult situations, and "Control," the tendency to see difficult situations as controllable. More total scores from both components indicate cognitive flexibility ability in handle life's challenges.

Emotion regulation

Ability to handle negative emotions and thoughts in older adults. This elderly group self-reported the Thai Emotion Regulation Questionnaire (ERQ). The ERQ has 10 items with a 7-point scale from "strongly disagree" to "strongly agree". Individuals normally regulate emotions by "cognitive reappraisal," changing thoughts about a

situation to change its emotional impact, and "expressive suppression," reducing outward expression. A high ERQ indicates more emotion regulation. Expression suppression has less affective and cognitive effects than cognitive reappraisal.

Yoga-based mindfulness program

This onsite group activity was for Thai young-old adults. Tailored yoga positions stimulated the brain and nervous system to improve cognitive and emotional health in the elderly. Certain breathing exercises that support brain and autonomic nervous system function could help manage emotions without surgery or medication. Both Buddhist and Langerian mindfulness practices were implemented. The program incorporated observation learning and neuroplasticity model as learning approaches, yoga practice increased neuroplasticity through observational learning and repetitive practice. Training improved emotion regulation and cognitive flexibility for adaptive thinking in different situations. The 4-week recruitment period included 16 sessions, the 5-10minute post-session discussion, and the 60-75minute in-depth interviews.

Research hypotheses

1. The experimental group, after participating the yoga-based mindfulness program, will demonstrate a greater increase in cognitive flexibility and emotion regulation scores compared to before participating.

2. The experimental group, after participating in the yoga-based mindfulness program, will demonstrate a greater increase in cognitive flexibility scores and emotion regulation scores compared to the control group.

CHAPTER 3
RESEARCH METHODOLOGY

This research study followed a Mixed Methods Intervention Design, consisting of two phases. Phase 1 involves a quantitative study using experimentation to assess the preliminary effectiveness of a yoga-based mindfulness program in improving cognitive flexibility and emotion regulation among Thai older adults, with a focus on qualitative data collection during the experiment. Phase 2 entails qualitative exploration post-experimentation through in-depth interviews to inform the design of a tailored program for this demographic. The study aimed to identify key components for Thai older adults, conducted onsite and involving participants from the 'young-old' stage. The Advanced Internship study, focusing on a tailored yoga-based mindfulness program for cognitive flexibility enhancement in Thai older adults, yielded insights despite not achieving statistical significance due to a short intervention period and small sample size. Participants reported improved well-being and relaxation, suggesting the potential benefits of brief mindfulness sessions for cognitive processes. The methodology details and stages of the research study are outlined in the following sections.

1. Populations and samples
2. Research design
3. Research tools and measurement
4. Data Collection
5. Data Analysis and Statistics
6. Ethics

Phase 1 The experimental research and qualitative research conducted during the experiment

The methodology details and stages can be described, as follows:

1. Research participants

Thai older adults aged 60-69 in the sub-district of Petchburi, representative of the later adulthood of 'young-old' stage and had no existing diagnosis of cognitive impair based on the cognitive impair assessment conducted.

Inclusion criteria

1. Thai adults in the 'young-old' stage* (see details * below)

2. Participants who obtained a total score ranging between 20 and 100on the Cognitive Flexibility Inventory** (see details ** below).

3. Participants with no pre-existing medical conditions that could impede participation in gentle to moderate physical activities.

4. Participants who were not diagnosed with any mental disorder.

5. Participants who had no experience in Hatha yoga.

6. Participants who expressed interest and motivation in improving cognitive flexibility and emotion regulation.

7. Participants willing to join the program onsite.

* The age range of 60-69 was chosen to align with the target population , ensuring participants are physically capable of engaging in yoga activities while still being cognitively fit for appropriate exercises. Including individuals aged 70 and over might present physical health limitations that could hinder their participation in group yoga sessions and potentially restrict cognitive flexibility improvements.

**Participants were required to have a total score ranging from 20 to 100 on the Cognitive Flexibility Inventory. Although the standard scoring range is 20 to 140, data from the Advanced Internship study and the try-out group indicated that typical scores fall between 20 and 100. Based on the positive outcomes observed in both groups, this adjusted range (20–100) was deemed more appropriate for identifying participants with relevant levels of cognitive flexibility for the present study.

Exclusion criteria

1. Returning to work as a full-time job employee.

2. Relocate outside the area.

3. Requiring urgent medical attention and being unfit for practicing

4. Attending less than 50 percent of the program duration, the criteria based on similar studies that utilize yoga interventions to enhance cognition.

Sample size

The sample size for this study was determined using G*Power version 3.1, with parameters set for 80% power and a significance level of 0.05. Based on an effect size from a relevant study with similar demographics (Asian older adults), variables (Cognitive function), research design (pretest-posttest yoga intervention) and statistic in MANOVA (Pandya, 2020), G*Power calculated a sample size of 20 participants. To mitigate potential dropout risks, 50% was added, resulting in a total sample size of 30 participants. The participants were divided into two groups:

1. Control group: Older adults who did not participate in the yoga-based mindfulness program, with an initial plan for 15 persons. However, 5 did not show up in the introduction and assessment process, resulting in a total of 10 persons. This control group will receive the program after the research intervention concludes.

2. Experimental group: Older adults who participated in the yoga-based mindfulness program, engaged in both phases, with an initial plan for 15 persons. However, two dropped out, resulting in a total of 13 persons

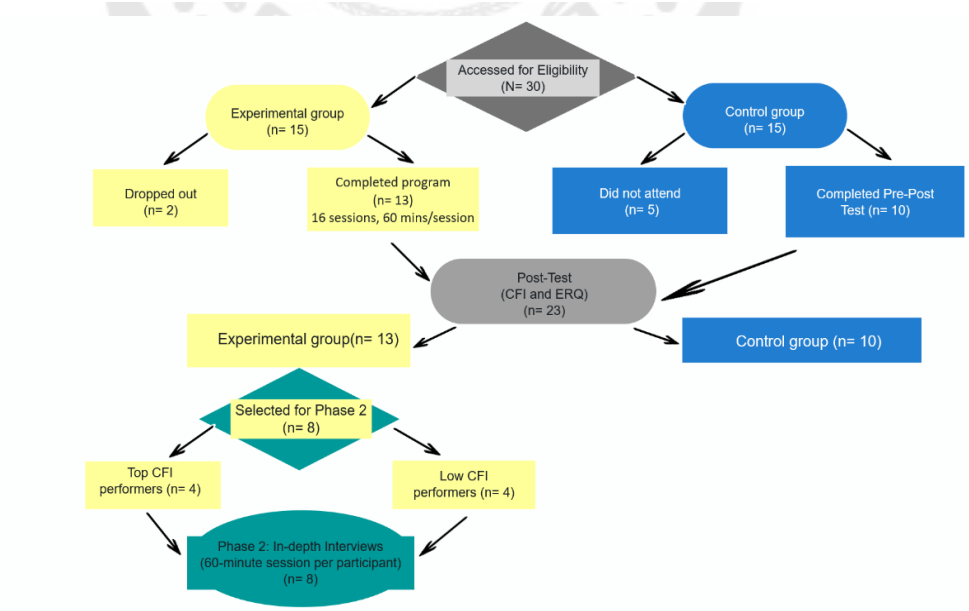

Figure 3 Participant flowchart

Initially the total of 30 participants agreed to the study. Participants were divided into 15 in each group. Two experimental participants dropped out, leaving 13 who completed 16 yoga-based mindfulness program sessions. Participants attended two to three 60-minute sessions per week, depending on availability. For control group, 5 members did not attend the questionnaire sessions, leaving 10 to complete pre- and post-assessments. The CFI and ERQ were given to all 23 participants after the session. Phase 2 included a 60-minute in-depth qualitative interview with eight experimental group participants, four with the highest CFI scores and four with the lowest.

2. Research design

Table 1 Pretest-Posttest Control Group Design diagram

R	E	O_1	X	O_2
R	C	O_3	-	O_4

R= Assignment of participants into either the control (C) or experimental (E) group by stratified randomization method, also on a voluntary basis. Participants were divided into homogeneous groups based on certain characteristic such as age and gender, which helped reduce bias and confounding variables and then random assignment were conducted with each stratum to ensure balance across groups.

C= Control group

E= Experimental group

O_1=Evaluation of cognitive flexibility and emotion regulation scores in the experimental group before the experiment

O_2=Evaluation of cognitive flexibility and emotion regulation scores in the experimental group after the experiment

O_3=Evaluation of cognitive flexibility and emotion regulation scores in the control group before the experiment

O_4=Evaluation of cognitive flexibility and emotion regulation scores in the control group after the experiment

X= Yoga-based mindfulness program

Research design during the experiment

1. Researcher gained valuable insights from participants regarding learning processes and etc. at the end of each session.

2. Gathering data for program improvement in the subsequent session.

Tailoring process of the program

The program was tailored through the following steps:

1. Health screening for research participants in the experiment group (details in Chapter 4; under table 12; background data in the experimental group).

2. Expert validation for the program

3. A try-out study with a similar group

4. Group-level customization into two groups based on baseline physical capacities (Group A: robust health; Group B: mobility limitations)

5. Real-time adaptation during sessions using After-Action Review

3. Research tools and measurement

3.1 Personal information questionnaire:

A demographic questionnaire was developed to collect information on participants' age, physical health status, physical limitations, recreational activities or exercise habits, and daily life activities. The content of the questionnaire was reviewed and validated by the research advisors and approved by the Human Research Ethics Committee of Srinakharinwirot University. Additionally, the questionnaire was utilized with the try-out group to assess its clarity and relevance.

3.2 Cognitive impair screening test, Thai Version

The test had been reviewed and validated by the research advisors and verified by the Human Research Ethics Committee of Srinakharinwirot University. The questionnaire was also utilized with the try-out group to assess its clarity and relevance.

3.3 Cognitive flexibility inventory (CFI), Thai Version

A 20-item self-report scale, each rated on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree) is designed to monitor how often participants engaged in cognitive behavioral thought challenging interventions (Dennis & Vander Wal, 2010). In order to preserve the content validity of the Thai translation developed by the Faculty of Psychology, Chulalongkorn University, a minor modification was implemented. This CFI modification was subsequently reviewed and validated by the research advisors and verified by the Human Research Ethics Committee of Srinakharinwirot University. This version was also revised to reduce the use of “neutral” or “unsure” responses that previously limited score changes in earlier practicum studies. CFI was administered to the try-out group to evaluate its clarity and relevance.

3.4 Emotion regulation questionnaire (ERQ), Thai Version

The 10-item self-report scale (J. Gross & John, 2003) is specifically designed to assess individuals' usage of two emotion regulation strategies. Each strategy is measured separately, with scale scores derived accordingly. Respondents rate items on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). In order to preserve the content validity of the Thai translation developed by the Faculty of Psychology, Chulalongkorn University, a minor modification was implemented. This ERQ modification was subsequently reviewed and validated by the research advisors and verified by the Human Research Ethics Committee of Srinakharinwirot University. This version was also revised to reduce the use of “neutral” or “unsure” responses that previously limited score changes in earlier practicum studies. ERQ was administered to the try-out group to evaluate its clarity and relevance.

Research program

The initial program was validated by three specialists in the fields of gerontology, learning Psychology, and yoga (see Appendix A for details). The program was pilot-tested in a try-out study and subsequently underwent minor revisions based on recommendations from the research advisors. The revised version was then implemented with the research study. The program was described in several key components, including implementation period, learning outcomes, theoretical and

conceptual foundations, procedures, techniques, and evaluation methods, as outlined below:

Table 2 Research program week 1

Period	Week 1, session 1, 2
Learning outcomes	Participants able to define and explain the concepts of cognitive flexibility and emotion regulation; perform a guided basic yogic breathing exercise; and warm-up practices
Psychological concept/theory	Yoga Mindfulness in Kabat Zinn's and Langerian mindfulness
Learning concept	Neuroplasticity model of mindfulness, Observational learning
Procedure/activity	Stage 1-Starting: -Introduce cognitive flexibility and emotion regulation/ -Customized breathing (deep abdominal), -Warm up activities Stage 2-Operational stage: Practicing breathing exercise, warm up series Stage 3-Cooling down stage: Yogic relaxation
Technique/method	Modelling concept (Observation, Attention, Retention, Reproduction, Motivation-positive reinforcement) Interaction (Social engagement, practice in pairs)
Duration (min's)	60
Evaluation	Pre-test of ERQ will be administered before starting class (CFI pre-test will administered at recruiting process) Breath counting, a valuable indicator in physical responses and ability to regulate emotions (Zaccaro et al., 2018) After Action Review, discussion

Table 3 Research program week 2

Period	Week 2, session 3, 4
Learning outcomes	Participants able to practice concentrative meditation, perform balance and flow-based yoga postures
Psychological concept/theory	Yoga Mindfulness
Learning concept	Neuroplasticity model of mindfulness, Observational learning
Procedure/activity	Stage 1-Starting by refreshing knowledge from previous week or session. Introduce customized yoga poses (balance and flow) and concentrative meditation Stage 2-Operational stage: Practice breathing exercise, warm up series, basic yoga postures Stage 3- Cooling down stage: Concentrative meditation Relaxation
Technique/method	Modelling concept (Observation, Attention, Retention, Reproduction, Motivation-positive reinforcement) Interaction (Social engagement, practice in pairs)
Duration (min's)	60
Evaluation	Breath counting After Action Review, discussion

Table 4 Research program week 3

Period	Week 3, session 5, 6
Learning outcomes	Participants able to practice breathing exercise (Three-part breathing) and customized yoga postures in seated poses
Psychological concept/theory	Yoga Mindfulness
Learning concept	Neuroplasticity model of mindfulness, Observational learning
Procedure/activity	Stage 1-starting: -Refreshing previous class activities -Introduce customized breathing exercise (Three-part breathing) -Warm up activities Stage 2-Operational stage: Practicing customized yoga postures (balance and flow) in seated poses Stage 3- Cooling down stage: Concentrative Meditation Relaxation
Technique/method	Modelling concept (Observation, Attention, Retention, Reproduction, Motivation-positive reinforcement) Interaction (Social engagement, practice in pairs)
Duration (min's)	60
Evaluation	Breath counting After Action Review, discussion

Table 5 Research program week 4

Period	Week 4, session 7, 8
Learning outcomes	Participants able to practice breathing exercise (retention in deep abdominal breathing) and customized yoga postures in standing poses.
Psychological concept/theory	Yoga Mindfulness
Learning concept	Neuroplasticity model of mindfulness, Observational learning
Procedure/activity	Stage 1-starting: -Refreshing knowledge from previous session -Introduce customized breathing (retention in deep abdominal breathing) -Warm up activities Stage 2-Operational stage: Practicing customized yoga postures (balance and flow) in standing poses Stage 3- Cooling down stage: Concentrative meditation Relaxation
Technique/method	Modelling concept (Observation, Attention, Retention, Reproduction, Motivation-positive reinforcement) Interaction (Social engagement, practice in pairs)
Duration (min's)	60
Evaluation	Breath counting After Action Review, discussion

Table 6 Research program week 5

Period	Week 5, session 9, 10
Learning outcomes	Participants able to practice breathing exercise (retention in deep abdominal breathing), perform customized yoga postures in standing, and practice Anapanasati meditation (Breathing awareness)
Psychological concept/theory	Yoga Mindfulness
Learning concept	Neuroplasticity model of mindfulness, Observational learning
Procedure/activity	Stage 1-starting: -Refreshing knowledge from previous session -Refreshing customized breathing (retention in deep abdominal breathing) -Warm up activities Stage 2-Operational stage: Practicing customized yoga postures (balance and flow) in standing poses Stage 3- Cooling down stage: Concentrative and Anapanasati Meditation Relaxation
Technique/method	Modelling concept (Observation, Attention, Retention, Reproduction, Motivation-positive reinforcement) Interaction (Social engagement, practice in pairs)
Duration (min's)	60
Evaluation	Breath counting After Action Review, discussion

Table 7 Research program week 6

Period	Week 6, session 11, 12
Learning outcomes	Participants able to practice breathing exercise (Chantra Bedha breathing), to perform customized yoga postures in supine poses, and practice mindfulness meditation in Kabat Zinn's approach
Psychological concept/theory	Yoga Mindfulness
Learning concept	Neuroplasticity model of mindfulness, Observational learning
Procedure/activity	Stage 1-starting: -Refreshing knowledge from previous session -Introduce customized breathing (Chandra Bedha breathing) -Warm up activities Stage 2-Operational stage: Practicing customized yoga postures (balance and flow) in supine poses Stage 3- Cooling down stage: Concentrative and mindfulness Meditation Relaxation
Technique/method	Modelling concept (Observation, Attention, Retention, Reproduction, Motivation-positive reinforcement) Interaction (Social engagement, practice in pairs)
Duration (min's)	60
Evaluation	Breath counting After Action Review, discussion

Table 8 Research program week 7

Period	Week 7, session 13, 14
Learning outcomes	Participants able to practice breathing exercise (Anuloma Viloma breathing), to perform customized yoga postures in gentle flow poses, to practice Langerian Mindfulnes meditation
Psychological concept/theory	Yoga Mindfulness
Learning concept	Neuroplasticity model of mindfulness, Observational learning
Procedure/activity	Stage 1-starting: -Refreshing knowledge from previous session -Introduce customized breathing (Anuloma Viloma breathing) -Warm up activities Stage 2-Operational stage: Practicing yoga postures in balance and flow (modifying gentle flow serie) Stage 3- Cooling down stage: Concentrative and Langerian mindfulness Meditation Relaxation
Technique/method	Modelling concept (Observation, Attention, Retention, Reproduction, Motivation-positive reinforcement) Interaction (Social engagement, practice in pairs)
Duration (min's)	60
Evaluation	Breath counting After Action Review, discussion

Table 9 Research program week 8

Period	Week 8, session 15, 16
Learning outcomes	Participants able to practice breathing exercise (Ujjayi breathing), to perform challenging yoga postures in variation and modification
Psychological concept/theory	Yoga Mindfulness
Learning concept	Neuroplasticity model of mindfulness, Observational learning
Procedure/activity	Stage 1-starting: -Refreshing knowledge from previous session -Introduce Ujjayi breathing -Warm up activity Stage 2-Operational stage: Practicing challenging in yoga postures (balance and flow serie) tailor-made and modify to each individual (goal for self-practice) Stage 3- Cooling down stage: Concentrative meditation, mindfulness Meditation (Anapanasati, Kabat zinn's and Langerian's approaches Relaxation
Technique/method	Modelling concept (Observation, Attention, Retention, Reproduction, Motivation-positive reinforcement -Interaction (Social engagement, practice in pairs
Duration (min's)	60
Evaluation	Breath counting After Action Review, discussion CFI and ERQ as post-test

Research processes

1. Researcher conducted a comprehensive study and review of various yoga poses, breathing exercises, and mindfulness programs available.

2. Researcher thoroughly selected specific and appropriate yoga poses, breathing exercises, and mindfulness programs suitable for older adults.

3. Researcher established a yoga-based mindfulness program focusing on enhancing cognitive flexibility and emotion regulation skills in older adults. The program emphasized gentle poses, breathing exercises, and mindfulness techniques targeting aspect of attention to improve cognitive flexibility and emotion regulation.

4. Implementation of the yoga-based mindfulness program involved conducting onsite sessions over a span of 8 weeks in phase 1, totaling up to 16 sessions, with each session lasting 60 minutes and a week time in phase 2 to gain the valuable insights from participants. The process included the following steps:

4.1. Researcher proposed program to research advisors.

4.2. Researcher presented the program to three research specialists to ensure acceptability and congruence with the IOC (Index of Congruence) in various aspects such as program content, theory, objectives, techniques and procedures.

4.3. Researcher applied the program in a try out with a group similar to the study samples. The try-out participants included four older adults in the young-old stage, residing in a subdistrict of Phetchaburi. All participants were free from mild cognitive impairment (MCI) or any mental disorders and had health conditions appropriate for participation in the program. The Cognitive Flexibility Inventory (CFI) and the Emotion Regulation Questionnaire (ERQ) were administered as pre- and post-tests to evaluate cognitive and emotional outcomes. Upon completion of all sessions, After Action Reviews (Van Dis, #110) and interviews were conducted to gather qualitative feedback on participants' experiences and perceptions of the program.

4.4. After the try out, with feedback and guidance from research advisors and specialists, the researcher finalized and set up the program for the research study.

4. Data collection

This study employed a mixed methods approach, consisting of two distinct phases: a quantitative research phase and a qualitative research phase. Researcher collected data in two stages: the tryout group study and the research study. The procedures and details of each stage, as well as the design of both phases of research across these two stages, can be explained as follows.

Tryout group study stage

1. Publicized the project through the subdistrict administration organization to inform those interested in participating in the program.

2. Presented the permission letter from Srinakharinwirot University to the tryout sample group.

3. Recruited 4-5 volunteers for the tryout sample group, starting by cognitive impair screening test and CFI and kept it as the pre-test scores.

4. Once the sample group had been selected, provided the information sheet and consent form. To explain the details regarding confidentiality, the right to withdraw, permission for recording and audio (if necessary), and the data storage process. Clarified that the data will be used strictly for academic purpose, with the research findings presented in aggregate form. The participants' rights will be protected by not disclosing their real names and safeguarding any other personal information that could identify them. Confidentiality will be maintained, and all data and documents will be destroyed one year after the conclusion of the research (unless participants have signed consent for their data to be retained).

5. Specified in detail, within the information sheet and consent form, how participants would be involved in this period.

6. Administered CFI and ERQ as the pre-test scores.

Quantitative study to examine the program effectiveness, and during the experiment to assess learning processes in the tryout group

1. Implemented the yoga-based mindfulness program (8 sessions, 60 mins per session).

2. Observation and feedback were conducted after each session to gain participants' learning processes and to get insights for program improvement.

3. After action reviews, during the program experiment. Observation and feedback after each session were conducted after each session to assess participants' learning processes. Research questions based on observational learning and the neuroplasticity model of mindfulness were presented in appendix B.

4. Administered CFI and ERQ as the post-test scores. Analyzed pre and post-test quantitative data.

Summary of Tryout Phase and Implications for the Main Study

The purpose of the tryout phase was to gain valuable insights for refining the program design and data collection procedures. It was intended as a preparatory step to revise and adapt the intervention prior to full implementation, particularly in cases where improvements in cognitive flexibility and emotion regulation might not be clearly observed. Key elements evaluated included session timing and duration, pose selection, breathing exercises and home practices, in enhancing components appropriate for older adults within the yoga-based mindfulness program.

Findings from the tryout phase were directly applied to enhance the quality and accuracy of data collection during the main study. Notably, it was observed that older adult participants scored unusually low on the Cognitive Flexibility Inventory (CFI) during the pre-test (see Appendix F). Upon further investigation, these low scores were found to result largely from misunderstanding or misinterpretation of questionnaire items, particularly abstract concepts and negatively worded statements. In response, the researcher adopted a more supportive and interactive approach during the research study period. This included reading each questionnaire item aloud, clarifying terms as needed, and providing relatable examples to ensure participant comprehension. For instance, when a participant expressed uncertainty about a question, the researcher explained the item in simpler terms and provided culturally relevant context to guide understanding.

This tailored administration strategy helped minimize confusion and improved the validity of participant responses, particularly for individuals with limited literacy or slower cognitive processing, an important consideration when conducting research with older adult populations. These findings underscore how tryout-phase insights can meaningfully inform the rigor, cultural sensitivity, and ethical implementation of full-scale studies.

Research group study stage

1. Publicized the project through the subdistrict administration organization to inform those interested in participating in the program.

2. Presented the permission letter from SWU to the research study sample group.

3. Recruited 30 volunteers for the research study sample group, starting by cognitive impair screening test and CFI and kept it as the pre-test scores.

4. Once the sample group had been selected, provided the information sheet and consent form. To explain the details regarding confidentiality, the right to withdraw, permission for recording and audio (if necessary), and the data storage process. Clarified that the data will be used strictly for academic purpose, with the research findings presented in aggregate form. The participants' rights will be protected by not disclosing their real names and safeguarding any other personal information that could identify them. Confidentiality will be maintained, and all data and documents will be destroyed one year after the conclusion of the research (unless participants have signed consent for their data to be retained).

5. Specified in detail, within the information sheet and consent form, how participants would be involved in this period.

6. Administered CFI and ERQ as the pre-test scores and divided sample group into the control and the experimental group.

Phase 1 Quantitative study to examine the program effectiveness in the research study group

1. Implemented the yoga-based mindfulness program for the experimental group (8 weeks, 2 sessions per week, 60 mins per session).

2. Observation and feedback were conducted after each session to gain participants' learning processes and to get insights for program improvement.

3. After action reviews, during the program experiment. Observation and feedback after each session were conducted after each session to assess participants' learning processes. Research questions based on observational learning and the neuroplasticity model of mindfulness were presented in appendix B.

