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ARTICLE



A health promotion program for older adults (KABAN!): effects on health literacy, quality of life, and emotions

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ABSTRACT

The importance of an integrated health promotion program has been proposed in recent years. However, the traditional program with lectures might decrease the effectiveness of learning. A game-based learning program provides a supportive social environment and further increases the quality of life and positive emotions. The present study evaluates the effectiveness of the proposed game-based health promotion program, KABAN!, to enhance health literacy, positive emotions, and quality of life for older adults. The proposed intervention included physical exercises, nutritional knowledge, social interaction, cognitive training, and oral health care skills. All activities were designed based on the gamification principles and experiential learning theory. Both qualitative and quantitative data were collected from participants and instructors. A total of 221 older adults were randomly recruited (age: mean = 71.1, SD = 7.1) as participants. To gather feedback on program implementation, 22 experienced instructors were selected based on the criteria of leading five or more sessions. Health literacy, quality of life, and emotional states before and after participation were collected. The instructors were invited to provide constructive feedback through open-ended survey questions. Analyses revealed that health literacy levels, positive emotions, and quality of life significantly increased after participation, while negative emotions remained identical. Further investigation of qualitative data via the constant comparison method showed positive feedback on instructors' perceived changes in participants. This study showed that participation in health promotion programs like KABAN! significantly enhanced older adults' health literacy, quality of life, and positive emotions.

Background

As the world's population is aging, studies have begun to focus on healthy ageing, that is, emphasizing a healthier lifestyle and improving the quality of life of elderly (Drewnowski & Evans, 2001). In 2019 the healthy life expectancy was 63.5 years worldwide, while life expectancy at birth was 73.5 years (GBD 2019; Demographics Collaborators, 2020). There are ten years of potentially unhealthy lifespan that could result in low quality of life, economic burdens, rapid ageism, and various societal issues (Chang et al., 2020; Savage et al., 2021; World Health Organization, 2015). Non-communicable diseases contribute to the significant fatalities in human beings (Bennett et al., 2018), which are the result of unhealthy lifestyles and mental health issues, such as a sedentary lifestyle, nutritional imbalance, smoking, alcohol abuse, and depression. Extending a healthy lifespan is as important as

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extending life expectancy. Reducing the period of ill health and reducing suffering is a consensual approach to the older population's healthcare (Fries, 1980, 2005).

Health literacy and quality of life

Health literacy is the foundation to enhance healthy life expectancy and quality of life, especially since the older population generally has fewer years of formal education than the younger generations (Duffin, 2020; Ministry of Education, 2018). Limited formal education is strongly associated with older adults' lower cognitive status, functional disability, and frailty status (Brigola et al., 2019). The average number of years of schooling worldwide in 2019 was around 8.5 years among individuals 65 years and older (United Nations, 2020). In Taiwan, around half of the older population (aged 65 years old and above) received less than nine years of compulsory education (Ministry of Education, 2018), which may imply having lower health literacy in general. Attention to health literacy in modern healthcare research has been extensively discussed across academia. Adequate health literacy is associated with better health outcomes, such as the ability to comprehend medical instructions (Jacobson et al., 2021) and an overall lower all-cause mortality risk (McDonald & Shenkman, 2018). Studies have also demonstrated that limited health literacy increases health costs, generally due to poor disease management, leading to more extended hospitalizations and high readmission rates (Berkman et al., 2011; Howard et al., 2005; Rajah et al., 2019). According to past literature, health literacy challenges may affect the older population more than other age groups. For example, studies examining health literacy differences among age groups in the United States (Kutner et al., 2006), South Korea (Lee et al., 2017), and Taiwan (Lee et al., 2010) reported that older age groups tend to have lower health literacy. Low health literacy among older adults leads to poor health status (Raghupathi & Raghupathi, 2020), and less health promotion behaviors, resulting in increased disability, social isolation (Pardasani et al., 2018), and poor psychological well-being (Tokuda et al., 2009).

Integrated health promotion toward healthy ageing

Health promotion programs have been identified as one of the effective ways to increase health literacy (Nutbeam, 2000). Many health promotion programs focus on a single healthy domain, such as physical exercise (Beauchamp et al., 2018; Gheysen et al., 2018), fall prevention (Kato et al., 2008; Stevens et al., 2020), and disease prevention (Yang & Park, 2020; Yang et al., 2016). What makes KABAN! stand out from the current options is the integrated diversity it is capable of providing. Ranging from maintaining functional capacity to stimulating one's social network, all game-based learning strategies within KABAN! aim to contribute to an independent and self-sufficient quality of life at old age. Moreover, the accessible design of the game props proves that learning and enjoyment can coexist in effective health promotion activities among seniors. As suggested by the literature, game-playing is a practical learning resource for the older population, boosting the motivation and capability to learn and interact (Oppl & Sary, 2020). It has been suggested that integrated health promotion programs are more effective and have a longer-lasting effect than single subject-oriented implementations (Chen et al., 2020; Gudlaugsson et al., 2019; Rodriguez-Mañas et al., 2019). In addition, from a functional ability perspective on supporting healthy aging, the newly developed integrated care of older people guidelines (World Health Organization, 2019) emphasizes the importance of integration. To maximize one's functional ability throughout his life, research suggests investing in intrinsic capacities (Beard et al., 2016), the composite of all physical and mental capabilities that an individual can draw upon during their life. In addition, the self-healing ability (Chu et al., 2022), also known as a natural-born healing power, coordinates respective physiological system functions smoothly and keeps our body and mind in a homeostasis state. The suggested integration model often includes the physiological lifestyle factors, such as physical functional ability, diet, cognition, sleep quality, oral care, and psychological factors, such as emotion, social participation, and depression. All are considered crucial aspects of influencing the quality of life.