4. Administered CFI and ERQ as the post-test scores. Analyzed pre and post-test quantitative data.

Phase 2 Qualitative study in the research study group

This phase was designed to explore the experiences and perceptions of Thai older adults who participated in the yoga-based mindfulness program. It aimed to complement and deepen the understanding of the quantitative results by capturing participants' perspectives and identifying culturally relevant program components; the suitable components for this demographic. After the completion of the 16-session intervention, the in-depth semi-structured interviews were conducted with a purposively selected subsample of 8 participants from the experimental group (top 4 and bottom 4 performers of CFI scores). Each interview followed a guiding protocol structured around key questions, validated by the specialists (see Appendix A for details of specialists and Appendix B for questions).

The final step of this research group study stage was to schedule the control group to participate in the yoga-based mindfulness program after the completion of the experimental trial.

5. Data analysis

1. Descriptive Statistics: Utilized descriptive statistics to summarize the characteristics of the sample groups and the collected data, including measures of central tendency (mean), variability (standard deviation), and distribution.

2. Statistics for Hypothesis Testing: Conducted multivariate analysis of variance (MANOVA) for comparing multivariate sample means, basically to analyze the effectiveness of the yoga-based mindfulness program on cognitive flexibility and

emotion regulation scores for pre-post test scores and to compare the scores with the control group. Key assumption testing for the use of MANOVA included Mauchly's Test of Sphericity, assessment of inter-variable correlations, evaluation of skewness and kurtosis for normality, and testing for homogeneity of variance-covariance matrices. Detailed results of these assumption checks are presented in Appendix C.

During the experiment, data analysis involved examining discussions or after-action reviews conducted after each session. Thematic analysis was employed to classify the approach that participants employed to learn, with a focus on identifying themes and subthemes related to observational learning. This analysis aimed to gather insights to support phase 2, providing valuable understanding of how learning concepts were applied in the context of learning yoga-based mindfulness activities. These insights had aided in a deeper comprehension of participants' learning processes.

Phase 2 Qualitative research conducted after the experiment

The methodology details and stages were underlined, as follows;

1. Research participants

Participants were from phase 1

Inclusion criteria

Participants ranked among the top and bottom 4 based on CFI scores

Exclusion criteria

1.Participant has relocated

2. Participant has medical emergency or any emergency incidents

Sample size

8 participants

2. Research design

To conduct the in-depth interviews until data saturated.

3. Research tools

Tape recorder, researcher

4. Data collection

Conducted in-depth interviews in the experimental group to gain feedback and insights from the program. Research questions were presented in appendix B.

5. Data analysis

5.1 Analyzed the qualitative data from AARs during the experimental and the in-depth interviews using qualitative analysis methods of thematic analysis. To Identify common themes, patterns, and insights related to the participants' approaches, strategies in enhancing cognitive flexibility and emotion regulation, also experiences with the yoga-based mindfulness program.

5.2. Interpreted and summarized the findings from AARs during the experiment and the in-depth interviews to complement the quantitative results.

5.3 Validation process in strengthening the credibility of the program was integrated. The input and feedback from specialists in the fields of learning psychology, yoga and mindfulness, and gerontology was instrumental through the checklist in assessing the relevance, effectiveness, and appropriateness of the tailored yoga-based mindfulness program.

Ethics

Ethics considerations were outlined for both phases, as follows:

1. Obtain ethics license from Srinakharinwirot University ethic center.

2. Present permission letter from Srinakharinwirot University to all interested participants for conducting the research.

3. Provide documents regarding confidentiality of participant data and their rights to withdraw from the program.

4. Obtain permission for data collection methods such as recording, and explain data handling procedures.

5. Assure confidentiality and protection. Notify participants that data collection will be used for academic purposes only, and results will be presented in aggregate form without disclosing individual identities. All data will be destroyed after completing the research study.

CHAPTER 4
FINDINGS

This research study followed a mixed-methods intervention design, consisting of a quantitative study as phase 1 using experimentation to assess the effectiveness of a yoga-based mindfulness program in improving cognitive flexibility and emotion regulation among Thai older adults, with a focus on qualitative data collection during the experiment. Phase 2 entailed qualitative exploration post-experimentation through in-depth interviews to inform the design of a tailored program for this demographic. The study aims to inform the development or refinement of programs tailored to this demographic. The study and data were conducted onsite in the central west of Thailand and involving participants from the 'young-old' stage. This chapter structured the findings from phase 1: quantitative findings and phase 2: qualitative findings as follows.

Section 1 Quantitative Findings of Phase 1 The Experiment

1.1 General data analysis of the sample group

1.2 Statistical analysis of variables

1.3 Assumptions and Data analysis for hypothesis testing

Table 10 The symbols and abbreviations

Symbols/ abbreviations	Definition
M	Mean
SD	Standard deviation
n	Number of samples
df	Degree of freedom
F	F-test
p	p-value
η^2	Effect size

1.1 General data analysis of the sample group

An overview of the sample demographic; general characteristics were presented as follows.

Table 11 Gender and Age Distribution in both groups (N=23)

Characteristics	Experimental Group (n = 13)		Control Group (n = 10)		Total (N = 23)	
Gender	Number (%)	Age Range (Years)	Number (%)	Age Range (Years)	Number (%)	Age Range (Years)
Cisgender man	2 (15.4%)	61–62	2 (20.0%)	63–64	4 (17.4%)	61–64
Cisgender woman	11 (84.6%)	60–69	8 (80.0%)	60–67	19 (82.6%)	60–69

Table 11 showed the gender and age distribution of experimental (n=13) and control (n=10) participants. In both groups (N = 23), 82.6% (19) were cisgender women and 17.4% (4) were cisgender men. Cisgender women comprised 84.6% of the experimental and 80.0% of the control groups.

Both groups were 60–69-year-olds. The experimental group included cisgender women 60–69 and men 61–62. Cisgender men were 63–64 and cisgender women were 60–67 in the control group. Even though the range is slightly different, the experimental and control groups had similar age distributions. A balanced investigation was possible because both groups were similar ages.

Table 12 Background data of participants in the experimental group

Name	Gender	Age	Health condition	Occupation
Nu	Cisgender man	61	Leg issue	Retired (Company staff)
T	Cisgender man	62	Former stroker survivor	Retired (Company staff)
L	Cisgender woman	60	Overall physical healthy	Part time (Farmer)
P	Cisgender woman	61	Herniated disc	Part time (Farmer)
No	Cisgender woman	61	Severe back pain	Part time (Farmer)
Tu	Cisgender woman	62	Overall physically healthy	Retired (housewife)
Ke	Cisgender woman	62	Overall physically healthy	Retired (housewife)
S	Cisgender woman	63	Overall physically healthy	Part time (Company staff)
K	Cisgender woman	63	Overall physical healthy	Part time (Company staff)
Y	Cisgender woman	64	Overall physical healthy	Part time (Company staff)
Th	Cisgender woman	66	Overall physical healthy	Retired (Contractor)
J	Cisgender woman	67	leg and hip accident	Retired (Company staff)
Pi	Cisgender woman	69	Herniated disc	Retired (housewife)

There were 13 Thai older adults aged 60–69 in the experimental group, 2 cisgender men and 11 cisgender women. The majority age was 61, 62, or 63, in their early to mid-60s. At the baseline, some participants reported healthy conditions, some report limitations; leg problems, herniated discs, back pain, or strokes. Most participants were retired or part-time. The variations in health condition helped tailor the yoga-based mindfulness program to each participant's physical capacity.

To support the tailored intervention process, the experimental group participants were divided into two groups based on their baseline health conditions, this is to serve the process of tailored-intervention and also to ensure safety of the program, individual attention, and appropriate pacing to balance the need of each participant. The group was divided into A) participants with physical limitations B) participants in generally good health.

Group A: Physical limitations (mobility-limited condition)

Participants classified in this particular group were participant Nu, T, P, No, Th, J and Pi. They have musculoskeletal, or neurological issues (legs, back, herniated disc, and stroke). The yoga-based mindfulness practice sessions were prioritized with yoga props and strong support from yoga teacher; restorative poses, gentle movement, breath awareness had been emphasized to ensure safety and comfort.

Group B: Generally good health (strong condition)

This group comprised of six participants (L, Tu, Ke, S, K and Y) who reported overall good physical health. They engaged in challenging poses, focus on strengthening and in more dynamic poses compared to group A. Mindful movements remained centered and the adaptations in varieties of poses were offered.

1.2 Statistical Analysis of Variables

Descriptive statistics of mean and standard deviation shown in Table 13.

Table 13 Descriptive Statistics of CFI and ERQ (N = 23)

Variable	Experimental group (n= 13)		Control group (n= 10)		Total (N= 23)	
	M	SD	M	SD	M	SD
Cognitive flexibility (CF)						
Pre-test	103.00	6.49	122.20	7.74	111.35	11.93
Post-test	129.15	5.68	111.35	6.87	118.00	14.35
Emotion regulation (ER)						
Pre-test	38.23	3.06	49.50	4.95	43.13	6.91
Post-test	46.00	1.68	44.90	6.81	45.52	4.56

The control group had a higher pre-test Cognitive Flexibility (CF) score (M = 122.20) than the experimental group (M = 103.00). The experimental group had a higher CF (M = 129.15) after the program intervention than the control group (111.35). After the program, the sample's SD decreased slightly, indicating lower CF score variability. The control group had higher Emotion Regulation (ER) pre-test scores (M = 49.50) than the experimental group (M = 38.23). The program significantly improved ER (M = 46.00) in the experimental group, while the control group had a minor drop (M = 44.90). The program reduced the experimental group's SD (1.68) to improve ER score consistency. Experimental group improved significantly in Cognitive Flexibility (CF) and Emotion Regulation (ER) after the program. CF and ER scores dropped in the control group.

Table 14 Breath count per minute in the experimental group

Participant	Before	After
Nu	19	3
T	10	4
L	13	3
P	6	2
No	12	2.5
Tu	15	7
Ke	16	4
S	15	5
K	20	6
Y	15	4
Th	12	3
J	14	6
Pi	14	4

This table presented the breathing frequency (breath count per minute) of participants before and after practicing breathing exercises. Prior to the program practice, participants showed a wide range of breathing frequency, with values ranging from 6-20 breaths per minute. After the program practice, all participants demonstrated a marked decrease in their breathing frequency, ranging from 2-7 breaths per minute.

1.3 Assumptions and Data analysis for Hypothesis Testing

This section focused on testing statistic and validating the research hypotheses through data analysis.

1.3.1 Assumptions

The key assumptions were evaluated prior to conducting the statistical analysis. Further details/ figures in each assumption are presented in appendix C

Normal Distribution Assumption

The assumption of normal distribution was evaluated using descriptive statistics for skewness and kurtosis. According to Byrne (2010) and Hair et al. (2013) for data to meet the normality assumption, skewness values should fall between -2 and +2, and kurtosis from -7 to +7. In this current study, the skewness for all variables in control group and experimental group both fell within the range of -2 to +2, and kurtosis values remained within the range of the expectation at -7 to +7. Therefore, the data in this current study did not violate normality assumption, as both skewness and kurtosis values were within the acceptable range. Additionally, the Shapiro-Wilk test indicated that all data points for both groups met the assumption of normality, with Shapiro-Wilk p-values greater than 0.05. Therefore, the data accepted the normality assumption and was proper to further proceed in the statistical analysis.

Homogeneity of Variance-Covariance Matrices Assumption

The assumption of homogeneity of variance-covariance matrices was assessed to make sure that at the base line, both groups were equivalent. This assumption was evaluated by using Box's M test for equality of covariance matrices across groups, for both variables, during the pretest period. The results showed that the variance in each group was equal, this confirmed that the groups were comparable at the baseline or before intervention, thereby ensuring homogeneity within each group

concerning the independent variable. The results for Box's M test were as follows: Box's M = 10.131, p = .028 (evaluated at α = .001) (Tabachnick & Fidell, 2013). In addition, the assumption of homogeneity of variances was not violated, as indicated by Levene's test for homogeneity of variance. Specifically, for Cognitive Flexibility (CF), Levene's test was 1.464 with a p-value of .240, and for Emotion Regulation (ER), Levene's test was 3.666 with a p-value of .069 (evaluated at α = .05). Since the p-values for both Box's M test (p > .001) and Levene's test (p > .05) are greater than the respective criteria, the assumptions of homogeneity of variance-covariance matrices and homogeneity of variances were met.

Mauchly's Test of Sphericity Assumption

Mauchly's Test of Sphericity was conducted to evaluate if the assumption of sphericity was met for the within-subjects factor Time in both CF and ER scores. The results for CF indicated that the assumption was met, with Mauchly's W = 1.00, χ^2 (0) = .00, p = 1.00. Similarly, for ER, Mauchly's Test showed no violation of the assumption, W = 1.00, χ^2 (0) = .00, p = 1.00. These findings confirm that the sphericity assumption was satisfied, allowing for proceeding in statistical analysis.

Correlation Assumption

The assumption of the correlation matrix was examined. Pearson correlation coefficients between CF and ER variables at both the pre-post-test peiord. The significant correlations were found between CF Pre-test and CF Post-test (negative relationship), with a correlation of $r = -0.719$, $p < 0.01$, and CF Pre-test and ER Pre-test (positive relationship), with a correlation of $r = 0.779$, $p < 0.01$. These correlations do not exceed the criteria of 0.85. According to Kline (2005), a Pearson correlation coefficient (r) greater than 0.85 can indicate potential multicollinear.

1.3.2 Data Analysis for Hypothesis Testing

To investigate the statistical relationships and validate the hypotheses, series of analyses were conducted. Step 1, as mentioned earlier involved testing the assumptions for the appropriate application of statistical methods, once these assumptions were accepted, the hypotheses were tested, and the results were

interpreted accordingly. The application of the Multivariate Analysis of Variance (MANOVA) was implemented to assess the within-group changes (pre-test vs. post-test) and between-group differences (experimental group vs. control group). The analysis was to determine if there were significant changes in CF and ER scores both within and between the groups. The subsequent sections show results in details.

Hypothesis Testing

Hypothesis 1: A repeated measures MANOVA within-subjects was used to test this hypothesis, which stated that "The experimental group, after participating in the yoga-based mindfulness program, will demonstrate a greater increase in cognitive flexibility and emotion regulation scores compared to before participation." As shown in Table 19

Hypothesis 2: A between-subjects MANOVA was used to test this hypothesis, which stated that "The experimental group, after participating in the yoga-based mindfulness program, will demonstrate a greater increase in cognitive flexibility scores and emotion regulation scores compared to the control group."

Table 15 Multivariate Test Results for CF, Pre-Post in the Experimental Group

Source	Wilk's Lambda	F	df	p-value	partial η^2
Experimental group	.029	395.665	1.000	<.001	.971

p-value = .05

A repeated measures MANOVA was conducted to test the effect of time (pre-test vs. post-test) on CF scores for the experimental group. The results indicated a significant effect of time, Wilks' Lambda = .029, F (1, 12) = 395.665, $p < .001$, $\eta^2 = .971$, suggesting a substantial improvement in cognitive flexibility after participation in the yoga-based mindfulness program. The effect size was large ($\eta^2 = .971$), indicating that 97.1% of the variance in cognitive flexibility scores was explained by the intervention.

Table 16 Multivariate Test Results for ER Pre-Post in the Experimental Group

Source	Wilk's Lambda	F	df	p-value	partial η^2
Experimental group	.139	74.551	1.000	<.001	.861

p-value = .05

A repeated-measures MANOVA was conducted to test the effect of time (pre-test vs. post-test) on ER scores in the experimental group. The results indicated a significant multivariate effect of time, Wilks' Lambda = .139, F (1, 12) = 74.551, $p < .001$, $\eta^2 = .861$, suggesting a large effect size.

These findings supported the hypothesis 1 that the yoga-based mindfulness program effectively enhanced cognitive flexibility and emotion regulation scores in the experimental group from pre-test to post-test.

Table 17 Multivariate Tests for Hypothesis 2 (Between-Group Differences, CF and ER)

Effect	Wilk's Lambda	F	df1,2	p-value	Partial Eta Squared	Observed Power
Group (Experimental VS Control)	.108	37.299	4, 18	<.001	.892	1.000

p-value = .05

A between-subjects multivariate analysis of variance (MANOVA) was conducted to examine whether there were significant differences between the experimental and control groups in cognitive flexibility (CF) and emotion regulation (ER). The results of the multivariate tests indicated a statistically significant effect of group on

the combined dependent variables, Wilks' Lambda = .108, F (4,18) = 37.299, p < .001, partial η^2 = .892, observed power= 1.00.

Based on these evidences, it was sufficient to reject the null hypothesis and conclude that Thai older adults used yoga-based mindfulness program to enhance cognitive flexibility and emotion regulation significantly, suggesting that the experimental and control groups significantly differed in their CF and ER scores as measured by the Cognitive Flexibility Inventory (Dennis & Vander Wal, 2010) and the Emotion Regulation Questionnaire (Gross & John, 2003). The effect size was large, indicating that 89.2% of the variance in the dependent variables (CF and ER) could be explained by the group differences. The observed power was high, confirming the robustness of the findings, indicating that there was a 100% chance that the results could have come out significant.

To determine the specific effects of the intervention on CF and ER, follow-up univariate tests (Tests of Between-Subjects Effects) was examined. If both CF and ER show significant results individually, this further supported the hypothesis 2 that the experimental group demonstrated greater improvements compared to the control group.

Table 18 Tests of Between-Subjects Effects for CF and ER

Variable	Source	SS	df	MS	F	p-value	Partial η^2
CF pre	Group	2083.617	1	2083.617	41.8	<.001	.666
CF post	Group	3719.808	1	3719.808	5	<.001	.821
CF pre	Error	1045.600	21	49.790	96.1		
CF post	Error	812.192	21	38.676	8		
ER pre	Group	717.801	1	717.801	45.2	<.001	.683
ER post	Group	6.839	1	6.839	9	.578	.015
ER pre	Error	332.808	21	15.848	0.31		
ER post	Error	450.900	21	21.471	9		

p-value = .05

The results showed a significant between-group difference for both pre-test cognitive flexibility, F (1,21) = 41.848, p < .001, η^2 = .666, and post-test cognitive flexibility, F (1,21) = 96.179, p < .001, η^2 = .821. The findings suggest that the experimental group had significantly higher cognitive flexibility scores compared to the control group, both before and after participation into the yoga-based mindfulness program. The effect sizes were large, with 66.6% and 82.1% of the variance in CF scores explained by the group differences.

For emotion regulation, a significant between-group difference was found for pre-test ER scores, F (1,21) = 45.293, p < .001, η^2 = .683, indicating that the experimental group initially had higher ER scores. However, for the post-test ER scores, there was no significant between-group difference, F (1,21) = 0.319, p = .578, η^2 = .015, suggesting that the program did not lead to significantly greater improvements in ER scores between the groups.

These results supported the hypothesis 2 that the experimental group demonstrated greater improvements in cognitive flexibility scores compared to the control group, while the intervention significantly effected pre-test ER scores, it did not lead to a statistically significant improvement over time compared to the control group.

However, given that emotion regulation (ER) consists of two main strategies, cognitive reappraisal (CR) and expressive suppression (ES). The literature suggests that individuals with higher ER tend to apply cognitive reappraisal strategy more frequently while relying less on expressive suppression (D. A. Preece et al., 2020). Cognitive reappraisal, an antecedent-focused strategy, involves changing the interpretation of an event to regulate emotions effectively, inducing to improved psychological well-being. In contrast, expressive suppression, a response-focused strategy, is associated with greater psychological distress and alexithymia due to the inhibition of outward emotional expressions.

Since cognitive reappraisal is linked to better emotional and cognitive outcomes, it can be proposed that cognitive appraisal scores (rather than overall ER

scores) be used in Hypothesis 2 when analyzing between-group differences. This approach aligns with findings that higher cognitive reappraisal scores correlate negatively with psychological distress and alexithymia, whereas expressive suppression correlates positively with these outcomes. Therefore, focusing on cognitive reappraisal can provide a more precise measure of the program's effectiveness in enhancing emotion regulation. For this reason, cognitive reappraisal was examined in the Hypothesis 2 testing.

Table 19 Multivariate Tests for Hypothesis 2 (Between-Group Differences, CF and CR)

Effect	Wilk's Lambda	F	df1,2	p-value	Partial Eta Squared	Observed Power
Group (Experimental VS Control)	.082	50.345	4, 18	<.001	.918	1.000

p-value = .05

The results of the multivariate tests indicated a statistically significant effect of group on the combined dependent variables, Wilks' Lambda = .082, F (4,18) = 50.345, $p < .001$, partial $\eta^2 = .918$, observed power= 1.00. Based on the results, suggesting that the experimental and control groups differed significantly in their Cognitive Flexibility Inventory (CFI) and Emotion Regulation Questionnaire (ERQ) in the Cognitive reappraisal (CR) scores. The effect size was larger than ER, indicating that 91.8 % of the variance in the dependent variables (CF and CR) can be explained by the group differences. The observed power was high, confirming the robustness of the findings, showing that there was a 100% chance that the results can come out significant.

Table 20 Tests of Between-Subjects Effects for Cognitive Flexibility (CF) and Emotion Regulation in Cognitive Reappraisal (CR) strategy

Variable	Source	SS	df	MS	F	p-value	Partial η^2
CF pre	Group	2083.617	1	2083.617	41.85	<.001	.666
CF post	Group	3719.808	1	3719.808	96.18	<.001	.821
CF pre	Error	1045.600	21	49.790			
CF post	Error	812.192	21	38.676			
CR pre	Group	2774.047	1	2774.047	164.71	<.001	.887
CR post	Group	707.062	1	707.062	23.92	<.001	.533
CR pre	Error	353.692	21	16.842			
CR post	Error	620.677	21	29.556			

p-value = .05

The results showed a significant between-group difference for both pre-test cognitive flexibility, $F(1,21) = 41.848$, $p < .001$, $\eta^2 = .666$, and post-test cognitive flexibility, $F(1,21) = 96.18$, $p < .001$, $\eta^2 = .821$. The findings suggest that the experimental group had significantly higher cognitive flexibility scores compared to the control group, both before and after participating in the program. The effect sizes were large, with 66.6% and 82.1% of the variance in CF scores explained by the group differences.

For cognitive reappraisal (CR) strategy in emotion regulation, a significant between-group difference was found for pre-test CR scores, $F(1,21) = 164.71$, $p < .001$, $\eta^2 = .887$, and post-test cognitive reappraisal, $F(1,21) = 23.92$, $p < .001$, $\eta^2 = .533$.

These findings suggested that the experimental group had significantly higher cognitive reappraisal (CR) scores compared to the control group, both before and after the program. The effect sizes were large, with 88.7% and 53.3% of the variance in CR scores explained by the group differences. Thus, the results support Hypothesis 2 that the experimental group demonstrated greater improvements in

cognitive flexibility scores, and emotion regulation scores (in cognitive reappraisal strategy) compared to the control group.

Table 21 Mean Differences of Cognitive Flexibility (CF) and Emotion Regulation (ER) in Experimental and Control Group

Group	Variable	Comparing period	Mean difference
Experimental			
	CF	Post-test - Pre-test	26.15
	ER	Post-test - Pre-test	7.77
Control			
	CF	Post-test - Pre-test	-10.85
	ER	Post-test - Pre-test	-4.60

p-value = .05

For the experimental group, there was a significant improvement in cognitive flexibility scores from pre-test to post-test (M difference = 26.15). Similarly, emotion regulation scores showed a notable increase (M difference = 7.77). The results suggest that the yoga-based mindfulness program effectively enhanced cognitive flexibility and emotion regulation in the experimental group.

Conversely, for the control group, cognitive flexibility scores decreased from pre-test to post-test (M difference = -10.85), and emotion regulation scores also declined (M difference = -4.60). These findings suggest that, in the absence of the program, cognitive flexibility and emotion regulation did not improve and, in fact, slightly declined over time.

To present the differences between cognitive flexibility and emotion regulation scores withing the experimental and control groups, a graphical representation was provided in the following figures. The scores at pre-test and post-test were showed in Figures 2 and 3, highlighting the changes observed in each group over time.

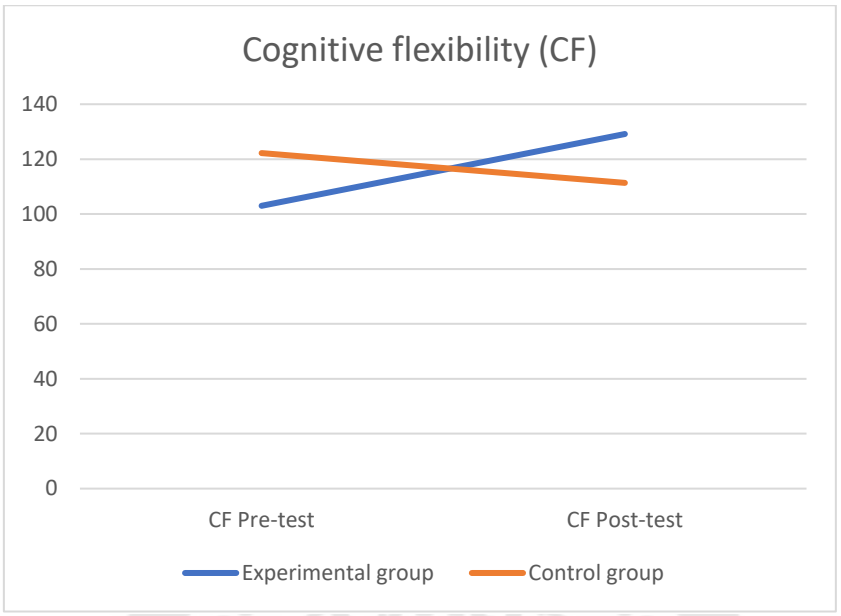

Figure 4 Graph comparing cognitive flexibility between experimental and control groups at pre-test and post-test

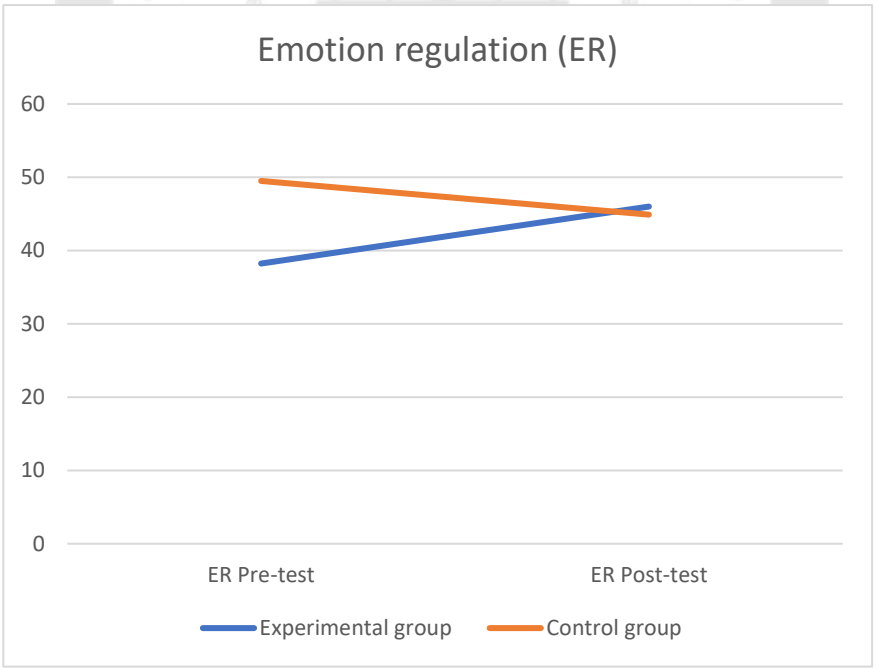

Figure 5 Graph comparing emotion regulation between experimental and control groups at pre-test and post-test

Table 22 Research Hypotheses Testing Results

Hypothesis	Results
1. The experimental group, after participating in the yoga-based mindfulness program, will demonstrate a greater increase in cognitive flexibility and emotion regulation scores compared to before participation.	accepted (The large positive effect sizes in the experimental group support this)
2. The experimental group, after participating in the yoga-based mindfulness program, will demonstrate a greater increase in cognitive flexibility scores and emotion regulation scores compared to the control group.	accepted (The substantial improvements in the experimental group support this)

Section 2 Qualitative Findings of During the Experiment and Phase 2

This section presented the interpretation of qualitative insights to complement the quantitative findings. It comprises two studies: (1) learning processes explored through After-Action Reviews, and (2) Insights into the program's impact and its suitable components, examined through in-depth interviews. These studies addressed research questions 2 and 3. Research question 2 investigated learning processes, focusing on how Thai older adults perceive learning new skills and acquiring knowledge. Research question 3 explored how Thai older adults experienced the yoga-based mindfulness program and aimed to identify its suitable components. Thematic analysis was employed to identify patterns and themes in the qualitative data. Thematic maps are presented in the following findings and data analysis.

Table 23 Participants' data during the experiment (n=13)

Name	Gender	Age	Health condition	Occupation
Nu	Cisgender man	61	Leg issue	Retired (Company staff)
T	Cisgender man	62	Former stroker survivor	Retired (Company staff)
L	Cisgender woman	60	Overall physical healthy	Part time (Farmer)
P	Cisgender woman	61	Herniated disc	Part time (Farmer)
No	Cisgender woman	61	Severe back pain	Part time (Farmer)
Tu	Cisgender woman	62	Overall physically healthy	Retired (housewife)
Ke	Cisgender woman	62	Overall physically healthy	Retired (housewife)
S	Cisgender woman	63	Overall physically healthy	Part time (Company staff)
K	Cisgender woman	63	Overall physical healthy	Part time (Company staff)
Y	Cisgender woman	64	Overall physical healthy	Part time (Company staff)
Th	Cisgender woman	66	Overall physical healthy	Retired (Contractor)
J	Cisgender woman	67	leg and hip accident	Retired (Company staff)
Pi	Cisgender woman	69	Herniated disc	Retired (housewife)

This table presented descriptive data and background information of the experimental group who were participating in phase 1 (The experiment phase) and also were participants in the study of learning processes (During the experiment)

2.1 Learning processes

This qualitative study employed an inductive approach to explore the learning process experienced by participants in a yoga-based mindfulness program during the experiment in phase 1. Data were collected through after-action reviews at the end of each program session, focusing on participants' reflections on their learning experiences. The After-Action Reviews or AARs aimed to gain information on how Thai older adults experienced and perceived learning new skills and acquiring knowledge through the program activities, as guided by neuroplasticity model of mindfulness and observational learning, contributed to their overall learning processes and outcomes.

Stage 1 Observation

The after-action reviews activity highlighted the critical role of observational learning, particularly in the initial stage of skill acquisition. Participants emphasized the importance of having a teacher as a model, which enhanced their comprehension and practical application of yoga techniques.

Findings

Participants showed that observational learning approach was the key in acquiring new skills, especially focusing on the teacher's role in demonstrating breathing exercises, techniques, and yogic poses. Observing yoga teacher improved participants' understanding, also contributing in anxiety reduction, and even increased participants confidence in movements.

"I watched the teacher in details and closely, I observing every moment. Now I can do some poses on my own." (Participant J)

"I observed the teacher demonstrating breathing exercises and poses. I can understand them very well. Without the teacher's demonstration, I would have done them incorrectly." (Participant P2)

"Having a teacher as a model is crucial for me since I had no prior experience with exercising, yoga, or meditation. Before starting yoga class. I was so nervous that I wouldn't be able to do yoga poses. Since I watched teacher very closely, observing every moment in detail. This aspect has really helped me to perform, now I have knowledge and understand the practice. I can even do some poses on my own." (Participant J)

In summary, observational learning with modeling was vital, as the key in the initial stage of learning processes, this offered participants clarity and further benefit to reduce stress and anxiety of those who had no experience in yoga.

Stage 2 Attention

The AARs for this stage investigated how participants engaged attention while observing the other participants' practice.

Findings

Participants described attention in focus as one of the elements to learn effectively. By concentrating in teacher's demonstration and instruction, participants understood more and also promote their emotions in term of regulation.

"Because I want to learn more poses, I always listen to teacher and give full attention to her" (Participant J)

"I forgot about the worries that disturbed my mind because I pay attention on breathing." (Participant S)

In summary, focused or sustained attention largely promoted participants' in acquiring skills, this led to emotional health, making participants go deeper in learning experience.

Observation and Attention (Focused observation)

This stage of AARs investigated how participants reflected on the role of both observation and attention aspects in effective learning.

Findings

The reflection of participants on techniques or strategies that they used to stay focus, away from the distractions all around, this underlining the self-regulation ability in attention.

"Whenever distracted, I simply start counting my breath again." (Participant Th)

"I remind myself to pay attention to the teacher… I don't want to fall behind others." (Participant P)

"I can hear cars passing by very loudly, and I am aware of it, in my mind, I only focus on practicing correctly. Practicing correctly is very important to me." (Participant S)

In summary, participants utilized specific mindfulness strategies, such as breath counting, self-talk, and deliberate refocusing, to overcome distractions and enhance their observational learning. The findings underlined the significance of observation and attention (focused observation) learning process, as distractions can easily occur.

Stage 3 Retention

The AARs findings showed that participants observed techniques internally and utilized those techniques in the practice.

Findings

Participants displayed the success of retention and also integrated yoga techniques, along with applying memory and practice that became habit to strengthen learning.

"Nowadays, whenever I feel tired, I just breathe deeply, it becomes natural." (Participant No)

"I memorize what the teacher has taught, and I use this breathing strategy to relieve pain. I remembered it very well because it helped me. Nowadays, I use this technique every time I feel pain." (Participant Y)

Overall, participants attributed techniques successfully through the repetition aspect, together with the integration of memory, this representing practical recall and applying techniques automatically as habit.

Stage 4 Reproduction

The AARs findings focused on how the feedback could lead to the improvement of the skills and changes in behaviors.

Findings

Participants highlighted how the important of the feedback and of practicing repeatedly, this results in skill reproduction of their own practices at home.

"I practice at home every day to make sure I don't forget how to do the pose correctly." (Participant Y)

"The teacher asked me to demonstrate the warrior pose… I had done it correctly." (Participant Nu)

"I practice the joint movement series at home every morning. Now I how to move my wrist freely with no pain." (Participant J)

In general, feedback or comments from the yoga teacher motivated participants to reproduce and rectify their own practice correctly; this led to learning improvement. Regular home practice enhanced participants' yoga practice and learning skills, also contributing to physical well-being through stretching correctly.

Stage 5 Motivation

The AARs investigated the intrinsic motivation of participants and its role in making engagement sustainable, together with improvement.

Findings

Intrinsic motivation was the primary element to make participation sustained. Participants reported the improvement in both emotional and physical health, with noticeable results of pain relief becoming the main factor of motivation.

“Yoga reduces pain. I want to join yoga class every day.” (Participant Y)

“My back pain relief, I look forward to attending class.” (Participant P)

“I have fun practicing breathing exercises and yoga poses. I am curious to learn new breathing techniques and poses.” (Participant L)

Summary: participants' motivation derived from physical and emotional well-being, pain relief, and also the enjoyment of learning new knowledge. These motivations supported engagement continuously, leading to behaviors of consistency in practice and also improved effects of yoga practice and the learning process.

Stage 6 Retention and Reproduction (Neuroplasticity)

The AARs demonstrated participants’ cognition and physical changes as a consequence of practicing yoga consistency.

Findings

Participants outlined cognition, behavior, and physical changes arising from consistency in mindful yoga practice, demonstrating the adaptation in neuroplastic.

“I have incorporated deep breathing into my daily life. Last night, I had a busy mind filled with problems in the middle of the night, which kept me awake. However, I used the deep breathing technique, and it worked, I don’t even know what time I fell asleep.” (Participant S)

“Nowadays, I sit very straight… it comes naturally, I am more aware.” (Participant S2)

"I practice breathing exercises every morning. These breathing exercises can really help me out. My head and my mind are clear, and I feel very light, no longer having heavy head, this makes me think so clear nowadays." (Participant Nu)

In conclusion, retention and repetition process has guided to neuroplastic changes in participants' brains. With practice in consistency, participants have combined yoga practice into their daily lives, showing by the improvements of physical, mental, and psychological health. Furthermore, participants' cognitive awareness and ability in gaining new perspectives have been elevated.

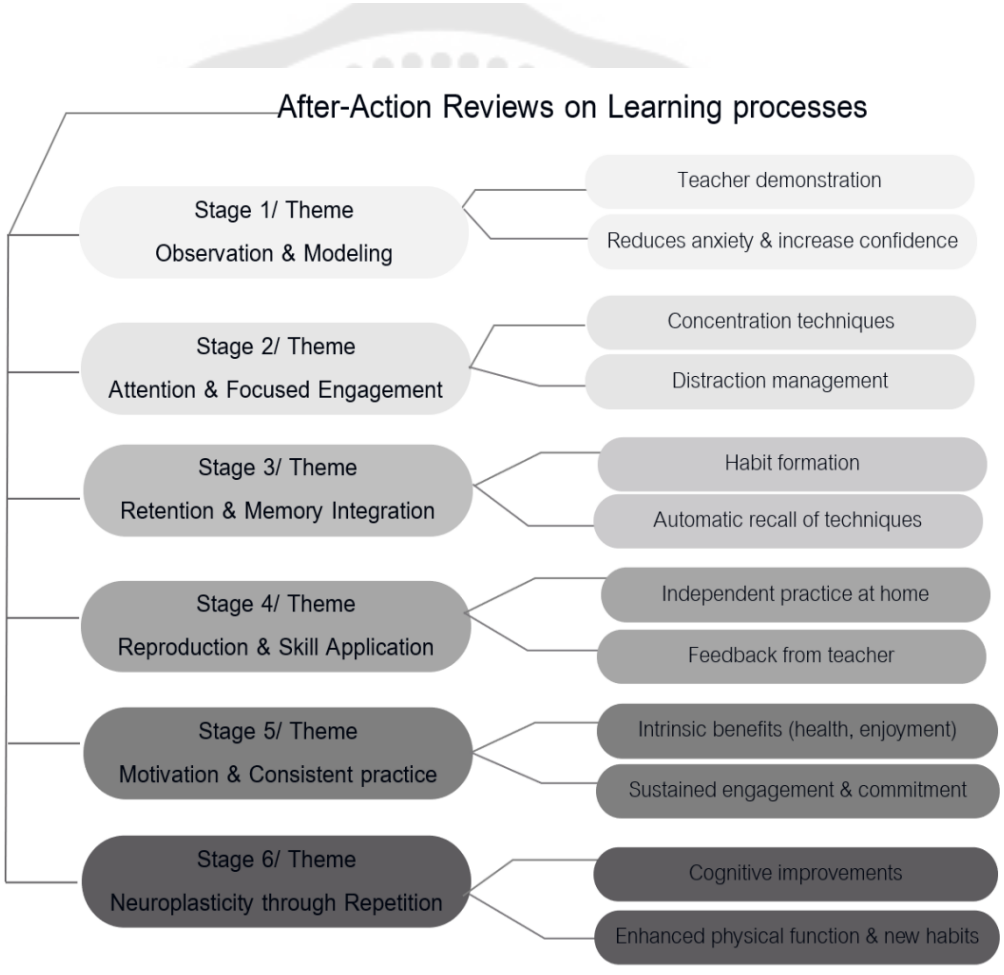

Figure 6 Summary of the Thematic Map in Learning Processes

In response to research question no. 2, which explores how Thai older adults experience and gain learning new skills and acquiring knowledge through program

activities as guided by the neuroplasticity model of mindfulness and observational learning, this section examines how these factors contribute to their overall learning processes and outcomes. Learning processes in this yoga-based mindfulness program can be explained into the following six interconnected stages:

Stage 1 Observational Learning: Participants' first step was learning through modeling by the yoga teacher, setting up a foundation of effective practice.

Stage 2 Attention & Focus: Participants developed sustainable attention, focusing on the teacher's demonstrations while effectively governing distractions.

Stages 3 & 4. Memory Retention & Skill Reproduction: To observe repeatedly resulted in the automatic recollection and practicing habit, processing in the autonomy application of learning skills.

Stage 5 Motivation & Engagement: Gaining positive experiences, such as physical improvements, along with emotional well-being, encouraged participants to practice regularly and sustainably.

Stage 6 Neuroplasticity through Repetition: Continuous repetition supports cognitive adaptation and physical habit formation, reinforcing the internalization of skills.

These learning processes can be shown in figure 2. The circular arrows clearly illustrate how these stages form an ongoing cycle. The arrow from Stage 6 back to Stage 1 represents continuous reinforcement, indicating that neuroplastic changes enhance further observational learning, thereby progressively deepening mindfulness practices.

Figure 7 Learning Processes

2.2 Insights Program's Impact and Suitable Components

The in-depth interview was conducted as Phase 2 study. Its goal was to perceive the insights of how Thai older adults gain and experience the program and also to identify the specific, most suitable components of the program that are the most beneficial and culturally suitable for Thai older adults.

Table 24 Participants' data for the In-depth Interview Study (n= 8)

Name	Gender	Age	Health conditions	Occupation	CFI
Nu	Cisgender man	61	Leg issue	Retired (Company staff)	125
T	Cisgender man	62	Former stroker survivor	Retired (Company staff)	125
P	Cisgender woman	61	Herniated disc	Part time (Farmer)	138
No	Cisgender woman	61	Severe back pain	Part time (Farmer)	134
S	Cisgender woman	63	Overall physically healthy	Part time (Farmer)	120
Y	Cisgender woman	64	Overall physically healthy	Part time (Company staff)	127
Th	Cisgender woman	66	Overall physically healthy	Retired (Contractor)	137
J	Cisgender woman	67	leg and hip accident	Retired (Company staff)	136

The table presented the demographic and background information of the eight participants who took part in the in-depth interview study (n = 8). The inclusion criteria required that participants had completed the yoga-based mindfulness program in Phase 1 and had received post-test Cognitive Flexibility Inventory (CFI) scores ranking in either the top four or bottom four. The sample group was consisted of two cisgender men and six cisgender women, age averaging from 61 to 67.

Participants stated various occupations, both retired and still engaged in the part-time job. Retired participants had previously worked in roles of private company employees and contractor. The currently employed part-time participants were involved in farming and as the company staff. CFI scores ranged from 120 to 138, stating stable cognitive functioning across these research participants. The age, gender, and occupational backgrounds diversity gave rich qualitative insights into the perceived impact of the yoga-based mindfulness program and also contributed in identifying the most suitable components for this demographic in Thailand. The findings point to inform the refinement of the program tailored to the needs and preferences of Thai older adults.

In-depth Interview Key Areas

The in-depth interview explored two key areas, each aligned with Research Objective No. 3: to gain insights into the program's impact and identify the

most suitable components, specifically in the areas of poses, breathing exercises, session structure, program duration, and frequency for Thai older adults. The aim was to inform the refinement of the yoga-based mindfulness program tailored to this demographic. The two key areas included: (1) Program impact on health and well-being, and (2) Key components and participant preferences.

Key area 1 Program Impact on Health and Well-being

Participants stated how the program impacted the physical health, improving the ability in daily activities. They also underlined enhancement in emotional well-being, along with behavioral and emotional changes positively. Moreover, they developed the ability to let go of bad thoughts and find a sense of peace.

Findings

Participants reported extensive physical, mental, emotional, and behavioral improvements resulting from participation in the yoga-based mindfulness program. Findings in this key area revealed three main themes: physical benefits, mental and emotional well-being, and behavioral changes and emotional shifts. Each theme consists of various categories resulted from participants' perspectives.

Theme 1 Physical Benefits

Participants underscored physical enhancements such as pain relief from the chronic one, increased joint mobility and strength, better in sleeping, and energy levels improvement. They explained the particular yoga poses and breathing exercises that could alleviate the physical discomfort, making them to be back in their daily activities on their own.

Subtheme 1 Pain Relief

Several participants experienced considerable reductions in chronic pain, notably in the hips, back, and legs. For instance;

"It relieved pain in my hips, back, and legs well… now I sleep deeply without pain." (Participant P)

Similarly, another participant reported complete relief, sharing;

"My back pain is completely gone. My back is more straight up, and now I sit in the cross-legged easily." (Participant No)

The pain-management improvement supported in enhancing the quality of life.

Subtheme 2 Improved Mobility and Strength

Joint mobility and muscular strength were underlined by several participants.

One Participant noticed dramatic improvement:

“In the past, I hardly walked or stood up. Now I don’t even need a support.” (Participant J)

Likewise, another Participant noted enhancements that impacted the daily activities:

“Nowadays, I can stand longer and do things in my shop with less effort.” (Participant P)

These physical improvements build independence and functionality in participants’ daily lives.

Subtheme 3 Better Sleep and Increased Energy

Enhancements in sleep quality and increasing of the energy levels were generally stated.

“My sleep has improved a lot; I sleep for long hours without waking up nowadays.” (Participant No)

This subject was repeated by another participant, who asserted,

“I am energetic, unlike in the past, I got tired very easy.” (Participant Y)

Sleep better and increasement in energy level essentially improved participants' ability to engage actively in daily activities.

Theme 2 Mental and Emotional Well-being

Apart from the physical improvements, participants experienced remarkably benefits in mental and emotion aspects. They stated stress reduction, improving in emotional resilience, and clear thinking assigned to mindful yoga practice.

Subtheme 1 Stress Reduction

Participants often described breathing exercises as needed in reducing stress and anxiety.

“Deep breathing makes a such big difference it helps me to reduce stress and fatigue.” (Participant T)

Further, another participant focused on the effect of breathwork, mentioning,

“Nowadays, whenever I’m stressed, I use deep breathing, it helps to calm me down.” (Participant P)

Mindfulness practices within this current program remarkably contributed to participants’ ability to manage stress effectively.

Subtheme 2 Greater Emotional Resilience

Enhanced emotional strength was highlighted. One Participant expressed greater emotional stability,

“My mind is stronger now. I’m no longer overwhelmed by financial struggles. I face challenges with a sense of readiness.” (Participant Th)

Two Participants expressed mood, emotion improvement, hope and optimism,

“In the past, I felt useless and burdened by my injury, I often crying in frustration. But now, my mind is at peace. My goal is to recover enough to go back to work.” (Participants J)

“Nowadays, I wake up feeling excited to cook for my grandson, whereas in the past, I didn’t care.” (Participant No)

One participant employed breathing exercises as coping strategy for life’s difficulties,

“I don’t get tired as easily now. I use breathing practice whenever I feel exhausted. It helps. My life is great, and I feel so fortunate….” (Participant Y)

Subtheme 3 Enhanced Mindfulness and Mental Clarity

Clearer cognitive procession was highlighted. One participant described a newfound clarity and hopefulness, remarking,

"Practice of poses, breathing exercises and meditation lifts my mood, and I feel lighter. Problems are still there, even if they haven't disappeared, my mind is clearer, I can think straightly, I don't feel trapped anymore- I can see a way forward, what I should do with my life or to solve problem." (Participant Nu)

The yoga-based mindfulness program provided participants' capabilities, to be effective in problem-solving and decision-making. Furthermore, one participant emphasized to be more mindful in daily life,

"I use breathing in everything in my life nowadays, I have become more aware of my breathing." (Participant Y)

Theme 3 Behavioral Changes and Emotional Shifts

Participants expressed changes in behavior and emotional responses, underlined better conflict management, improvement in relationships, increased patience, and ability to release negative thoughts.

Subtheme 1 Improved Relationships

Participants stated remarkable enhancements in interpersonal relationships through the process of emotion regulation skills.

"Now I don't react harshly anymore on my grandsons' misbehavior. I become calmer." (Participant Y)

Similarly, another participant experienced improved interaction in the family, reporting,

"I don't argue with my daughter-in-law anymore; I don't know why, nowadays, I am comfortable with breathing, I just breathe. Even my daughter-in-law has started being nicer to me." (Participant S)

These insights show how mindfulness practices can grant to harmony and healthy relationships within family interactions.

Subtheme 2 Increased Ability to Let Go of Negativity

Participants underscored ways to release negative thoughts, emotions, resulting to emotional health improvement.

"I often could not get rid of excessive worries, but nowadays, I easily let go of them." (Participant Y)

Likewise, another participant revealed emotional changes:

“I am calmer, and happy. Nothing much can bother me as it used to be in the past.” (Participant S)

Participants praised these emotional changes due to the regular practice of yoga and mindfulness breathing.

Subtheme 3 Renewed Purpose and Independence

Yoga-based mindfulness program cultivated sense of purpose and also increased independence in participants, positively impacting their views of life.

“Nowadays, I have things to accomplish. I feel that my life is meaningful again. I wake up enthusiastically to cook for my grandson.” (Participant No)

Another participant also stated renewed motivation:

“I look forward to have a part-time job. My body become strong and healthy, I want to work again.” (Participant J)

Such findings express that the program remarkably affected participants’ motivation, independence, and sense of purpose, more meaningful in life.

In summary, the yoga-based mindfulness program improved participants' physical and mental health, emotion well-being, and behavioral patterns. Participants consistently identified remarkable benefits across three main subthemes: physical benefits, mental and emotional well-being, and behavioral changes and emotional shifts. Yoga poses and breathing exercises were repeatedly noted as key practices for improvements in pain relief, sleep quality, emotion regulation, stress reduction, and interpersonal relationships. In conjunction with these results suggest that yoga-based mindfulness program can improve holistic well-being in older adults.

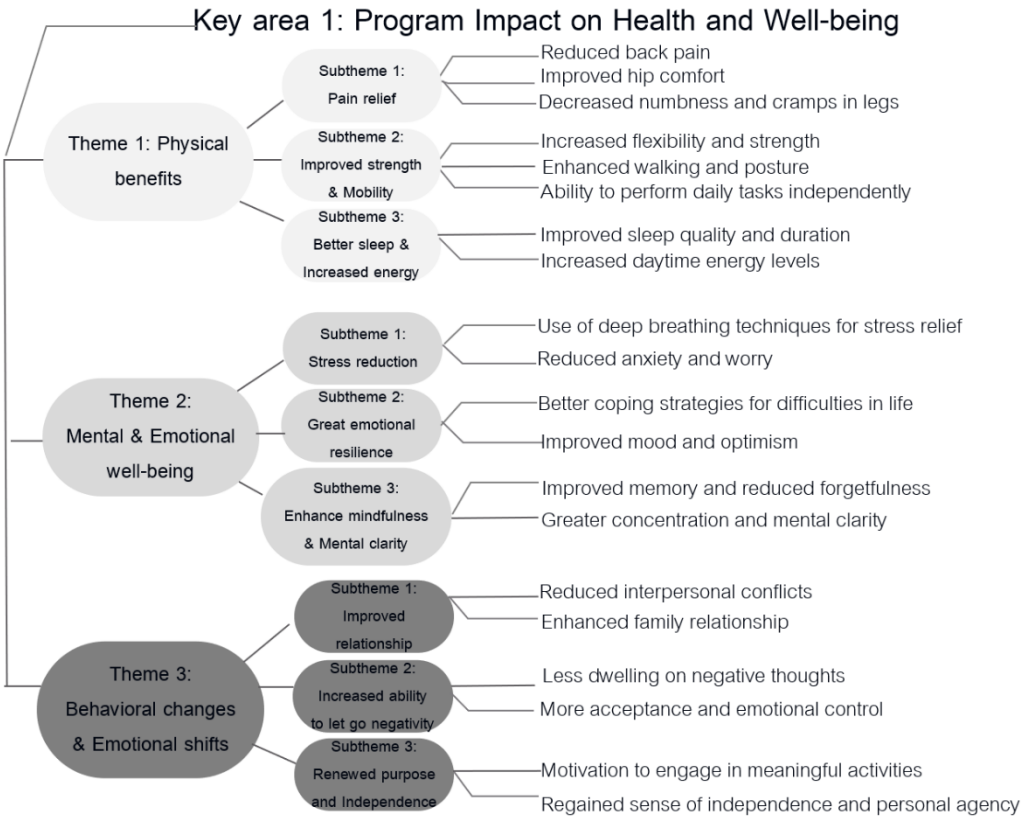

Figure 8 Thematic Map for Key area 1 Program Impact on Health and Well-being

Key area 2: Key Components and Participant Preferences

Theme 1: Behavior - Overcoming Challenges and Gaining Strength Through Practice

According to the in-dept interview, participants underlined their efforts in overcoming physical challenges and building the strength through consistent practice. Firstly, many participants struggled with some specific poses due to lack of strength, stiffness or even pain. But, throughout the progress step by step, adaptation, and the combination of breathing techniques, participant could eventually gain physical and emotional enhancements.

Findings

Participants constantly described how to overcome challenges at the beginning through persistency, adaptation, and mindfulness approach. The behaviors revealed during session practice underlined perseverance, effort in

consistence, and the breathing techniques to deal with the physical limitations. Participant responded to the in-depth interview questions can be structured in the four following subthemes.

Subtheme 1 Facing and Adapting to Initial Physical Challenges

Participants outlined the initial struggles with yoga poses due to physical limitations including stiffness, lack of muscular strength, and pain. Nevertheless, rather than being discouraged, participants adapted to continue practicing.

Participant expressed knee discomfort at the beginning of practicing, during the cat-cow pose but adapted through gently exposure eventually:

"The cat-cow pose fits me very well, as I feel my spine has been stretching deeply. Kneeling position was painful at the beginning. In spite of discomfort, I continued because I felt so good in the spine. I took it slowly, limited the duration, and gradually helped to build my tolerance." (Participant P)

Similarly, Participant Th faced challenges in balancing; leg shaking but using props helped to overcome the difficulties:

"The chair pose and warrior pose are matching with my daily activities. Initially, my legs shook badly, and I struggled to be in poses. Following the teacher's advice, I used pillar as the support, and in about ten classes, I was eventually able to do poses without shaking." (Participant Th)

Participants' capability to modify and adapt practices presented resilience and commitment, vital for the continued engagement in yoga practice.

Subtheme 2 Gradual Progress and Adaptation

Moderate progress through consistent, repeated practice came up in participants' descriptions. Participants used patience and gradual progression as essential strategies for managing physical challenges. They underlined incremental learning and adaptation in practice:

"Firstly, warrior pose was very much challenging for me, my legs lacked strength and shook. However, even I couldn't do poses exactly as teacher's

instruction, I kept going through trial and error. Later, my legs stopped shaking." (Participant No)

One participant also embodied incremental progression in overcoming discomfort and in enhancing practice:

"At first, I could feel pain in my spine, but I didn't give up. Every day, I pushed a bit furthermore, also comparing my progress to the previous day. Little by little, I overcame pain eventually." (Participant L)

This incremental approach cultivated sustained encouragement, self-efficacy, and visible improvements eventually.

Subtheme 3 Integration of Mindful Breathing

Participants often reported about the integration of mindful breathing techniques to overcome pain, improve concentration, and support physical health. This mindful approach resulted in emotional well-being and helped participants to persist in spite of physical discomfort. One participant stated the calming and guiding part of breathing exercises:

"Because of my physical limitations from the accident, I pay attention on breathing specifically to guide my movements. Whenever I experience pain, I use deep and slow breathing to help. Eventually, my stiff body in the past, has become much more supple." (Participant J)

The integration of mindful breathing also improved participants' ability to remain calm during challenging poses.

"Simply sitting straight and breathing deeply gives me great joy. Ultimately, with home practice and repetition, my back became naturally straightened up." (Participant S)

Subtheme 4 Perseverance and Consistency

Regular effort through challenges led not only in physical well-beings but also valuable emotional and psychological benefits. Participants stated a strong sense of success, self-efficacy, and emotional fulfillment arose from persistent practice.

One participant described the profound transformation resulting from repetitive, continuous practice.

"Warrior, tree, and bridge poses have been life-changing. At first, balancing poses were a major challenge. I believe in repetition and continuous practice. Even though I experienced pain in class, I still practiced at home. Today, I no longer need the wall for support, and practice without pain." (Participant Nu)

Another participant explicitly related persistent practice to broader life improvements:

"I believe in delayed gratification; hence I dedicate time daily. Now I have strength. Severe pain almost disappeared. From barely walking, now I can walk and work. If my body is strong, I can earn an income, eventually helping my family." (Participant P)

Subtheme 5 Postural and Body Awareness

Teacher's corrections and self-awareness in alignment, posture and breathing were expressed of this theme.

"Accomplishing each pose was not easy, it took continuous corrections and reminders from the teacher. During class, teacher's corrections helped me adjust my pose. Finally, my back naturally straightened. Now, to sit upright is not difficult anymore, it comes naturally with my own awareness." (Participant S)

"I try very hard to be mindful when stretching, not to overstretch my body. I remember teacher's correction during the Stick Pose due to I had overstretched in my ribcage area. Now, I practice mindfully, I'm mindful of my movements, and I don't experience pain in my chest anymore." (Participant Y)

In conclusion, participants' experiences emphasized the importance of overcoming physical challenges through effort, adaptive techniques, incremental progression, and mindful breathing. These techniques allowed them to achieve remarkable enhancements in physical strength, flexibility, and emotional well-being. Participants' dedication and perseverance were essential in enhancing resilience, self-confidence, and a sense of achievement that expanded beyond the yoga practice into

daily life. These findings show that the program enhances physical and psychological well-being in older adults effectively, especially through behaviors focusing on consistent effort and adaptation mindfully.

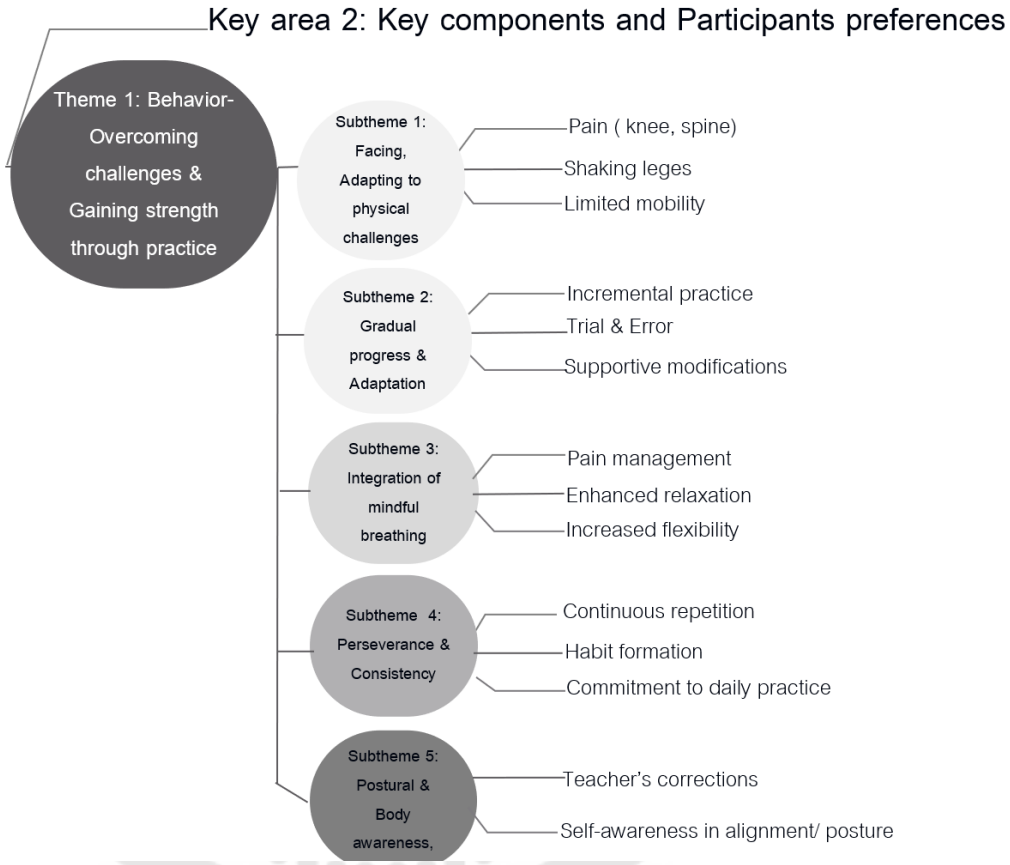

Figure 9 Thematic map for Key area 2, Theme 1

Theme 2 Alignment with Thai Cultural Values/ Proverbs

Participants shared that their experiences in the program were closely aligned with traditional Thai cultural proverbs; values. These cultural faiths including patience, discipline, perseverance, incremental progress, and the connection of mind and body, escorted participants' practice and remarkably affected their daily life and overall well-being.

Findings

Participants steadily reflected on traditional Thai values that echoed their personal experiences in practicing yoga.

One participant reported similar to the value of delayed gratification, stating:

“I dedicate time for practice daily to give my body supple and strong. Now my body is much better; from severe pain in the past, it almost disappeared. I had challenges in walking, nowadays, I can walk steadily. I have certain belief that if my body is strong enough, I will be able to work more, hence to earn better, which will ultimately help me and my son.” (Participant P)

Another participant positioned her practice with the proverb, If there is a will, there is a way, expressing perseverance in managing the initial stage of physical challenges:

“Even I used huge efforts always, I was not tired at all. I kept going, and telling myself to keep practicing with strong determination and perseverance. Now I feel that I am successful in practicing.” (Participant Th)

Participant also underlined moderate and regular effort through proverbs like Take care of the pence, and the pound will take care of themselves:

“I give myself time. I practice bit by bit, part by part, due to my uncertain schedule. Abdominal breathing exercise fits my lifestyle well. Because of my stroke condition, which makes me tired very easily, having deep and slow breathing helps prevent fatigue.” (Participant T)

Further, embracing the approach of trial and error, participant indicated an openness to learning and improvement through persistent practice, regardless of initial inaccuracies:

“Even if I could not do exactly what the teacher told me, I just kept practicing, sometimes following instructions, sometimes not. For me, it doesn’t matter at all even it’s right or it’s wrong; as long as I keep practicing, I was trying through trial and error, nowadays I can master some poses easily and correctly.” (Participant No)

One participant outlined the idea of incremental progress: Saving Little by Little, representing participant's patience and progressive improvement:

"I practice in my own way, even sometimes I was not available, I did not give up practicing. I keep going bit by bit. Today, I can do this far, the next day I compare with yesterday and move a little further. Little by little, I overcame the pain." (Participant Y)

Highlighting the interconnectedness of mental and physical health, another participant adopted the principle of Mind over body; a sound mind in a sound body, explaining:

"When I feel pain while doing poses, I use deep and slow breathing to ease it away. This makes my body relax. Once my mind is at ease from breathing exercises, my body becomes totally light and relaxed." (Participant J)

Similarly, the proverb Diamond cuts diamond or the concept of continuous repetition and persistence was emphasized by Participant Nu:

"I believe in repetition and continuous practice; it's my golden rule. Even though I was in pain in class some time, I still kept practicing at home. I moved gently but still kept on moving, kept repeating. Now I don't need to use wall to support, I also have no pain." (Participant Nu)

Lastly, the essence of disciplined correction, concepted by the proverb *Spare the rod, spoil the child*, was outlined in one participant's experience of having regular teacher advice:

"At the beginning, I could not control myself in sitting upright, I kept forgetting to position myself straight. But teacher always reminded and corrected me, hence I adjusted my posture. Overtime, after continuously practice, my back is now straight up naturally, I sit upright without any effort." (Participant S)

Participants' reflections showed an explicit align between the program and Thai cultural values. Core themes pointed out through participants' insights included perseverance in managing challenges at the beginning, gradual enhancement and patience, determined effort and discipline, and the integration of both mental and

physical well-being. These traditional values did not only echo participants' personal beliefs but also encouraged motivation and conformity in yoga practice, eventually resulting in meaningful physical, mental, and emotional enhancements. These values can be outlined in the following figure.

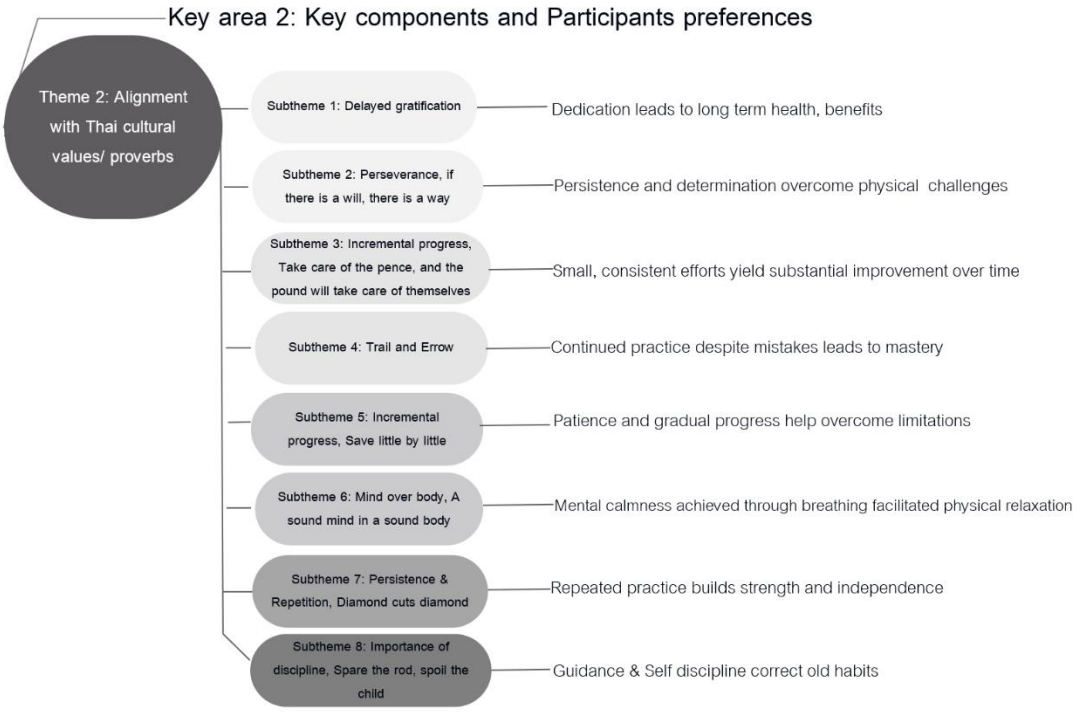

Figure 10 Thematic map for Key area 2, Theme 2

Theme 3: Suitability with Thai older adults Lifestyle

Participants agreed that the yoga-based mindfulness program fits well with necessity and lifestyle of Thai older adults. They underlined the program's benefits in overcoming challenges in age-relation, encouraging social interaction, and holistic promoting in both physical and mental health.

Findings

When asked whether the yoga-based mindfulness program fit well with the lifestyle of Thai older adults, participants stated perspectives focusing both physical and psychological well-beings.

Subtheme 1 Holistic Health Suitability

In physical well-being; Participant P stated that overall health issues in older adults including diabetes, high blood pressure, and gout, can definitely get improved after practicing or joining the yoga-based mindfulness program:

"Once we age, we are not as strong as we used to be, and many diseased such as diabetes, high blood pressure, and gout become common in older adults, especially the ones live in this area. From what I've heard, everyone who had issues with their body and joined the program has seen improvements and feels better." (smile). I feel sorry for many older adults who do nothing but sit at home with nothing practical to do. But of course, it depends on whether they are interested in joining or not." (Participant P)

"It fits older adults well. It strengthens the body, improves breathing, clears the mind, and helps maintain a positive mood." (Participant J)

"It is suitable. It will definitely good for any one, any older adult, even those who are using respiratory tool." (Participant Nu)

Some participant outlined program's benefits over the physical well-being, viewing it as a holistic aspect that supports longevity, emotional health, and life quality in overall:

"This program supports in prolonging life. Older adults can stay with their families longer, live longer, have a good time together, and maintain good physical and mental well-being." (Participant No)

Subtheme 2 Social Suitability

Social interaction was also viewed as a main benefit. Participant Th highlighted the program's ability to reduce loneliness for older adults who live alone:

"Any older adult that engages in practicing like I do, I'm certain that he or she would definitely gain improvement, particularly in the minds. Many older adults live alone, and they could feel lonely especially for this community. Coming to class, interacting with others, and practicing in a group could help them feel better and have someone to chat with, this shall prevent depression." (Participant Th)

"The program fits well with general older adults, and also for this community. I feel sorry for those older adults who do nothing but sit at home with nothing practical to do; there are quite many of them. It would be great for them to join the program, but of course, it depends on whether they are interested in joining or not." (Participant P)

"This program gives us a chance to gather and talk, it's a great form of socialization (laugh). Once I look around this area, I see many elderly just sit and do nothing practically. This program would be great for them." (Participant Y)

Overall, participants concurred that the yoga-based mindfulness program can enhance the physical health, social, and emotional well-being of Thai older adults effectively. They underlined its suitability due to its outstanding health benefits, and the chance for meaningful social interaction, making it particularly beneficial for this demographic group.

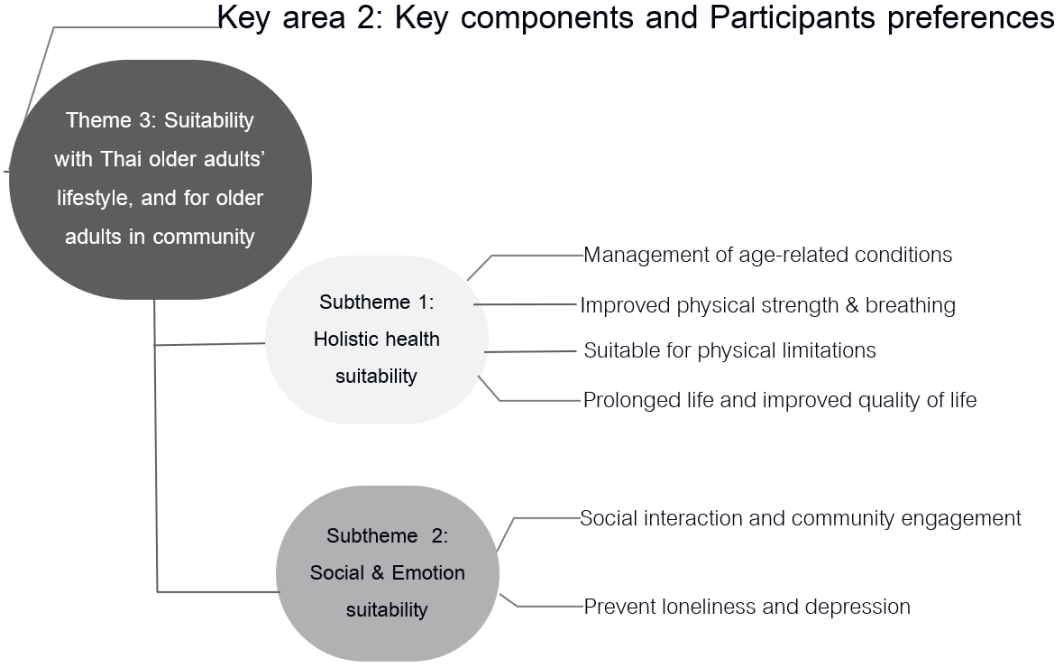

Figure 11 Thematic map for Key area 2, Theme 3

Theme 4 Overall Experience with the Program

Participants expressed experiences with the program, stating autonomy and inspiration. The program was also outlined in positive social and family support.

Subtheme 1 Social and family support

Social support and family forces were strong. Most participants got encouragement from members in the family, contributing motivation to practice. One participant expressed family support directly, stating,

"My son is a reminder in practicing (smiled), 'Mum, it's time to practice yoga now." (Participant P)

Another participant also acknowledged great support from her daughter and husband as essential in maintaining regular participating in the program.

"My family is quite happy with me practicing yoga, my husband drove me to the class, my daughter kept motivating me to join the class, she knows yoga and said yoga would be good for me." (Participant Th)

Subtheme 2 Increased Independence, Motivation and Autonomy

Participants showed increased motivation and independence, inspiring their routines and goals in the future positively. One participant expressed resumed confidence:

"I feel that I have completed something that brought my life back. Nowadays, I can walk without support. I am now even looking forward to a part-time job." (Participant J)

Likewise, another participant stated achieved independence,

"I don't need to ask for help anymore, I can do many things in the farm on my own. I also wish to cook for my nephew." (Participant No)

In summary, Thai older adults joining the yoga-based mindfulness program experienced varied enhancements. The program supported them with practical aids to regain independence and motivation, social and family support, thereby improving their quality of life in generally.

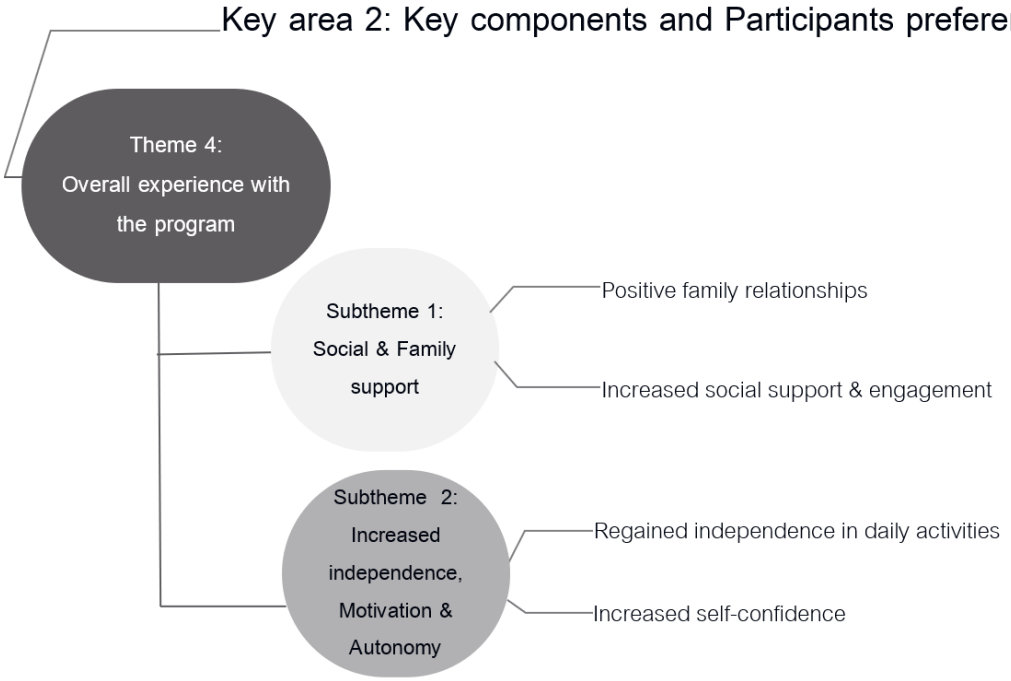

Figure 12 Thematic Map for Key area 2, Theme 4

Theme 5 Techniques used in practice

Participants used various techniques to improve yoga poses and breathing exercises. The techniques were stated from breath control and focus attention to perseverance and mindful body awareness, respecting the physical limitations.

Findings

Techniques included breath control, strong mind, listening to the body, observation in details, memorization, and regularity in routines. These methods applied reflect discipline, self-awareness, and adaptability, stating an combination approach of yoga-based mindfulness program.

Subtheme 1 Breath control as a core technique (Breathing technique)

Participants outlined breath control as base to their yoga practice. One participant expressed the value of breath retention:

“I could practice well in the breath retention. My technique is to sit super straight while practicing. After a big and long inhalation, I block my breathing,

hold it as long as possible, and then very slowly release it bit by bit. That makes my head become so clear, apart from feeling light all over my body." (Participant P)

Similarly, another participant used breath awareness to guide physical movements and manage pain, stating:

"I use breathing as the foundation of my practice...Whenever I feel pain, I use my breath to ease it away. I always memorize what the teacher has taught me; breathing is really beneficial." (Participant No)

These aspects underline breath control's role in overcoming pain, cultivating relaxation, and enhancing the clarity of mind.

Subtheme 2 Mental strength and willpower (Mental technique)

Mental resilience and determination were focal to participants' in manage difficulties in poses. One participant explained the vital belief in willpower.

"I don't know what method I have utilized; I just use willpower. I believe a strong mind can win anything. I use effort and determination in my own practice and to complete my goal." (Participant Th)

Another participant emphasized the significant of mental strength, resulting from past military experience:

"I use concentration. I used to be a conscript soldie, I was fortunate to be in the intensive training. It was such a great life experience; willpower, concentration, patience, these essences help me in living and doing anything in life." (Participant T)

These statements identify participants appraised mental strength and perseverance as vital for managing physical challenges.

Subtheme 3 Body awareness and adaptability (Physiological technique)

Participants regularly expressed the importance of being mindful in their physical limitation and adaptation in practicing accordingly. One participant shared a pivotal lesson on mindful adaptability:

"I remembered the teacher's advice that the pain I had gained came from overstretching...Now I know how to do it, become aware of my limitations, and listen to my body. Once it's too much, it's not a good pain. I just step back and then restart again. I keep practicing little by little, I don't rush myself." (Participant Y)

Another participant similarly supported progression of mindfulness without forcing in the movements:

"The warming-up stage is a vital, we can't miss it. In case if the pain occurs, we should never give up, we must keep practicing: and keep repeating, we don't have to force ourselves or push too hard, but just keep continuing." (Participant No)

These perspectives focus on the respect of physical limitations, expressing in safety and sustainability in progression.

Subtheme 4 Observation and Memorization techniques

To observe carefully and to memorize were also structural to practice effectively. One participant outlined the benefits of observing teacher's modellings:

"I remembered the teacher's demonstrations. I always observed the teacher, I observed closely. This led to my active memory. When I am at home, I still can remember what teacher has taught, hence I can practice on my own every morning." (Participant J)

In addition, another participant expressed focused attention during teachings:

"I just followed the teacher's instruction. Put full concentration on the teacher, I don't want to pay attention to the cars' loud noise or anything else. In my mind, I must watch teacher and do it correctly." (Participant S)

These techniques cultivated precise practice, memory retention, and autonomy in practicing.

Subtheme 5 Consistency and structured practice techniques

Participants often outlined the role of regular practices in accomplishing benefits in the long run. One participant highlighted the importance of designed sessions:

“I believe in the warming-up practice, it’s mandatory, we have to do it before practicing yoga poses. This stage supports practicing, to make the fast progress and gain no more pain.” (Participant Nu)

“I practice on my own every day in the morning, my back is getting much better, I somehow feel that my memory is also better, I am not that forgetful like in the past”

In addition, participant Th emphasized “I practice often in the evening, especially the child pose, it is needed for me, I have to practice this pose before going to bed. This specific pose really helps me to sleep in long hours.” (Participant P)

Participants supported session designed of the practice, and consistent practice schedules, bolstering learning and expanding yoga’s benefits ultimately.

In conclusion, most participants integrated breathing control techniques, mental ability, adaptability in mindfulness, skills in observation, and designed of stage in session practice to effectively progress in the yoga-based mindfulness program. These multifaceted yet supporting techniques cultivated remarkable enhancements in physical health, emotional well-being, and mindfulness, highlighting participants' strong engagement and commitment into the long-term well-being and personal growth.

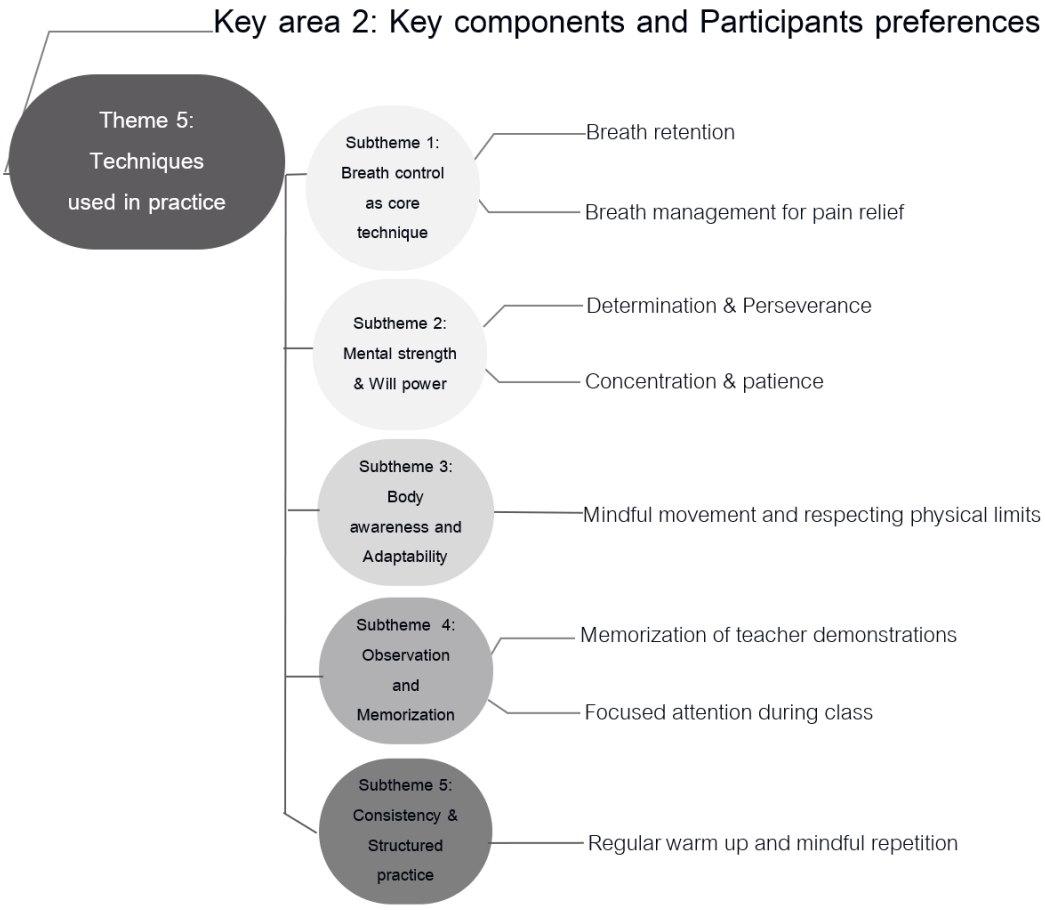

Figure 13 Thematic Map for Key area 2, Theme 5

Theme 6: Satisfaction with the Yoga-Based Mindfulness Program

Participants highlighted general satisfaction with program, outlining its benefits, appropriation of the program session, durations, and frequency of the program, along with the enhancements in physical and mental well-being.

Findings

In spite of overall satisfaction, participants proposed the minor suggestions to adjust the program to their preferences.

Subtheme 1 Program structure and duration

Participants experienced stage of session in this current program advantageous and practicable, specially focusing on the proper session durations and frequency. One participant noted positively,

"Yes, I am so happy with this program. The program duration suits Thai older adults. I also prefer the longer sessions, from 60 mins to 120 mins, and frequency at two or three times per week is just right for me." (Participant P)

Likewise, another participant stated that a session of 90 mins at three times per week would be suitable. Participant P also propose combination of cultural set up such as walking meditation, the Thai Buddhist style to bolster mindfulness practice.

"The program could be adjusted by combining the Thai style mindful walking meditation. It would be great, especially, for those who enjoy the practice of meditation. As for program duration, I propose 1.5 hours, and the program frequency at three sessions per week." (Participant Th)

Nevertheless, some participant mentioned a concern regarding work commitments in some older adults, stating that shorter like 30 minutes session would be suitable for the busy older adults, however, it would not be adequate, while the two-hour sessions might be too long for those who have to work regularly: "Everything is fine in my opinion, but two-hour session could be too long and 30 mins session would be too short, since many of them still have work commitments in daily routines. Some older adults still work for a living. Also, it shouldn't be too early in the morning." (Participant T)

Subtheme 2 Desire for Program Extension and Increased Focus on Specific Needs (Program extension and more variety in poses)

Several participants expressed a wish for extending the duration of the overall program or sessions to deepen their practice and address specific health concerns more thoroughly. One participant suggested adding four more sessions to the current 16-session format to further improve physical health:

"I wish the program could be longer, not just 16 sessions. Another four sessions would be great. I still want to work on my legs more and fully recover. Lengthening the session to 1.15 hours and extending the total session of the yoga-based mindfulness program to 20 hours." (Participant Y)

Another participant particularly suggested more yoga poses emphasized on the spine, identifying personalized attention could improve more in participant satisfaction:

"I want to learn more poses specially designed on the back area since I have issues with my back, it would be great for me." (Participant P)

Subtheme 3 Clarified and easy-to-follow instructional materials

Clear instructions and easy to understand materials were pointed out as essential aids to participant satisfaction. Participants particularly praised the clarity of the instructional handouts, noting their ease of use:

"Everything else is well-structured. The poses are good, easy to follow. The information sheet provided by the teacher is very clear; when I look at the pictures, I know how to practice." (Participant J, Th and No)

Subtheme 4 Intensity of Practice and Relaxation Components (session stage, pose intensity)

Some participants desired adjustments in practice intensity and lengthening the relaxation period. One participant proposed to have more intensive poses, highlighting the developing readiness and ability for more challenging exercises:

"Some poses could be deeper, harder, and longer time such as the chair pose." (Participant Nu)

Another participant suggested lengthening period of relaxation at the end of each session, underscoring the dominant of this phase in gaining ideal satisfaction:

"It would be good to expand duration of the relaxation pose. It should be a bit longer. So, I think 1 hour and 10 minutes would be ideal, with two sessions per week." (Participant S)

Participants expressed "Breathing exercises, especially the deep abdominal breathing, should always be the main components of session stage." (Participant P, No and J)

In summary, participants generally expressed high satisfaction with the current yoga-based mindfulness program. Their recommendations for minor developments including length of session adjustments, adding relevant mindfulness practices culturally, having individual physical needs through specific poses, increasing intensity of some poses, and prolonging period of relaxation. These suggestions inform general satisfaction alongside occasions for improving the program's receptive to the various needs of Thai elderly. These insights suggest that minor adjustments can remarkably enhance program satisfaction, highlighting the importance of participants' collaboration tailoring programs to specific demographic and cultural factors. The findings echo participants' perspectives in respect of suitable components of the program regarding poses, breathing exercises, stage or the structure of sessions, and program duration and frequency. The findings also reveal that the yoga-based mindfulness program is not only appropriate but advantageous for the older adults, improving their physical, social, and emotional necessity effectively.

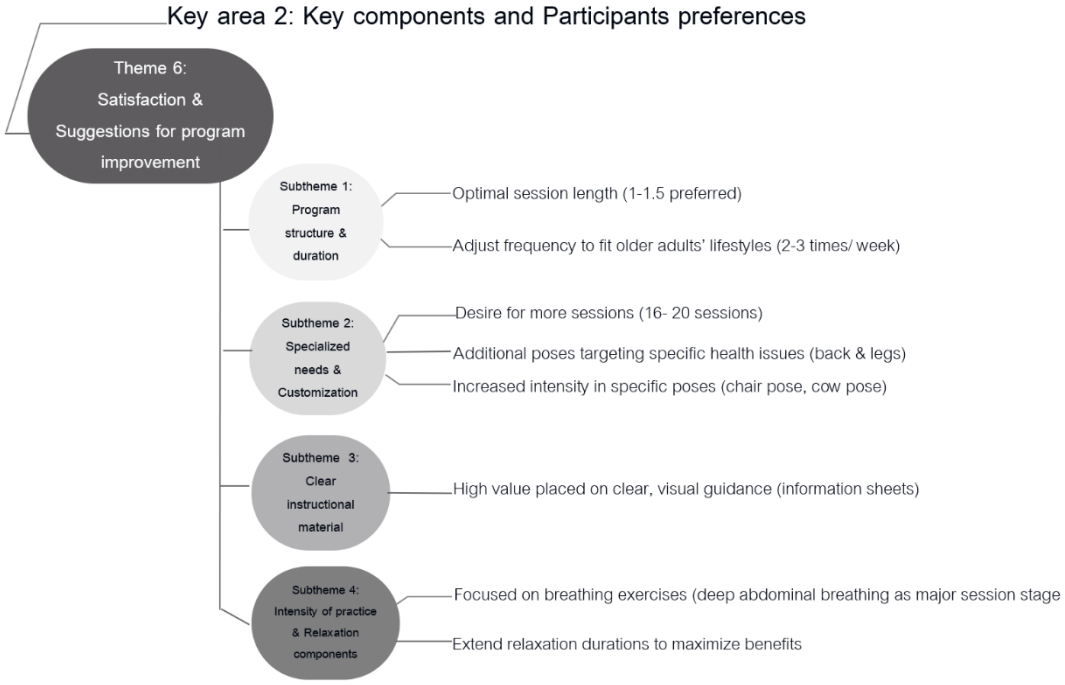

Figure 14 Thematic Map for Key area 2, Theme 6

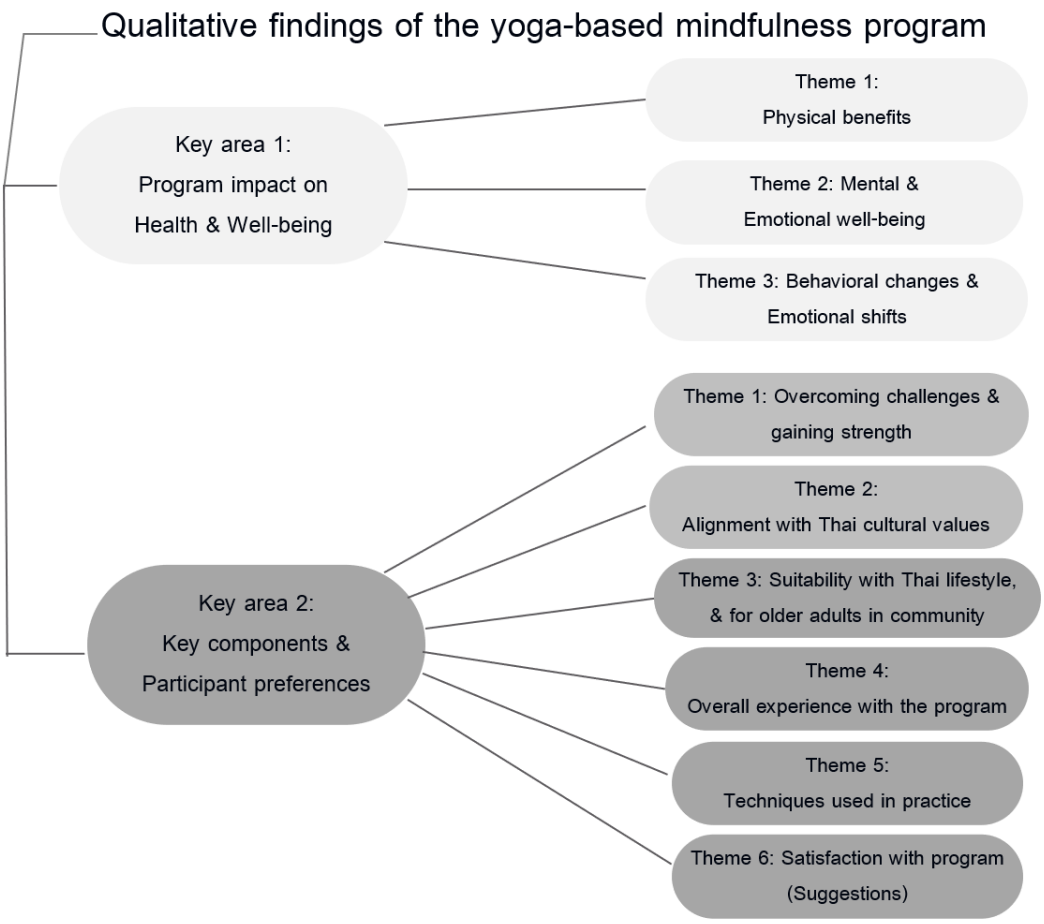

Figure 15 Summary of the thematic maps on the Insight Program's Impact and Its Suitable Components

CHAPTER 5
CONCLUSION AND DISCUSSION

This pilot study investigated the effectiveness and suitability of a yoga-based mindfulness program aimed at enhancing cognitive flexibility and emotion regulation among Thai older adults aged 60-69. A mixed-methods design with quantitative (Phase 1) and qualitative approaches (Phase 2) was employed. The conclusions drawn from the analyses of results and findings from both phases are summarized as follows:

Conclusion and Discussion

Phase 1 Conclusion

Demographic overview

The demographic information outlined that the experimental group (n = 13) had 15.3% cisgender men and 84.6% cisgender women, although the control group (n = 10) had 20% and 80%. Most research participants were cisgender women (82.6%). Ages in both groups were evenly distributed, resulting in demographic balance.

Descriptive statistics and findings

The findings showed that before joining the yoga-based mindfulness program, the control group had higher mean of CFI scores (122.20; Experimental: 103.00) and ERQ scores (49.50; Experimental: 38.23). The experimental group's CFI (M increased to 129.15) and ERQ (M increased to 46.00) improved the post-test scores significantly. After testing, the control group had lower CF (M = 111.35) and ER (M = 44.90) scores.

MANOVA; a test of assumptions

The data showed a normal distribution with skewness and kurtosis values of ±2 and ±7 for both experimental and control groups.

Homogeneity of Variance-Covariance Matrices: Box's M test and non-significant Levene's tests for CFI scores (p =.240) and ERQ scores (p =.069) confirmed homogeneity

Pearson correlations between dependent variables were below 0.85 (maximum: 0.779), stating no multicollinearity.

Mauchly's tests met the sphericity assumption (W = 1.000, p = 1.000 for both CFI and ERQ scores).

The data was suitable for MANOVA analysis and met all assumptions. Even though the experimental and control groups have 13 and 10 samples, MANOVA is able to prove the hypothesis. Tabachnick and Fidell (2013) argue that MANOVA can handle moderate sample size differences if variance-covariance matrices and variance are homogeneous. Wilks' Lambda sustains a suitable test for statistic analysis in moderately different sample sizes (13 vs. 10), under the condition of non-violated assumptions. However, even MANOVA can work with unequal sample sizes, Byrne (2010) suggests in evaluating carefully. If the homogeneity assumptions of both Box's M test and Levene's test are accepted, MANOVA sustains a valid test in the unequal sample sizes.

Hypothesis Testing Results

Hypothesis 1 (Within-Group Improvement): A repeated-measures MANOVA revealed significant improvements in CF and ER in older individuals from pre-test to post-test, with significant effect sizes (Wilks' Lambda =.029, F (1, 12) = 395.665, p <.001, η^2 =.971 and.139).

Hypothesis 2 (Between-Group Differences): MANOVA revealed significant between-group differences post-intervention (*Wilks' Lambda* = .082, *F* (4, 18) = 50.345, *p* < .001, η^2 = .918). Specifically, the experimental group showed significantly greater increases in CF (*F* (1,21) = 96.18, *p* < .001, η^2 = .821) and cognitive reappraisal, an ER strategy (*F* (1,21) = 23.92, *p* < .001, η^2 = .533) compared to the control group. Effect sizes indicated substantial intervention impacts.

MANOVA demonstrated significant post-test differences between groups (Wilks' Lambda =.082, F (4, 18) = 50.345, p <.001, η^2 =.918). In comparison with the control group, the experimental group showed significantly greater increases in CFI scores (F (1,21) = 96.18, p <.001, η^2 =.821) and cognitive reappraisal in ERQ

scores ($F(1,21) = 23.92$, $p < .001$, $\eta^2 = .533$. This can be concluded that the yoga-based mindfulness program had significant effects.

These statistical analyses support both hypotheses that the yoga-based mindfulness program improved cognitive flexibility and emotion regulation (particularly cognitive reappraisal) in Thai older adults.

Phase 1 Discussion

This tailored yoga-based mindfulness program was tested for cognitive flexibility and emotion regulation in Thai elderly in the young-old stage. This phase in quantitative study labelled a remarkable research gap and in line with research objective 1, to preliminary assess a program to enhance cognitive flexibility and emotion regulation in this demographic.

Descriptive and MANOVA statistics bolster the two research hypotheses:

Hypothesis 1: Yoga-based mindfulness program significantly enhanced cognitive flexibility scores (CFI) and emotion regulation scores (ERQ) in the experimental group compared to the baseline scores; before participating in the program ($p < .001$).

Hypothesis 2: The yoga-based mindfulness program significantly enhanced cognitive flexibility and emotion regulation scores (cognitive reappraisal strategy) in the experimental group compared to the control group ($p < .001$).

Demographic statistic demonstrated the balance in age and gender distributions in both experimental group (n=13, 2 male, 11 female; ages 60-69) and control group (n=10, 2 male, 8 female; ages 60-67), advocating internal validity.

Large effect size justification

This pilot study's strong effect sizes in both hypothesis tests suggest the yoga-based mindfulness program enhances Thai older adults' cognitive flexibility and emotion regulation. Small sample size and high partial eta squared values may raise concerns about statistical inflation, but several lines of evidence from past research support these conclusions.

A study of yoga education program enhanced memory and cognitive function in 792 Asian older adults, according to Pandya (2020). Buddhist, female older adults were more receptive to yoga and meditation practices. This research integrated mindfulness, morality, and community support with the intervention. Cultural background conformity can possibly elevate participation in the program and program effectiveness. Pandya found that program success can be predicted by regular attendance and self-practice. In this current study, research participants practiced mindfulness and yoga exercise at home, supporting this finding. Culturally familiar content, organized learning, and group cohesion likely enhanced pre-post scores. Pandya's findings, especially among Asian Buddhist women, match the demographic and cultural profile of this current study.

Field (2016) reviewed that yoga practices outperform the control group and waiting conditions mentally, emotionally, and cognitively. Field states that program integration combining physical postures, breathing exercises, and meditation can boost parasympathetic nervous system activation and regulate emotion. Yoga practice matches or exceeds other physical activities in this associates' aging conditions, particularly with culturally appropriate. This review also noted that even yoga study has limitations in methodology such as variation in delivery intervention and participants' backgrounds, this current study directed these limitations with program fidelity, teaching guidelines, and a rational group of yoga and mindfulness beginners. High and powerful participant motivation and the cultural involvement of a Buddhist-informed mindfulness concept can possibly have resulted in the large effect sizes.

While small sample sizes can statistically inflate the effect size, methodical implementation, rich qualitative outcome, and good alignment with larger studies support these conclusions. Thus, the large effect sizes shown here are the intensity and impact of a well-structured, culturally based older adult practice, not statistical anomalies.

This study matched previous research on the yoga-based mindfulness interventions for elderly. Related research study examined and confirmed:

Cognitive flexibility is the key for emotion regulation and mental health (Malooly et al., 2013). Cognitive inflexibility elderly are more likely to experience depression and anxiety (Joormann & Gotlib, 2010; Loevaas et al., 2018). Cognitive flexibility and neuroplasticity can be developed by yoga practice in increasing the level of BDNF (Brain-derived neurotrophic factor), neurogenesis, and neurotransmission (Cotman & Berchtold, 2002; Naveen et al., 2016). This supports previous findings that yoga alters brain structure to improve cognition (Gothe et al., 2019; van Aalst, 2020). Mindfulness-based therapies reduce attention lapses and enhance cognitive flexibility (Moore & Malinowski, 2009; Zeidan et al., 2010). Hence, this yoga-based mindfulness program improved cognitive flexibility.

Yoga-based mindfulness intervention improved cognitive reappraisal, the common strategy of emotion regulation. Cognitive reappraisal improves mental health by altering emotion perception (Gross & John, 2003). Cognitive reappraisal, psychological resilience, and emotional distress improve with mindfulness meditation (Garland et al., 2015). Yoga pranayama breathing exercises regulate the autonomic nervous system, vagal nerve activity, stress, and emotional well-being (Mondal, 2024; Noble & Hochman, 2019). Yoga practice alters the hippocampus and insula, advocating in stress reduction and emotional reactivity (Gothe et al., 2019; Villemure, 2015).

Integrating cognitive flexibility and emotion regulation: A study found that yoga-based mindfulness integrated cognition and affection. Cognitive flexibility enhancements can develop mental adaptation, positive emotional responses, and dysfunctional rumination, depression, and anxiety in older adults (Ramirez Ruiz et al., 2019). Yoga and mindfulness improve neurogenesis mechanism of neuroplasticity phenomenon, which improves cognitive flexibility and emotion regulation, according to Anacker and Hen (2017)

In theoretical contributions, this pilot study enhances theory by filling the theoretical and empirical gaps in mindfulness-based programs for elderly demographic. Firstly, it advocates Kabat-Zinn (1990)'s Western meaning of mindfulness as moment-to-moment awareness and nonjudgmental acceptance by demonstrating that mindfulness

interventions improve psychological well-being and cognitive flexibility by enhancing attention and regulating emotion. This current study validates mindfulness concepts of Kabat-Zinn among Thai older adults, representing the applicability globally. Further, the theory domain is enhanced by Langerian mindfulness, stating cognitive flexibility, novelty, and curiosity actively (F. Pagnini, K. E. Bercovitz, & D. Phillips, 2018). Langerian mindfulness supports cognitive adaptation and creativity by acknowledging new dissimilarities instead of the passive observation. This approach develops mindfulness's neuroplasticity by cultivating repeated engagement in cognition, which enhances both cognitive and emotional outcomes (FitzGerald & Folan-Curran, 2002; Moore & Malinowski, 2009). Hence, the passive and active mindfulness can build up a holistic framework that directs elderly's cognitive and emotional necessities in Thai culture context, the place where perseverance, patience, and intended cognitive engagement are natural mindfulness practices.

This current study highlights attention, retention, reproduction, and motivation applying Bandura's observational learning approach (Bandura, 1977, 1986). When participants started the program practice, they watched teacher. Clear demonstrations help to reduce participant nervousness and fear, improve yoga pose and breathing exercise correctly, in addition, the greater intrinsic motivation through physical and emotional enhancements (Schmalzl et al., 2015). According to Bandura's theory, this pilot study underlines modeling, focused attention, and motivating encouragement for learning purpose in this demographic and for behavioral changes in the long term.

The study outlines an overarching, culturally relevant framework by integrating mindfulness (Kabat-Zinn, 1990; Pagnini et al., 2018), observational learning (Bandura, 1977 #273), and neuroplasticity (FitzGerald & Folan-Curran, 2002) for enhancing cognitive flexibility and emotion regulation in Thai elderly demographic. Neuroplasticity phenomenon exhibits how yoga along with mindfulness can alter brain structure through repetition and awareness in practice. These changes enhance cognitive flexibility and emotion regulation, bolstering the knowledge that mindfulness

practices can increase synaptic plasticity and neurogenesis, especially in older population. These theoretical contributions reinforce culturally relevant mindfulness practices' scientific perception for well-being in this demographic.

For practical implications: this pilot study increases knowledge by supplying a culturally suitable and evidence-based yoga program to enhance cognitive flexibility and emotion regulation in Thai older adults. Results advocate that yoga-based mindfulness can be a reachable, non-pharmaceutical way to direct aging-related cognitive and emotional issues such as to reduce cognitive rigidity, emotional dysregulation, depression and anxiety (Joormann & Gotlib, 2010; Loevaas et al., 2018). The process of cautious selecting yoga poses; gentle stretching, and breathing exercises including deep abdominal, alternate nostril breathing fit well with age-related physical limitation and cognitive necessities, elevating safe yet effective engagement, relaxation, and independent regulation for emotional health and cognitive flexibility.

The program's group design advocates community support and socialization. Interpersonal interaction is very much needed for older adults, this is because they can often feel social isolation, loneliness, and decrease in social connections, which impacts cognition and emotion (Sims et al., 2014). Mindfulness practices that reflect common Thai values such as perseverance, patience, delayed gratification, and community-focused aspects enhance intrinsic motivation and faithfulness, magnifying the intervention's sustainability and long-term affect (Pagnini et al., 2018). Qualitative data from participants' insights also show developments in physical health, clarity mind, reduction in stress, and wellness, reinforcing life quality and daily life activities (Malhotra et al., 2023; Gothe, 2019). Thus, the combination program of observational learning, yoga, mindfulness, and neuroplasticity for aging demographic in fact, integrated way. This tailored program labels cognitive and emotional health issues to help elderly developing coping skills and adaptive psychological processes to improve holistic health. To advocate healthy aging in Thai older adults, healthcare professionals and yoga instructors should integrate culturally sensitivity approach and mindfulness as group interventions into the practice.

In general, phase 1 evaluated a program to meet research objective 1. After the intervention, the experimental group demonstrated significant increases ($p < .001$) in cognitive flexibility and emotion control (cognitive reappraisal strategy), supporting research assumptions. The experimental group's significant improvements over the control group confirmed the yoga-based mindfulness program's effectiveness and potential as a robust non-pharmaceutical program for cognitive and emotional well-being in aging demographic. This pilot study strongly recommends that yoga-based mindfulness can enhance cognitive flexibility and emotion regulation in Thai older adults. Significant results advocates that yoga and mindfulness are effective practices for older adults. This reinforces neuroplasticity and observational learning approaches with a strong evidence, culturally appropriate cognition and emotion solutions.

During the Experiment Conclusion

Thai older adults applied observational learning and attention control to learn and practice yoga along with developing intrinsic motivation. With neuroplasticity phenomenon, consistent practice enhanced physical health, cognition and emotion. Research participants expressed various improvements including physical health, mindful awareness, and quality of life. The following six interrelated stages exhibited how the observational learning approach including observing, modeling, attention focused, memory retention, skill reproduction, intrinsic motivation, and repetition in practice enhanced cognition, emotion and physical well-beings.

Stage 1: Participants focused on yoga teacher’s modelling; demonstrations. The observational learning concept also reduced participants’ anxiety, improved their performance, and increased confidence.

Stage 2: Attention to the yoga teacher's demonstration enhanced skill learning, emotion regulation, and practice engagement.

Stage 3: Regular yoga practice assisted participants internalize and retain yoga techniques, highlighting on the importance of observation and focused attention in learning. These older adults applied breath-counting and conscious

refocusing to manage distractions. Integrating techniques into daily routines improved memory consolidation.

Stage 4 Reproduction; teacher and peer feedback enabled autonomic skill application. Home practice and reflection bolstered replicate yoga poses and breathing exercises.

Stage 5: Participants' reflections exhibited intrinsic motivation from pain reduction, enjoyment, and well-being obtains, supporting regular participation.

Stage 6: Consistent in practicing mindful yoga enhanced the retention and reproduction neuroplasticity phenomenon. Improvement in participants' physical and cognitive health.

Finally, the After-Action Reviews in qualitative phase demonstrates that participants learned and enhanced by engaging actively in a yoga-based mindfulness program. Along with the teacher's instructions, participants learned yoga poses and breathing exercises. Cognitive flexibility and emotion regulation improved with focused attention, successfully overcoming distraction, precise in memory recall, and consistent practice in reproducing learned skills. Improvements in physical health, emotional well-being, and clarity of mind cultivated intrinsic motivation, which extended engagement in the long run and shape mindfulness practice effortless to incorporate into daily life. Yoga was easy for some, but others struggled due to personal obligations. All participants said yoga and mindfulness improved their health. These findings show that observational learning and neuroplasticity can help Thai older adults achieve holistic health and lifelong learning through tailored yoga-based mindfulness programs.

Phase 2 Conclusion

In-depth interviews demonstrated that a yoga-based mindfulness program enhanced physical health, cognitive function, emotional resilience, and social interaction. Structured mindfulness sessions, gentle yoga poses, breath awareness, and social group interactions are culturally relevant. No major participation barriers were discovered, and adjusting session duration and adding culturally appropriate mindfulness techniques improved program suitability. This qualitative analysis of semi-

structured, in-depth interviews corresponded with research question 3: how do Thai older adults view and experience the yoga-based mindfulness program, and what parts are the most beneficial and suitable. The main findings are as follows:

Key area 1 Program impact on health and well-being

Yoga-based mindfulness program improved physical, mental, emotional, and behavioral health for most participants. Pain reduction, better movement, more energy, sleep quality, and independence in living. Mental and emotional developments were highlighted such as stress reduction, mood enhancement, emotional well-being, and mindful awareness. Participants lived in harmony after overcoming conflict, having better relationship and transformation in life goals.

Key area 2 Key Components and Participant Preferences

Theme 1 Behavior- Overcoming Challenges and Gaining Strength through Practice; Participants managed obstacles to develop flexibility, strength, and mobility, enhancing quality of life.

Theme 2 Alignment with Thai Cultural Values/Proverbs; Thai values such as perseverance, patience, delayed gratification, consistent practice, and trial-and-error learning bolstering their practices.

Theme 3 Suitability with Thai Older Adults' Lifestyle and for those in community; A gentle, group-based program supported participants in overcoming health limitations and loneliness while cultivating social interaction and community engagement.

Theme 4 Overall Experience with the Program; Participants obtained autonomy and self-confidence and positive relationships in family.

Theme 5 Techniques Used in Practice; Breathing control, mental, bodily awareness, memorization, and structured practice improve learning and safety.

Theme 6 Satisfaction with the Yoga-Based Mindfulness Program; participants were satisfied but suggested extending session durations, variety of poses, focus on special needs, intensity of practice, and relaxation for older adults

In summary, qualitative analysis supported Thai older adults' yoga-based mindfulness program. Outstanding physical, mental, emotional, and social improvements were reported. Adequate session time, frequency, modest physical and breathing activity, session stage, relaxation, and structured instruction were helpful.

During the Experiment, and Phase 2 Discussion

AARs and in-depth interviews met research objectives 2 and 3. Objective 2 used a neuroplasticity model of mindfulness and observational learning to study learning processes. Objective 3 sought program component participant input. Quality data showed that Thai older adults improved cognitive and emotional health by learning new skills and information through observational learning, repetition, and mindful practice. Participants chose program components that met their physical and emotional needs, emphasizing Thai perseverance, patience, social connection, and mindfulness.

Discussion According to Research Questions

Research Question 1: "How do Thai older adults experience and perceive learning new skills and acquiring knowledge through the program activities, guided by the neuroplasticity model of mindfulness and observational learning, contribute to their overall learning processes and outcomes?"

Observant learning benefited research participants, according to qualitative AARs results. By watching a skilled yoga teacher, participants internalized movements, improved self-awareness, and replicated yoga positions and breathing. This supports Bandura's observational learning theory (Bandura, 1977, 1986), which emphasizes attention, retention, reproduction, and motivation. Neuroplastic changes from practice, repetition, and mindfulness improved cognitive flexibility and emotion regulation (Cayoun, 2005; Moore & Malinowski, 2009). Yoga improves basal ganglia and cerebellar neurophysiology, which control motor learning, cognitive flexibility, and emotion (Schmalzl et al., 2015; Pierce & Péron, 2020). This study shows that mindfulness and observational learning improve Thai elderly' cognition and emotion.

Research Question 2: "How do Thai older adults perceive and experience the yoga-based mindfulness program, and what specific components of the

yoga-based mindfulness program are perceived to be most beneficial and culturally suitable for Thai older adults?"

Phase 2 in-depth interviews showed remarkable effects in physical, emotional, cognitive, and social domains, emphasizing culturally relevant program components. Light physical activity, breathing techniques (pranayama), mindfulness meditation, and group social interactions aligned with Thai values of patience, perseverance, delayed gratification, and mindfulness.

Discussion of enhancement in cognitive flexibility

Cognitive Flexibility Enhancement participant insights analysis. Phase 2 qualitative results showed significant changes in participants' thinking and behavior, supporting Dennis and Vander Wal's (2010) cognitive flexibility paradigm. Alternatives and Control were used to analyze participants' opinions. These measures show how yoga-based mindfulness improved older adults' adaptive cognitive functioning and physical and emotional health.

Component A: Alternatives, problem-solving, cognitive openness. Some participants improved in the “Alternatives” dimension by viewing issues more broadly and adaptively. In difficult times, this means being creative, choosing multiple paths, and reinterpreting one's experience. Participant Nu reported, “Problems haven't disappeared, but my mind is clearer, and I can think rationally about how to solve them,” demonstrating improved cognition. Participant No said, “Now my head becomes so clear after practice, I know how to solve problems,” demonstrating problem-solving self-efficacy. The results indicate increased metacognition and stress-regulated mental processes. Others behaved adaptably. No yoga props at home, participant Tu stated, “There was no prop at home, so I used a blanket to support my back, it relieved my pain and helped me sleep.” This spontaneous solution illustrates the alternatives component's emphasis on adaptability and creativity. Participant P linked socioeconomic planning to physical fitness: “If my body is strong and fit to work, I can earn an income to help my family,” reflecting personal growth-based strategic thinking. Participants L and Y described adaptive learning through self-comparison: “Every day, I

pushed a little further, comparing my progress to the previous day," and "Once I can do it, I am happy, it's a reward for me, so I keep going more. In these reports, internal feedback loops boost motivation, agency, and self-improvement. Participants T and S changed their routines and mental focus, demonstrating the program's mental adaptability and emotional reframing.

Component B: Control; Internal state influence feeling: Control the belief that one can handle difficult events with internal coping skills is the second cognitive flexibility factor. Participants showed flexibility in breathing, emotional management, and daily autonomy. Emotional and physiological regulation was often done through breath. "When I'm tired, I remind myself, 'Just do a few rounds of deep breathing, it will help.'" said participant T. Participant Y reported, "When I feel exhausted, I simply take deep, slow breaths, and it helps." These comments indicate a conscious, self-regulated response to physical and emotional fatigue. Participant S changed her behavior: she breathes to relax. I no longer fight with my daughter-in-law or worry about my husband's slow driving." This shows emotional control and less reactivity. Participant J said, "When I feel pain, I use deep, slow breathing to relax." Physical agency returned to many. Participant No said, "I no longer rely on others for help," and Participant L outlined, "Little by little, I overcame the pain, and now I can perform these poses comfortably." These experiences boost resilience, self-efficacy, and internal locus of control. Participants like participant S, who expressed, "Now I sit upright effortlessly", improved bodily awareness and intentional regulation through mindfulness.

Synthesis of findings: the program improved cognitive and emotional health, regarding these findings. The program helped older adults adapt psychologically by encouraging them to create alternatives and control emotions and behaviors under pressure. This evidence supports the cognitive flexibility hypothesis and shows that yoga poses and breath-based emotional control work together. Tables 24 and 25 show participant statement topic distributions by cognitive flexibility dimension to support this interpretation in alternatives and control statements. This category complements the program's impact, theoretical and quantitative findings.

Table 25 Component A: Alternatives

Participants	Evidence of Alternatives
Th	“I face challenges with a sense of readiness.”
Nu	“Problems haven’t disappeared, but my mind is clearer, and I can think rationally about how to solve them.”
No	“Now my head becomes so clear after practice, I know how to solve problems.”
J	“I am now even looking forward to doing a part-time job.”
P	“I dedicate time daily… I believe if my body is strong and fit to work, I can earn an income to help my family.”
L	“Every day, I pushed a little further, comparing my progress to the previous day.”
Y	“Once I can do it, I am happy—it’s a reward for me, so I keep going more and more.”
T	“I prefer not to fix a strict routine. Instead, I practice whenever I feel the need.”
S	“Now, I focus on my breathing instead of dwelling on negativity.”
No	“I even taught my sister… it worked, and her pain disappeared.”
Tu	“There was no prop at home, so I used a blanket to support my back, it relieved my pain and helped me sleep.”

Table 26 Component B: Control

Participants	Evidence of Alternatives
Th	*"*My mind is stronger now. I'm no longer overwhelmed by financial struggles."
T	"When I'm tired, I remind myself, 'Just do a few rounds of deep breathing—it will help.' And it always does."
Y	"Whenever I feel exhausted… I simply take deep, slow breaths, and it helps."
S	"I use breathing to relax… I no longer fight with my daughter-in-law or stress over my husband's slow driving*."*
Nu	*"*Now my mind becomes so clear after practice… I can think, I have a way out."
J	"When I feel pain… I use deep, slow breathing to relax."
L	"Little by little, I overcame the pain, and now I can perform these poses comfortably."
No	"I no longer rely on others for help."
P	"Despite the discomfort, I persisted… I took it slow, limited the duration, and gradually built my tolerance."
S	"Now I sit upright effortlessly."

In accordance with this mixed-method pilot study, yoga-based mindfulness practice enhanced cognitive flexibility, emotion regulation, overall physical health, overcoming pain, and social interaction. Participants appraised culturally harmonious factors such as group-based session building community engagement and Buddhist mindfulness, bolstering primary studies (Kabat-Zinn, 1990; Pagnini et al., 2019).

Research Study Conclusion

Yoga-based mindfulness program enhanced cognitive flexibility and emotion regulation, particularly cognitive reappraisal in Thai older adults referring this mixed-method pilot study. Quantitative findings supported the intervention's efficacy, while qualitative findings showed how observational learning, neuroplasticity, mindfulness, and the program's impact and suitability helped participants learn new skills. Strong evidence supports this tailoring yoga-based mindfulness programs in improving cognitive and emotional well-being in older Thai adults.

Research Study Discussion

Extensive studies show that yoga and mindfulness practices help to improve cognitive flexibility and emotion regulation in elderly (Cotman & Berchtold, 2002; Gothe et al., 2019; Naveen, 2016). Even this pilot study has a large effect size, but with the small samples, this issue can exaggerate its value. (Kunselman, 2024 #428).

Cognitive flexibility, emotion regulation, particularly in cognitive reappraisal improved significantly in the experimental group compared to the control group post-intervention after mindfulness-based yoga interventions in elderly populations, this is in line with prior study (Malooly et al., 2013; Garland et al., 2015; Zeidan et al., 2010). After-action reviews and in-depth interviews showed that observational learning, repetition, and mindful awareness help participants internalize and reproduce yoga poses and breathing exercises. This reinforces Bandura's observational learning approach regarding attention, retention, reproduction, and motivation (Bandura, 1986 #380). Moreover, the neuroplasticity model of mindfulness in repetition practice aids in cultivating cognitive and emotional adaptations (Cayoun, 2005; Moore & Malinowski, 2009; Schmalzl et al., 2015).

In agreement with qualitative findings, appropriate program components of gentle yoga poses, pranayama or breathing exercises, mindfulness meditation, and socially interacted group activities bridged with participants. These traits matched Thai values like patience, perseverance, delayed gratification, and mindfulness, demonstrating the importance of cultural congruence in intervention success. Health

improvements, reduced emotional distress, social connectedness, and mindfulness motivated participants to stay involved. This data substructures prior studies in yoga's physical health such as pain management, along with the mental health benefits, including reduced depression and anxiety, and enhanced cognitive functions, and emotion regulation (Gothe et al., 2019; Malhotra et al., 2023; Villemure et al., 2015). The current study recommends that health promotion in this demographic should include yoga-based mindfulness practice as a practical, culturally involvement, and holistic non-pharmaceutical approach to enhance cognition, emotion, and social well-being in this demographic populations.

Additional discussion

Buddhist-Informed Learning and Cultural Relevance:

Quantitative and qualitative studies show the yoga-based mindfulness program achieved both goals. In culturally coherent frameworks, transformative learning, cognitive flexibility, and emotion management improved. Anālayo (2019) explores the relationship between mindfulness-based interventions (MBIs) and the four satipatthanas, an early Buddhist mindfulness model. Although some MBIs overlap, most lack the depth and intent of early Buddhist practice. Early literature describes a systematic mindfulness practice. This model matches participants' self-awareness, emotional clarity, and reduced reactivity, showing that intentional and reflective mindfulness can change lives. This current pilot study investigated the first two domains. The first domain is Kayanupassana satipatthana, which underlines mindful movement and breathing awareness. Body awareness was encouraged by mindful yoga poses and breathing exercises with rhythmic movement. The second domain is Vedananupassana satipatthana, which represents feelings and emotions in the present-moment awareness. Vedananupassana investigates affective feelings with equanimity, often based in Anapanasati practice or mindful breathing, this aids to reduce automatic emotion reactivity and develop clarity of mind. Positive emotion regulation needs cognitive reappraisal strategy and acceptance mentality (Garland et al., 2015).

Embodied, breath-based practices connect Kayanupassana and Vedananupassana together. Kayanupassana develops interoceptive awareness and attentional stability to help individual notice emotions non-reactively. Equanimity and minimizing reactive responses aid Vedananupassana control emotions. Repeated mindfulness-based practices changed behavior and mental awareness, like learning. The path resembles early Buddhist mind cultivation. Cousins (2007) examined mindfulness (Satipatthana), mental cultivation, sati (observation), samadhi (concentration), and the perfection of wisdom (vipassana), understanding of reality, as interconnected stages that help early Buddhists understand and realize reality.

Participants' thoughts exhibit how mindfulness practices shifted them from passive to active stage with insightful engagement. Mindfulness practice also enhances neural pathways for emotion regulation and perception (Rolley, 2012), attention, and cognitive flexibility (Moore & Malinowski, 2009). Yoga is a well-grounded and effective mindfulness-based program. The modest improvement in expressive suppression suggests that individuals were learning healthier and more adaptive regulatory mechanisms rather than suppressing or avoiding emotions. According to the noble eightfold path (Bodhi, 2011), right effort (samma-vayama) requires actively cultivating healthy mental states (kusala vitakka) and letting go of the unwholesome ones. Like Buddhist learning, the group-based, teacher-guided program emphasizes shared reflection. Interpersonal, experiential, and community engagement (kalyana-mitta) foster ethics. Teacher modeling and collective practice's nonjudgmental, supportive environment can contribute to the intervention's high acceptability and effectiveness, especially for older adults undergoing psychological transformations. The program's success was due to Thai older adults' cultural beliefs. Progressive, non-competitive yoga taught patience, perseverance, and delayed gratification. Mindfulness-based elements reflected Buddhist concepts (sati, khanti), while group activities promoted Thai social peace and well-being. Participants' insights demonstrated motivation for personal health and functional freedom to fulfill family

obligations. Cultural congruence maintains health intervention participation and value (Kabat-Zinn, 1990; Pagnini et al., 2019).

Participants' perspectives in program benefits, barriers, challenges, and recommendations

The after-action reviews and in-depth interviews of participants' insights demonstrated numerous benefits including mindful awareness, comfort, clarity of mind, and emotional well-being enhanced. These evidences confirm that the yoga-based mindfulness program can effectively enhance well-being in elderly demographic. Participants stated only few program entry barriers, challenges, and recommendations. This was because of the easy program accessibility and great family support. Participants also supplied beneficial application information. Describing yoga's openness and advantages, motivating others to experience it, and encouraging regular and committed practice. These perspectives propose practical program enhancement recommendation. Corresponding practicing pathways with Thai cultural values and directing elderly' necessities can enhance quality of life and make yoga-based mindfulness practice sustainable.

Limitations of the Study

Although this mixed-methods pilot study had strong and outstanding results, limitations can be outlined:

The sample size: In spite of the statistical significance of quantitative study in phase 1. The small sample size (n=23) restricts generalizability. To enhance external validity, future studies should target on the larger samples.

Non-randomized control group: Phase 1 Selection bias and expectation effects may occur without randomization and blinding. RCTs with blinding provide more evidence.

Following up: Lack of follow-up evaluations limits understanding of the intervention's long-term cognitive and emotional gains.

Gender balance: Most participants were cisgender women, limiting applicability to cisgender men. Future research needs gender balance.

Specialists in program validation: Even the specialist in gerontology, learning psychology, and yoga experts validated yoga-based mindfulness. Their expertise was useful, but the small number of specialists may not meet doctoral validation standards. More expert or empirical validation may boost program credibility.

Recommendations for Future Studies

1. Practical implications and suggestions for relevant personnels: This study influences stakeholders substantially:

For yoga teachers, yoga teachers can use this approach to organize mindfulness-based practice for older adults' classes. Incorporate gradual instructions, along with observational learning, and culturally appropriate mindfulness practices. In Routine to Research (R2R), researcher embraced yoga instruction and mindfulness-based program delivery implications into class design specifically for elderly demographic. This study encouraged teaching languages that focuses on the cultural virtues such as perseverance, patience, and compassion, which support older adult emotional well-being.

Healthcare professionals: Physical, mental, and brain health professionals should acknowledge the yoga-based mindfulness program as a reasonable, non-pharmaceutical intervention for developing cognition, emotion, and overall well-being in elderly population.

Older adults: Older adults can assimilate these practice habits endlessly. Participating in communal activities can promote family relationship and social interaction.

2. Methodological advice for future studies, the future research should aim on the followings:

Larger, more variety in sample group: For reliability and generalizability, increase gender diversity and socioeconomic diversity in sample group would be advantages.

Bias reduction: Focusing on the scientific aspect, and reinforce determinant with randomized controlled trials (RCTs) with control groups and blinding.

Focus on demonstration and practice: To encourage participants in home practice and strengthen learning outside the yoga class with direct modeling, regular guided practice, and possibly video-assisted learning helps implementations in the future.

Follow-up evaluations: To assess the yoga-based mindfulness program's effectiveness in the long-term of cognitive and emotional changes

This comprehensive mixed-methods pilot study reveals that Thai older adults can advantage from a yoga-based mindfulness program. This study proves that yoga and mindfulness enhance cognitive flexibility, emotion regulation, and holistic well-being, contributing it a promising lifelong practice for Thailand's aging populations.

Disclosure of AI usage

In writing this dissertation, the author used ChatGPT throughout chapters and appendices in various stages, including gathering draft information, structural outlining, grammar correction, and paraphrasing to improve wording clarity, accuracy, and harmony. The author reviewed, revised, and integrated the ChatGPT output. AI provided first drafts and assisted in generating ideas; the author wrote and confirmed the final content and academic arguments. This approach respects Srinakharinwirot university's AI policy.

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Appendices

Appendix A: Specialists

Specialists responsible for validating research tools and Yoga-Based Mindfulness before and after the experiment:

1. Dr. Charin Suwanwong: Srinakharinwirot University
2. Dr. Sirinate Sukdee: Rajamangala University of Technology Suvarnabhumi
3. Ms. Thataree Sitthiratanadit: Yoga Master

Three specialists in learning psychology, yoga and mindfulness and gerontology confirmed yoga-based mindfulness program. Evaluation criteria included program goals, theory, methods, process, evaluation, and instruments with IOC at 0.94.

After-Action Review and In-Depth Interview Questions:

Specialist verified questions:

1. Assistant Professor Dr. Pitchayanee Poonpol: Srinakharinwirot University
2. Dr. Hanvedes Daovisan: Srinakharinwirot University
3. Dr. Piyawan Thatsananchalee: Shinawatra University

After-action review and in-depth interview questions were reviews and verified by these three experts with IOC at 0.80 and 0.81 respectively.

Through the IOC Validation Checklist, specialists validated the yoga-based mindfulness program using best practices and standards from learning psychology, yoga and mindfulness, and gerontology with IOC at 1.00.

Program validation:

A checklist to verify the 8-week tailored yoga-based mindfulness program. Area for learning psychology, yoga and mindfulness, and gerontology are integrated for specialist validation using the Index of Item-Objective Congruence with three score options: Accept (+1), Unsure (0), disagree (-1). Instructions: Read each item carefully and rate whether this program integrates Yoga and mindfulness/ learning psychology/ gerontology to improve cognitive flexibility, emotion regulation, and well-being in Thai older adults.

Yoga and Mindfulness

1. Older adults can perform some specific yoga poses including Tree, Chair, Warrior, and Bridge poses safely.
2. Breathing variety including the deep abdominal breathing, three-part breathing, and alternative nostril breathing can improve awareness and regulate emotion.
3. Awareness in cognition and emotion can be enhanced by body scan technique, mindful breathing (Anapanasati), and mindfulness meditation.
4. Relaxation techniques, including final relaxation technique (Savasana) and breathing into pain, can assist older adults in overcoming pain and stress.
5. Specific yoga poses, breathing exercises, and mindfulness practice fit with older adults' attention span and capacities.

Learning psychology

1. Observing teacher demonstration and modeling will enhance skill development of learners.
2. The yoga-based mindfulness program can enhance neuroplasticity and retention skill through repetition and practice effectively.
3. The pair and group activities in yoga-based mindfulness program along with reflective discussions can bolster peer reinforcement and active learning.

4. AAR and group discussions after each practice session can enhance cognitive integration and learned skill implementation.
5. Complexity and variety increment in session practice can develop cognitive flexibility in learners.

Gerontology

1. Schedule of 60-minute sessions, twice or three times a week for eight weeks period are suitable for older adults' cognitive and physiological capabilities.
2. Safe accommodations are made for age-related physical limitations in this program.
3. The content effectively addresses stress, anxiety, and emotional resilience in older adults.
4. Older adults can reduce loneliness and social isolation by integrating group activities and social interactions
5. Culturally sensitive integration (patience, perseverance, Thai values, Buddhist mindfulness) suits Thai older adults.

Appendix B: Research tools

Research tool was consisted of

1. Cognitive Flexibility Inventory (CFI), extracted from https://novopsych.com.au/assessments/formulation/cognitive-flexibility-inventory-cfi/
2. Emotion Regulation Questionnaire (ERQ), extracted from https://spl.stanford.edu/sites/g/files/sbiybj19321/files/media/file/english_0.pdf

3. After action review (AAR) and Semi-structured in-depth interview questionnaires
4. Yoga-based mindfulness program

After action review (AAR)

Key Questions in each stage are as follows:

Observation

After observing the teacher's demonstration, what steps did you take to replicate the yoga postures or breathing exercises during your own practice?

How did following the teacher's demonstration affect your ability to perform yoga postures or breathing exercises?

Were you able to perform the movements independently? To what extent?

Did you concentrate while practicing? What aspects did you focus on and why?

How did maintaining focus impact your learning and execution of yoga postures or breathing exercises?

Observation & Attention

From your experience in yoga training, what aspects of observation were most important for your learning?

Were there distractions while observing the teacher's demonstration? How did you refocus?

How did you manage distractions that affected your ability to concentrate?

Retention

When practicing on your own, how did you recall and apply the yoga postures or breathing exercises demonstrated by the teacher?

How did memory play a role in your ability to execute yoga postures or breathing exercises correctly?

How did you verify that you remembered the techniques accurately?

How did you feel when you successfully recalled and executed a yoga posture or breathing exercise correctly?

Reproduction

What feedback did you receive from the teacher during your practice?

Apart from the teacher, did you receive feedback from peers? How was it helpful?

How did you apply the feedback to improve your practice?

How did repeated practice help refine your techniques?

Motivation

What motivates you to continue practicing yoga postures or breathing exercises?

How does your motivation influence your practice?

Why do you feel that motivation plays a role in your progress?

Retention & Reproduction (Neuroplasticity)

Have you noticed any changes in your body, thoughts, or memory after practicing yoga postures or breathing exercises?

Do you think regular practice leads to long-term improvements? Why?

In what ways have you experienced mental, emotional, or physical changes due to repeated practice?

Supplementary Questions for Overall Summary

After completing the training, how do you feel about the learning process, observation, memory, practice, motivation, and overall experience?

How would you compare yourself before and after the training?

What changes have you noticed in your body, thoughts, or emotions?

How has your ability to concentrate, remember techniques, and regulate emotions evolved?

What aspects of the training were most beneficial for you?

Semi-structured in-depth interview

Key Questions in each key area are as follows:

Key area 1 Program Impact on Health and Well-being (15 minutes)

Before joining the program:

Did you have any health concerns or illnesses?

How did you feel physically and mentally before participating in the program?

After joining the program:

Have you noticed any improvements in your physical health (e.g., stability, flexibility, reduced pain)?

Has the program helped with your daily activities or increased your energy levels?

Do you feel more relaxed or stronger after practicing mindful yoga?

Emotional and psychological impact:

Before the program, did you experience stress or anxiety?

Have you noticed any changes in your emotions or mood after participating?

Do you feel calmer, more balanced, or less stressed?

Key area 2 Key Components and Participant Preferences (20 minutes)

Topic 1: Behavior and Current Lifestyle

Which aspects of the program (e.g., yoga postures, breathing exercises, meditation) were most beneficial or enjoyable for you?

Were there any challenges in adapting to the yoga practice?

How well does this program fit into your daily routine?

Topic 2: Reflection on Thoughts and Feelings from Yoga Practice

What was your overall experience with the program?

Were there any specific moments or practices that stood out to you?

Were there any difficulties you faced, and how did you overcome them?

Topic 3: Satisfaction with Yoga Program

What aspects of the program did you enjoy the most?

Were there any parts of the program that you found challenging or less enjoyable?

Would you suggest any modifications to make the program more suitable for Thai older adults?

Additional key area: Barriers, Challenges, and Suggestions for Improvement (10 minutes)

Barriers and Solutions:

Did you face any obstacles while participating in the program (e.g., physical limitations, difficulty understanding techniques)?

How did you manage or overcome these challenges?

Recommendations for Others:

What advice would you give to other older adults considering joining this program?

How would you explain the benefits of this program to your community?

Closing Questions (5 minutes)

Overall experiences

How would you summarize your experience with the program?

What impact has it had on your life?

Additional comments

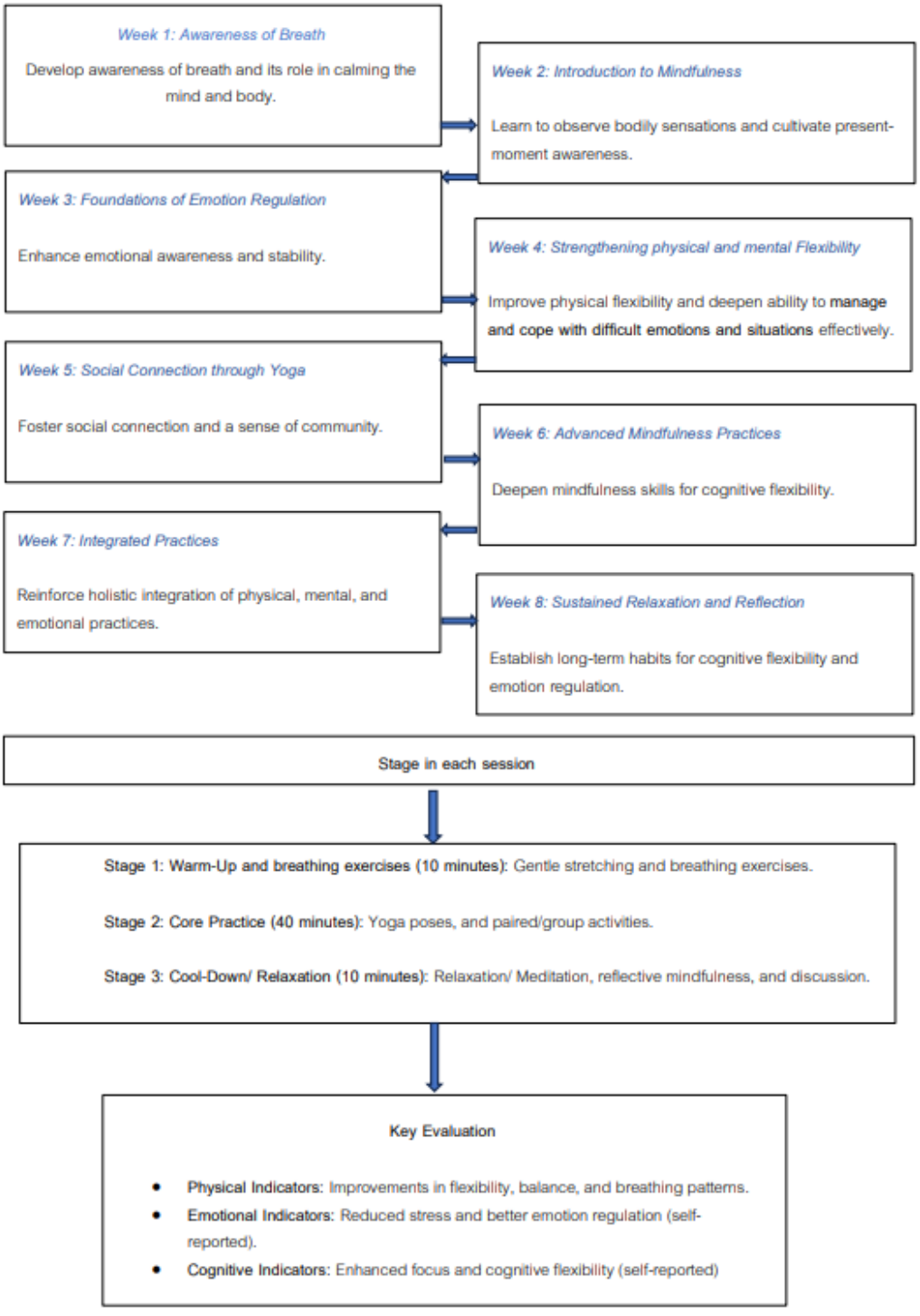
Is there anything else you'd like to share about the program?

In what ways do you think this program is suitable for older adults?

Yoga-based mindfulness program

Program framework:

Program framework (กรอบการสร้างกิจกรรมของโปรแกรม)



Stage of session program

Stage 1: Warm-Up activity and breathing exercise (10 minutes): Gentle stretching; joint freeing practice and breathing exercises.

Stage 2: Core Practice (40 minutes): Yoga poses, and paired/group activities.

Stage 3: Cool-Down/Relaxation (10 minutes): Yoga relaxation/ guided meditation, reflective mindfulness, and AAR discussion

Week 1

Stage 1: **Introduction to cognitive flexibility and emotion regulation (1st session only).** Gentle stretches/ warm up activities (e.g., neck rolls, shoulder shrugs, wrist movement). **Diaphragmatic breathing exercises** (Deep abdominal breathing -prepare the mind and body for deeper mindfulness). **Stage 2: (1) Yoga poses** (Joint-Freeing Series). (2) **Pair/group activities** (Practice poses/ techniques together). **Stage 3: (1) Relaxation/ Meditation** (Savasana, focusing on scanning body and breath awareness during relaxation as mindfulness meditation). (2) **Reflective mindfulness** (Participants reflect on their experience of focusing on breath). (3) **Discussion** (Optional sharing of how participants felt before and after the session). This week is mainly focused on emotion regulation.

Week 2

Stage 1: (1) Gentle stretches to relax and open the body. (2) **Deep breathing exercises to** relax the nervous system. **Stage 2: (1) Yoga poses** (Gentle stretch of joint movement in balance and flow with focus on breath awareness). (2) **Pair/group activities** (Discussing poses in flow experiences). **Stage 3: (1) Relaxation**/ Meditation (Savasana with attention to breath/ **Mindfulness meditation** (Focus on concentrative meditation /observing breath). (2) **Reflective mindfulness** (Participants reflect on their mindfulness practice). (3) **Discussion** (Group sharing on what they noticed about their body and thoughts). This week is mainly focused on emotion regulation.

Week 3

Stage 1: (1) Gentle stretching/ warm up (joint-freeing series). (2) **Deep breathing exercises (3-part)** to activate the parasympathetic nervous system. **Stage 2: (1) Yoga poses** (focused on seated poses: Virasana, Balasana). **(2) Pair/group activities** (Partner-assisted poses to build trust and emotional awareness). **Stage 3: (1) Relaxation**/ Meditation (Savasana, focusing on breathing concentration and emotional awareness/ **Mindfulness meditation** (Focus on concentrative practice in breath to help emotion regulation). (2) **Reflective mindfulness** (Participants reflect on emotions they encountered and how they handled them). (3) **Discussion** (Share how they were able to regulate emotions through mindfulness). This week is mainly focused on emotion regulation.

Week 4

Stage 1: (1) Gentle stretching/ warm up (Focus on full-body stretches to enhance flexibility). (2) **deep abdominal with retention breathing** (deepening diaphragmatic breathing) **Stage 2: (1) Yoga poses** (Seated poses in balance and flow style). (2) **Mindfulness practice** (observing how the body feels during stretches). **Stage 3: (1) Relaxation/ Meditation** (Concentrative meditation on sound / Mindfulness meditation during relaxation/ Savasana, encouraging full-body release and emotional relaxation). (2) **Reflective mindfulness** (Participants reflect on how they felt before and after the session). (3) **Discussion** (Share thoughts on the impact of physical flexibility on emotion regulation). This week is mainly focused on emotion regulation, however it emphasizes physical flexibility, which is closely tied to mental flexibility. As participants work on challenging poses, they learn to adapt their thoughts and reactions to discomfort or new experiences

Stage 1: (1) Gentle stretching/ warm up activities (2) **deep abdominal with retention breathing (**alleviate stress, anxiety, to encourage relaxation) **Stage 2: (1) Yoga poses** in standing poses for concentration to help emotional regulation and flexibility; Tree, Chair, Warrior 1-2 poses (Partner-assisted poses to build trust and connection**).** (2) **Mindfulness meditation** (Become aware of breathing, Anapanasati practice during resting pose (child pose), and also focus on social connection and awareness of others' energy). (3) **Pair/group activities** (Partnered yoga poses, building interaction and safety). **Stage 3: (1) Relaxation/ Meditation** (Savasana, also focusing on breathing awareness-Anapanasati). (2**) Reflective mindfulness** (Discussing the importance of social connection). (3) **Discussion** (Share experiences on building trust through yoga). This week practice is involved with partnered yoga and group discussions inherently require participants to adapt their actions and emotions to others, fostering flexible thinking in social contexts (additional focused on cognitive flexibility).

Week 6

Stage 1: (1) Gentle stretching/ warm up activities (Full-body stretches with focus on breath). (**2) Breathing exercises** (one side) (To work with parasympathetic nervous system) **Stage 2: (1) Yoga poses (supine poses);** Bridge, Wind relieve, Reclining twist **(2) Mindfulness meditation** (Kabat Zinn approach, become aware of the present moment without judgement- feeling during practicing poses, also focus on observing thoughts and emotions deeply). (3**) Pair/group activities** (Group mindfulness practices, focusing on the present moment). **Stage 3: (1) Relaxation/ Meditation** (Savasana with deep relaxation techniques/ Mindfulness meditation -focus on observing thoughts and emotions deeply). (2) **Reflective mindfulness** (Journaling or sharing mindfulness insights). (3) **Discussion** (Participants share how their mindfulness practices deepened). This week is focused mainly on cognitive flexibility since advanced breathing and mindfulness techniques challenge participants to shift focus, think creatively, and explore deeper self-awareness.

Week 7

Stage 1: (1) Gentle stretching/ warm up activities (Focus on full-body flexibility). (2**) Breathing exercises (alternate nostril breathing to balance and calm. Stage 2: (1) Yoga poses** (Integrated combination of yoga poses in gentle flow series for strengthening and flexibility). (2) **Paired/group activities** (work in pairs in practicing flow for safety reason). **Stage 3: (1) Relaxation/ Meditation** (Savasana, integrating all learned techniques/ **Mindfulness meditation** (Langerian) (2) **Reflective mindfulness** (Group discussion on overall progress). (3) **Discussion** (Reflection on integrating yoga and mindfulness into daily life). This week is focused mainly on cognitive flexibility in combined techniques learned in previous weeks, requiring participants to adapt and integrate multiple skills.

Week 8

Stage 1: (1) Gentle stretches (Full-body relaxation stretches). (2) **Breathing exercise** (Ujjayi) (promote concentration) **Stage 2: (1) Yoga poses in variation with props** (Combining poses from previous weeks for balance and flexibility). (2) **Pair/group activities** (Group practice in poses variation). **Stage 3: (1) Relaxation**/ Meditation (Extended Savasana for final relaxation and mindfulness integration- Mindfulness meditation: Sustained attention, observing thoughts and emotions without attachment)/ Focus on body sensations and emotional awareness). (2) Reflection and **Discussion** (Reflect on the entire 8-week journey and future practices). Reflection activities, such as journaling and group discussions, naturally encourage participants to evaluate their journey and consider how they can adapt these practices into their lives (additional focused on cognitive flexibility).

Appendix C: Assumptions

Skewness and Kurtosis: Experimental group

Variable	Time	p-value	Skewness	Std. Error	Kurtosis	Std. Error
CF						
	Pre-test	.977	.261	.616	-.180	1.191
	Post-test	.334	.269	.616	-1.104	1.191
ER						
	Pre-test	.247	-.154	.616	-.208	1.191
	Post-test	.136	-.496	.616	.367	1.191

p-value = .05

Skewness and Kurtosis: Control group

Variable	Time	p-value	Skewness	Std. Error	Kurtosis	Std. Error
CF						
	Pre-test	.118	-.552	.687	-1.353	1.334
	Post-test	.830	.289	.687	-1.015	1.334
ER						
	Pre-test	.508	-.237	.687	-1.375	1.334
	Post-test	.091	.871	.687	-.578	1.334

p-value = .05

Homogeneity of Variance-Covariance Matrices Assumption at the Baseline

Time/Variable	Box's M	p-value	Levene's test	p-value
	10.131	.028		
CF			1.464	.240
ER			3.666	.069

p-value = .05

Mauchly's Test of Sphericity Assumption

(Repeated Measures Analysis)

Variable	Mauchly's W	Chi-Square	df	p-value
Pre-Post				
CF	1.000	.000	0	1.00
ER	1.000	.000	0	1.00

p-value = .05

Correlation Assumption

(Correlation matrix)

Time/ Variable	Pre-test		Post-test	
	CF	ER	CF	ER
Pre-test				
CF	1.000	.779**	-.719**	-.085
ER	-	1.000	-.757**	-.132
Post-test				
CF	-	-	1.000	.231
ER	-	-	-	1.000

p-value = .05

** = strong correlation

CF Pre-test and CF Post-test: A strong negative correlation was found ($r = -0.719$, $p < 0.01$), indicating an inverse relationship between cognitive flexibility before and after the intervention.

CF Pre-test and ER Pre-test: A strong positive correlation of ($r = 0.779$, $p < 0.01$) suggests that higher cognitive flexibility at pre-test is associated with better emotion regulation at pre-test.

CF Pre-test and ER Post-test: The correlation was ($r = -0.085$, $p = 0.701$), indicating no significant relationship between CF pre-test and ER post-test.

CF Post-test and ER Pre-test: A strong negative correlation of ($r = -0.757$, $p < 0.01$) suggests that higher cognitive flexibility at post-test is linked to lower emotion regulation at pre-test.

CF Post-test and ER Post-test: The correlation was ($r = 0.231$, $p = 0.290$), showing no significant relationship between CF post-test and ER post-test.

ER Pre-test and ER Post-test: The correlation was ($r = -0.132$, $p = 0.548$), indicating no significant relationship between emotion regulation at pre-test and post-test.

Appendix D: Program evaluation

Weekly Evaluation

Indicator: Breath Counting

Criteria: Breathing rate lower than before practicing or lower than 12 breaths per minute.

Results: Passed (All participants demonstrated lower breathing rates after practicing Pranayama, as shown in the table above).

Note: Participants counted their breaths for one minute and reported it to the teacher. Breath counting indicates the physical response and ability to regulate emotions (Zaccaro et al., 2018).

Indicator: Attendance

Criteria: At least 50% attendance (based on reviews of yoga studies related to cognition and emotion regulation).

Results: Passed (All participants had 75-100% attendance).

Indicator: Teacher's Observation on Poses

Criteria: Participants must perform correctly at least 50% of the poses taught (e.g., if 8 poses are taught, participants must perform at least 4 poses correctly).

Results: Passed

Indicator: Discomfort in Physical and Emotional Responses

Criteria: No physical injury or negative emotions at the end of the session.

Results: Passed

Note: The indicator included improvement in flexibility and balance

Indicator: After-Action Review (AAR)

Criteria: At least one-third of participants should answer or share their perspectives.

Results: Passed

Note: The findings of AAR are presented in Chapter 4.

Table of Breathing ratio, and Table of Attendance record are presented below:

Breath count per minute in the Experimental Group

Participant	Before	After
1	19	3
2	10	4
3	13	3
4	6	2
5	12	2.5
6	15	7
7	16	4
8	15	5
9	20	6
10	15	4
11	12	3
12	14	6
13	14	4

The table shows participants' breath counts per minute before and after pranayama breathing exercises. Participants breathed 6–20 times/minute before the program. All participants reduced their breathing rate by 2–7 breaths per minute after practicing breathing exercises. All participants reduced breathing frequency after the intervention, indicating better breathing control. Slow and deep breathing improves mindfulness and relaxation. Beathing exercises can improve respiratory and well-being effectively. This

yoga-based program can possibly have enhanced respiratory regulation by decreasing breathing frequency through breathing exercising and mindfulness.

Research participants breathed deeply and slowly to relax, reduce stress, and regulate autonomic nervous system function. Study showed that mindful breathing can develop both physical and mental well-being. Each session of this yoga-based mindfulness program provided breath counting to assess relaxation and emotion regulation.

After practicing Pranayama or breathing exercises, participants' breathing frequency in general was below 12 breaths per minute. Gleichauf et al. (2024) found that meditation reduces breathing frequency down to 5 breaths per minute while normal relaxation breath is at 10-15 breaths per minute (Pande et al., 2013).

Class Attendance

Participant	Number of classes	Percentage
1	16	100
2	13	81
3	16	100
4	13	81
5	12	75
6	13	81
7	14	87
8	12	75
9	12	75
10	16	100
11	13	81
12	16	100
13	13	81

Conclusion:

This program showed positive results. After breathing exercises, participants' breathing frequency decreased, demonstrating breathing regulation, resulting in relaxation, and supporting physical and psychological advantages. Participants also developed balance and flexibility, revealing the program's effects. Class attendance was high, with all participants meeting the minimum criteria, echoing program commitment. From yoga teacher’s observation, participants performed greater than 50% of the poses correctly, evidencing the learning methods' effects and the participants' ability to learn and obtaining the skills. No physical injuries or negative emotional responses were stated, identifying a safe program. Most participants participated in the AAR, informing program’s success in supporting thought and engagement. In general, the program achieved its goals, with all participants improving in breathing control, awareness, and physical health, confirming that the yoga-based mindfulness practices enhance well-being.

Appendix E: A Tailored yoga-based mindfulness program

Utilizing the qualitative insights of the AAR and in-depth interview, the yoga-based mindfulness program had been built up. This included yogic poses, breathing exercises, and mindfulness practices customed for Thai elderly.

Program Overview

Session: 60 minutes

Stage 1: Warm-Up practice in joint series and breathing control exercises (10 minutes). This stage was mandatory due to health limitations in this demographic.

Stage 2: Gentle yoga poses (40 min)

Stage 3. Cool-down, relaxation, mindfulness meditation (10 min)

Frequency: Twice or three times per week

Duration: 8 weeks (over 16-20 sessions)

In the warm-up stage, participants observed yoga teacher as a model and followed, repeated practices in breathing exercises and yoga poses, particularly the joint-freeing series in order to prevent physical constraints and promote safety. A gentle practice is central, with supportive props like walls, chairs, tables, towels, and others are encouraged.

Weekly details

Week 1: Mindfulness Overview (Emotion Regulation)

Stage 1 (10 min): Gentle Warm-Up: Joint-Freeing Series (neck rolls, shoulder shrugs, wrist rotations).

Pranayama: Deep abdominal (diaphragmatic) breathing

Stage 2 (40 min): Joint-Freeing Yoga Poses

Practice positions slowly and mindfully with a partner or group.

Stage 3 (10 min): Relaxation: Savasana and body scan meditation.

Reflection: Being mindful of breath

Discussion: Initial feelings and experiences

Week 2: Breathing Awareness (Emotion Regulation)

First Stage (10 min): Joint-Freeing Warm-Up

Pranayama: Deep abdominal breathing Nervous system relaxation breathing

Stage 2: Joint-Freeing Yoga Poses (40 min) Series: Mindful repetition matters.

Practice in pair or group: To discuss body sensations

Stage 3 (10 min): Relaxation and focus on breathing during the corpse pose or Savasana

Meditation: Concentrative meditation

Discussion: In sensation and emotions

Week 3: Emotion regulation and breathing awareness (continued)

Stage 1 (10 min): Joint-freeing as the warm-up

Pranayama: Three-part breathing

Stage 2 (40 min): Yoga poses in seated: Virasana (Hero pose), Balasana (Child pose).

Practice in pair: Focus on emotional trust-building partner-assisted stretches

Stage 3 (10 min): Relaxation: Savasana, emotional awareness meditation

Reflection: Mindfulness and emotional regulation

Group Talk: Mindful emotion management

Week 4: Emotion regulation and cognitive flexibility via physical flexibility

Stage 1 (10 min): Joint-Freeing Series and full-body stretches for warm-up.

Pranayama: Deep abdominal breathing with retention

Stage 2 (40 min) : Yoga Poses (Seated): Virasana, Balasana, Bridge Pose Mindfulness Monitor body sensations during difficult positions

Stage 3 (10 min): Relaxation: Savasana with sound focus.

Discussion/ Reflection: Physical flexibility and mood, Mentally adapting to physical challenges

Week 5: Emotion regulation & Cognitive flexibility: Mindful Standing Poses & Social connection

Stage 1 (10 min): Joint-freeing warm-up series

Pranayama: Deep abdominal breathing with retention (stress relief)

Stage 2 (40 min): Yoga Poses (Standing): Initial preparation includes Mountain pose, Tree pose, Chair pose, Warrior I & II.

Pair/Group Activity: Partner yoga positions build trust and connection

Stage 3 (10 min): Relaxation: Anapanasati meditation (Mindful breathing), Savasana with breathing awareness

Reflection: Social and energy exchange awareness, Trust and mindful relationship techniques

Week 6: Mindfulness (Cognitive flexibility enhancement)

Stage 1, (10 minutes), warm-up included joint-freeing series and gentle stretches for the entire body.

Pranayama: one-sided nostril breathing

Stage 2 (40 min): Yoga (Supine): Bridge pose, Wind-relieving pose, Reclined spinal twist pose

Mindful movement: Kabat-Zinn mindfulness (present-moment awareness without judgment)

Stage 3 (10 min): Relaxation: Savasana, deep awareness meditation

Contemplation: Journaling personal insights

Group Discussion: How mindfulness has increased self-awareness

Weekly 7: Integrative flow and mindfulness (Cognitive flexibility enhancement)

Stage 1 (10 min): Joint-Freeing Series and full-body stretches for warm-up.

Pranayama: Alternative nostril breathing for balance and tranquility

Stage 2 (40 min): Yoga Poses: gentle flow incorporating joint-freeing series, Tree, Chair, Warrior I & II, Virasana, Balasana, Bridge, and Reclining Twist poses

Practice in pairs: To ensure safety in flow practice and social interaction

Stage 3 (10 min): Relaxation: Langerian Mindfulness and corpse pose or Svasana.

Reflection: Progress and daily life integration

Group Discussion: Post-program practice strategies

Week 8: Mindfulness integration & Future practice

Stage 1 (10 min): Warm-up: Joint-freeing series and full-body relaxing stretches.

Pranayama: Ujjayi breathing intensifies focus.

Stage 2 (40 min): Yoga poses combining all positions with flow (Joint-Freeing Series, Tree, Chair, Warrior, Hero, Child, Bridge, Reclining Twist)

Practice in pairs/ groups: Mindful adjustment in poses

Stage 3 (10 min): Relaxation, this stage was to focus on the mindfulness through the extended corpse pose or Savasana, to prolong attention to bodily sensations, emotions, and thoughts.

Reflection and Discussion: group sharing to plan for life long practice.

Summary of yoga poses:

Warm-Up: Joint-Freeing Series

Standing: Tree, Chair, Warrior I & II

Seated/Supine: Hero (Virasana), Child (Balasana), Bridge, Wind-Relieving, Reclined Spinal Twist

Relaxation: Savasana (Corpse Pose)

Summary of breathing exercises (Pranayama):

Deep diaphragmatic breathing

Three-part breathing, one sided and alternate nostril, and the Ocean breath

Relaxation Technique: Mindful breathing into the pain area, and mindful awareness in that specific area.

Cultural and practical involvement

This tailored program addressed cultural and practical considerations based on AAR (learning processes) and the in-dept interviews, it can be concluded as follows:

- Clear instructor demonstration
- Repetition and consistency enabled neuroplasticity
- Encouraged moderate, gradual improvement in line with Thai culture (patience, perseverance, gentle practice).
- Pair/group exercises for socialization
- Using Thai Buddhist-appropriate mindfulness techniques (Anapanasati meditation)

Recommendation in frequency/ duration:

Frequency: Twice or three times each week

Duration: 60 minutes per session over 8 weeks (16-20 sessions).

Yoga poses classification

A) Static Poses

Under concept of stillness in order to build up balance, strength and focus. Strong support with props are recommended.

- **Mountain Pose (Tadasana)** – standing pose as foundation
- **Tree Pose (Vrikshasana)** – standing, balance and focused pose
- **Warrior I and II (Virabhadrasana I & II)** – standing, considered as the static pose once they are in alignment, this can build up both focus and the strength
- **Chair Pose (Utkatasana)** – squatting pose
- **Hero Pose (Virasana)** – seated position, assisting in digestion and also grounding

B) Dynamic Poses

Poses in mindful flowing movement or repetitive approach.

- **Joint Series Movement** – including the repetition in mobilization dynamically
- **Cat-Cow (Marjaryasana–Bitilasana)** – this is a traditional spinal warm-up, practice in dynamic between the cat and the cow position

- **Warrior I and II –** these can be considered as dynamic poses if practiced in the sequence

C) Gentle Inverted Poses

These poses label the alignment of having head position lower than the heart, the inverted pose can be gentle without intense pressure, and practice with props.

- **Cat-Cow (drop head down below heart)** – considered as gentle inversion pose
- **Bridge Pose (Setu Bandhasana)** – gentle backbend by nature, and gentle in inversion when practice without strain.
- **Child's Pose (Balasana)** – considered as the mild forward bend pose with head down, unless any blood pressure condition.
- **Reclining Twist (Supta Matsyendrasana)** – twisting in the horizontal plane, this is considered as the mild inversion effect

D) Restorative Poses

These poses encourage relaxation and regulate the parasympathetic nervous system

- **Mountain Pose (Tadasana)** – to be centered and grounded mindfully
- **Child's Pose (Balasana)** – to be in calming and grounding mode of resting pose
- **Hero Pose (Virasana)** – to rest and relax, this restorative pose can be used in practicing breathwork or stillness
- **Reclining Twist** – to release the tension in spine gently
- **Bridge Pose (supported with props)** – it's the restorative when practice in passive approach
- **Savasana (Corpse Pose)** – the ultimate restorative pose in lying down

Some '**safe-to-pract**ice' poses with brief instructions and illustrations, with props encouraging, are shown as follows:

Mountain Pose (Tadasana)

Instructions:

- Stand straight up with feet joining together, mindfully ground all four corners evenly on the floor or yoga mat.
- Mindfully engage your thighs, mindfully lift your chest, and position the top of your head in upright position.
- Mindfully relax your shoulders and allow your arms to hang with no tension by your sides
- Mindfully breathe, hold the position

Benefits: This pose helps to strengthen legs and improve balance

Tree Pose (Vrikshaana)

Instructions:

- Start from Mountain Pose (as basic starting pose)
- Shift the body weight onto one foot. (left)
- Mindfully position the sole of another foot (right foot) on the left inner thigh or modification with calf position (avoid placing on the knee, as this will put pressure on the knee).
- Bring your palms together in front of the chest in Sawasdee (prayer) position or extend both arms up overhead, or grab support (table)
- Concentrate on a single point in order to maintain balance, if falling, restart again with mindful attention to the focal point

Benefits: To enhance balance, concentration, strengthens the legs

Child's Pose (Balasana)

Instructions:

- Kneel down on the mat with the knees apart
- Sit back on your heels or any props such as bolster, pillow and extend arms forward or make a pillow with the arms or hands
- Mindfully place your forehead (slowly) on the ground and breathe deeply.
- This pose is a restorative pose, if it's comfortable, this pose can be held up for 1–3 minutes (depends on physical condition), allowing the whole body to be grounded. Be mindful in breathing or body sensation

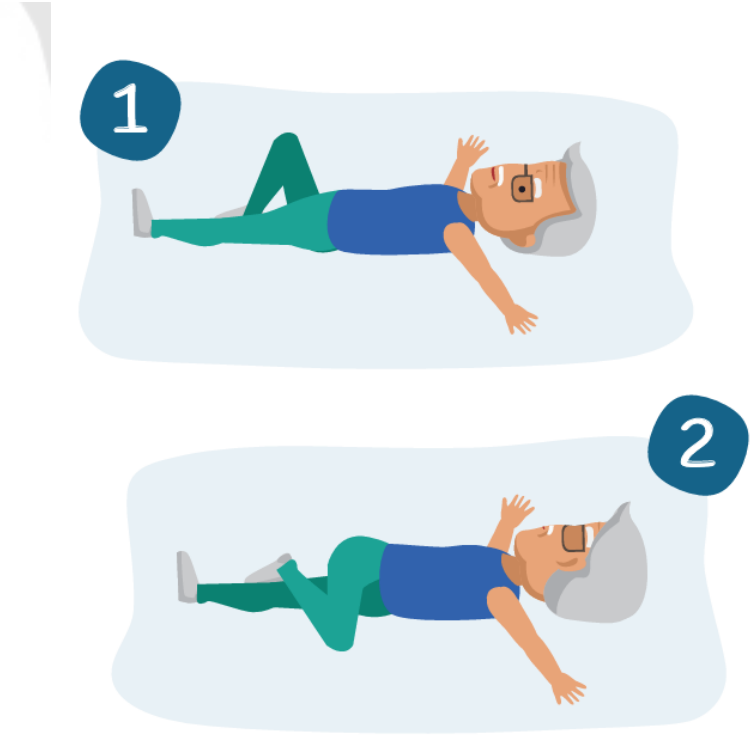
Benefits: This pose helps to calm mind, also relieve tension, stress physically and psychologically.

Reclining Spinal Twist (Supta Matsyendrasana)

Instructions:

1. Lying on your back
2. Gently draw both knees toward the chest, embrace them tightly but comfortably.
3. Extend the left leg, make it flat on the floor.
4. Guide the right knee across body toward the left side. (use support under the bending knee if needed)
5. Extend the right arm to the right side, make sure right palm is facing down, and gently turn your head to look over your right hands.
6. Ensure that both shoulders are grounded on the floor.
7. Hold in the position without any force, if it is comfortable, this pose can be held for 5–10 deep breaths long, make sure to be mindful in breathing and in each movement of twisting.
8. Switch to another side.

Benefits: To enhance spine flexibility, hip, glutes and lower back stretches.



Bridge Pose (Setu Bandhasana)

Instructions:

1. Lie down on the back with knees bent at hip-width apart, knees upright facing the ceiling, and make sure feet are flat on the mat/ floor.
2. Place both arms on the side of your body, make sure palms are facing up toward the ceiling to encourage shoulder opening.
3. Press both feet and arms down on the floor as you inhale mindfully to life up hips toward the ceiling.
4. Mindfully engage thighs, glutes, and abdomen to lift chest and hips higher.
5. Be mindful in controlling knees, not to let them opening in the outward direction; position them aligned with hips, at hip-width apart as the starting preparation.
6. Hold in pose for 5 breaths, or longer if comfortable, then mindfully exhale and then lower the spine down onto the floor, very slowly, one vertebra at a time.

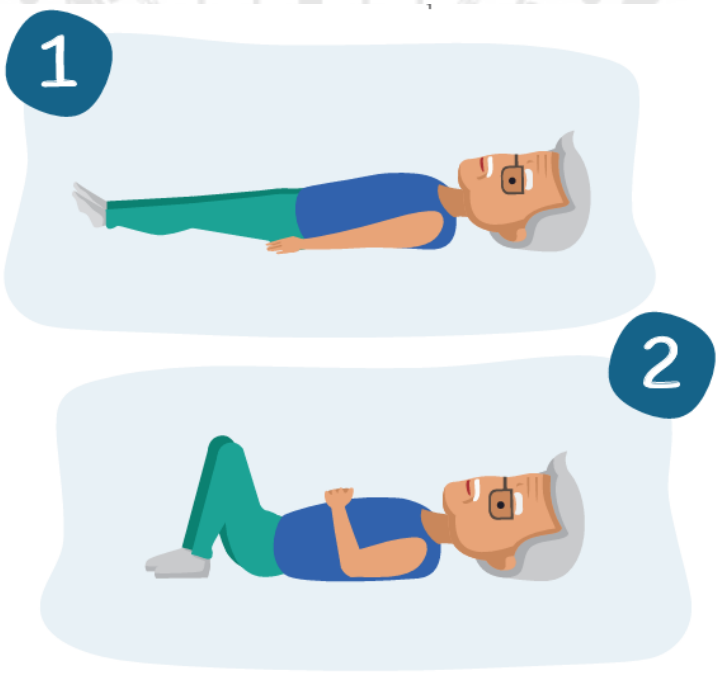
Benefits: To strengthens the back, glutes, and legs, it can also help to reduce back pain.

Corpse Pose (Savasana)

Instructions:

1. Lie on your back with legs extended and feet at the hip-width apart distance, allowing toes to fall outward naturally, feel free to use the pillow to support the head if needed.
2. Place both arms alongside the body, palms facing upward to the ceiling.
3. Gently close your eyes and draw awareness to the breathing, allowing breath to flow naturally and mindfully.
4. Relax every part of the body, from feet up to the crown head
5. Stay in the pose for at least 5 minutes, then gently bring your awareness back to surrounding and slowly and mindfully get up from the side or the recovery position.

Benefits: This corpse helps to enhance deep relaxation both body and mind, also helps to reduces stress and tension in the body.



Yoga photo source: Manual for older adults (Department of Thai Traditional and Alternative Medicine; Ministry of Public Health, 2018)

Appendix F: Tryout program results

Participants:

Four older adults in the young-age stage from a subdistrict in Petchburi, Thailand. Participants participated in the total of 8-session program, each session lasted for 60 minutes.

Table 1 Demographic information

Participants	Gender	Age
A	Cisgender woman	60
R	Cisgender woman	66
W1	Cisgender woman	60
W2	Cisgender woman	66

Qualitative Feedback from After-Action Review

1. Better in breathing: After chronic coughing and chest tightness, Participant A breathed deeper and more comfortably. Participant R, who has a nasal tumor and was scheduled for surgery but missed it, said her breathing was initially difficult but is now better. No back pain either.

2. Reducing pain and Sleep medication dependency: After running out, Participant A reported fewer body aches and no need for additional medications. She quit sleeping pills and started relaxation breathing and body scanning before going to bed , nowadays, she wakes up freshly, do a proper stretch mindfully in the morning, and even breathe mindfully.

3. Mindfulness in daily life and Family engagement: All participants spontaneously recalled yoga postures and breathing methods while waking, resting, and eating, indicating mindfulness integration. Participant A loved teaching her grandchildren, who enjoyed and imitated her practice. Mindful movement is practicing within the family.

Learning awareness and cognitive engagement

Participant W2 expressed, “My brain must still be good, that's why I can remember what teacher teach and can do this,” indicating self-efficacy and mental alertness.

Effects of Yoga and Breathing Practice

Participants reported increased mindfulness, posture (e.g., "I sit up straight now without being reminded"), and awareness of posture and breathing adjustments.

• Participant A reported mindful eating, slowing down, and focusing on breath while eating class snacks.

• Participant W1 who previously breathed quickly (23 breaths/min) now enjoys deep breathing.

Quantitative Outcomes

Table 2: Breath Counting (Breaths Per Minute)

• In each session, all participants reduced breathing frequency, demonstrating physiological relaxation and emotion regulation.

Participants	Session 2	Session 4	Session 6	Session 8
A	18 ⟶ 13	11 ⟶ 10	11 ⟶ 5	8 ⟶ 5
R	11 ⟶ 9	12 ⟶ 11	11 ⟶ 4	10 ⟶ 7
W1	23 ⟶ 13	12 ⟶ 5	9 ⟶ 4	5 ⟶ 4
W2	13 ⟶ 12	13 ⟶ 7	6 ⟶ 3	5 ⟶ 5

Conclusion of findings: Referring to Zaccaro et al. (2018), a slower breathing frequency demonstrated relaxation and self-regulation. Participants' reductions in breath counting frequency recommend that the intervention was effective.

Table 3 Cognitive Flexibility Inventory (CFI) in pre-post test

Participants	Pre-test	Post-test
A	56	130
R	65	128
W1	61	134
W2	50	117

Conclusion: All participants showed remarkable improvement in CF. The large increases could also reflect an improved questionnaire version, which had been revised to reduce the item of “neutral” or “unsure” responses that previously limited score changes in practicum studies in the past. Participant's qualitative insight can be classified into:

• Component A: ‘Alternatives’: the ability to perceive multiple options

• Component B: ‘Control’: to internal focus or perception of situation as controllable

Table 4: Alternatives*:* Ability to perceive multiple options and generate solutions

Participants	Qualitative insight	Explanation
R	“In the past, I had back pain, I did not know what to do, it was probably a very funny story to share but I frankly had observed my dog, the way he stretches. Now, I learned yoga, there is even dog pose and it’s exactly what I have seen dog’s stretch.”	Shows adaptive thinking and problem-solving creativity by connecting observed real-life behavior in animal to formal yoga learning, revealing the ability to generate and integrate alternatives.
W2	“I normally do an easy stretch by myself but after I have learned yoga, I know better what to do ... I learn proper stretching.”	Reveals the ability to assess multiple movement options identifying problem-solving and flexible thinking strategy.

Table 5: **Control:** *Perception of difficult situations as controllable*

Participants	Qualitative insight	Explanation
A	"I am now more aware of breaths, I even used it when I eat, now I am more mindful in eating."	Shows internal control by applying breath awareness to eating, reflecting intentional behavior.
W1	"In the past, I didn't' know how to exercise, so I seldom exercise, but now I know how to do."	Suggests a shift from inaction to self-efficacy, this echoed the belief in ability to act and control behavior.
W2	"After I learn yoga. I integrate the proper exercise into my daily life."	Exhibits internal control by making self-directed decisions based on the new knowledge

Table 6 Emotion regulation (ERQ) in Cognitive Reappraisal in pre-post test

Participants	Pre-test	Post-test
A	24	39
R	26	41
W1	28	38
W2	26	40

Conclusion of findings: All participants improved in cognitive reappraisal strategy, identifying a positive response in stressful situations adaptively (Preece et al., 2020).

Table 7 Emotion regulation (ERQ) in Expressive suppression in pre-post test

Participants	Pre-test	Post-test
A	18	6
R	13	5
W1	17	6
W2	16	5

Conclusion of findings: All participants showed reduced expressive suppression, meaning they became less likely to suppress emotions, a change associated with reduced psychological distress and better emotional processing (Preece et al., 2020).

Observation regarding safety and instruction

1. Physical limitation: Two participants had high and one low blood pressure. Avoiding fast movements, bending, and breath retention was crucial.
2. As participants had no experience in yoga. Some had health issues such as back or knee pain. For safety and clarity, instruction was adjusted.
3. Breathwork and observation-based learning helped this aging group adapt cognitively and physically.
4. Improved tool: The CFI and ERQ questionnaire reduced “neutral” responses, improving score sensitivity.

Conclusion of Try-out study

The program was safe, well-received, and improved physical relaxation, emotion regulation, and cognitive flexibility. Subjective insights and objective measurements supported the yoga-based mindfulness program for early older adults. Positive results support the main intervention phase's feasibility, safety, and efficacy.

Appendix G: Ethics approval

AF20-03-03.0
May, 2023

Certificate of Ethical Committee Approval

This is to certify that:

Protocol Title: THE EFFECTIVENESS OF A TAILOR-MADE YOGA-BASED MINDFULNESS PROGRAM ON COGNITIVE FLEXIBILITY AND EMOTION REGULATION IN THAI OLDER ADULTS: A MIXED METHODS STUDY.
Principal investigator: Mrs.Areeya Nilsson
Institution: Behavioral Science Research Institute, Srinakharinwirot University
Protocol code: SWUEC-672541
Documents approved:

1. Submission form — version no. 2 date 23 September 2024
2. Full research proposal — version no. 2 date 23 September 2024
3. Participant information sheet and consent form — version no. 2 date 23 September 2024
4. Questionnaire/data collection form — version no. 1 date 25 August 2024
5. Investigator's biography

have been reviewed and approved by the Human Research Ethics Committee of Srinakharinwirot University based on Declaration of Helsinki, Belmont Report, International Conference on Harmonization in Good Clinical Practice (ICH-GCP), International Guidelines for Human Research, along with laws and regulations of Thailand. Thus, the approval for conducting the study is granted.

Date of approval: 11/10/2024
Date of expiration: 10/10/2025

(Associate Professor Sittipong Wattananonsakul, Ph.D.)
Chairman, Social Science and Behavioral Science Research Sub-Committee
of Srinakharinwirot University (Panel 2)

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