Older adults' learning considerations

With a clear direction to the integrated model of health promotion program toward healthy aging, implement it for older adults effectively becomes pivotal. Based on the classical work of Horn and Cattell (1967), older adults experience a physiological decline with a decrease in fluid intelligence (Dhamala et al., 2021; Fisher et al., 2019; Veríssimo et al., 2022; Zaninotto et al., 2018). Several age-related changes could contribute to the decline in health literacy among older adults. Although the rate and severity of these age-related changes vary by individual, they should be considered when evaluating an older adult's health literacy. For example, a decline in cognitive ability in an older adult may contribute to an older adult's ability to comprehend or recall new topics (Lövdén et al., 2020; Park et al., 2001). Hearing and vision loss, for example, may also contribute to a reduced ability to process health information (Chesser et al., 2016; Speros, 2009). Furthermore, psychosocial factors such as socioeconomic status (Davis et al., 2020) and self-efficacy (Kim & Yu, 2010; Lee & Oh, 2020) may impact on health information comprehension. Therefore, a life-long learning perspective should be considered when designing the intervention. According to the cognitive aging theory (Anderson & Craik, 2016; Thomas & Gutchess, 2020; Van Gerven et al., 2006) the degradation caused by aging could cause a decline in working memory, inhibition ability, and speed. Moreover, cognitive load, which is defined as equal to the duration of attentional capture divided by the total time allowed to perform the task (Chandler & Sweller, 1991; Van Merriënboer & Sweller, 2010), may also be influenced if the same instructional material and facilitation methods are adapted to other age groups. In addition to the above-mentioned physiological changes in older adults, communicating with older adults during the learning facilitation process is also imperative. One of the most common stereotypical problems encountered when teaching older adults is they are often treated like children. (Ryan et al., 1995; Soliz & Giles, 2014). Based on the communication predicament model (Ryan et al., 1995), the elder people will feel disrespected and uncomfortable (Bernhold et al., 2020; Gallois et al., 2020; Rothermund et al., 2021). A review of the literature on promoting older adults' health literacy proposes that age-appropriate teaching strategies for older adults must be carefully planned, purposeful, and customized to meet their unique needs (Speros, 2009). In addition, researchers in older adult education recommend that it is vital to approach older learners with acceptance, respect, and support (Słowik-Krogulec, 2019). Speros (2009) reported that one of the challenges in older adult education is creating a learning environment in which the older learner can easily acknowledge what is and is not understood. Therefore, training appropriate instructors for the aging community is increasingly important and plays a vital role in the effectiveness of the health promotion program.

Another theory applied in program designs for older adults is the experiential learning theory (ELT) (Passarelli & Kolb, 2011). The ELT is a dynamic view of learning, based on a learning cycle driven by the resolution of the dual dialectics of action/reflection and experience/abstraction. It is also a holistic theory that defines learning as the primary process of human adaptation involving the whole person. With emphasis on activating participants, creating engagement, and proposing meaningful content on connecting to the real world, more recent evidence showed that experiential learning, possibly has functional change on the effectiveness of learning in older adults (Kolb, 2014). The traditional way of learning is often instructor-centered, with passive learners and dry content requiring much memorization, which may be impractical and challenging for older learners.

Gamification learning benefits and limitations

Although the statement that health is essential seldom finds disagreement, it takes a lot of perseverance and long-term investment to be effective (Koivisto & Hamari, 2019), which can quickly lead to boredom and lack of enthusiasm. An integrated health promotion program still lacks innovative elements to overcome the challenges of incorporating an experiential learning mechanism. Gamification or game-based learning (Koivisto & Hamari, 2019; Koivisto & Malik, 2020) has gained tremendous attention and demonstrated effectiveness in promoting motivation and engagement. The

academia reported positive results on gamification learning among young people, but research on older adults remains scarce. Moreover, health literacy and quality of life are rarely discussed in gamification learning research (Koivisto & Hamari, 2019). The existing gamification research also ignores the importance of interpersonal interaction and teamwork cooperation (An, 2020; Kapp, 2012), which have been found to have a positive impact on older adults' well-being (Rook, 1984) and emotions (Roheger et al., 2022). Social isolation and loneliness have been frequently reported among older adults, and the impact of loneliness that may cause damage to the body is equivalent to smoking up to fifteen cigarettes per day (Holt-Lunstad, 2017). Especially under the Covid-19 pandemic, the issue of older adults' loneliness needs more attention and instant support (Wu, 2020).

KABAN! - a health promotion program

This research aims to design a game-based health promotion program for older adults with integrated health domains (improving health literacy, quality of life, and positive emotions) through gamification design and experiential learning concepts. Topics consist of physiological aspects, such as healthy diets, physical activity, oral care, cognitive stimulation, and psychological aspect via social interactions. Research tends to focus on learners' feedback rather than the instructor's input on their perspective of the intervention. Past literature reported that instructors recognize the benefits of games but resent the challenges of implementing effective instructional design, which substantially undermines the benefits of game-based learning (Chen et al., 2020). Therefore, instructors' feedback can also be utilized to evaluate the implementation of game-based learning experiences (Lukosch & Comes, 2019).

Designed as a portable suitcase, KABAN incorporates healthy aging knowledge through game-based elements with an ELT setting. The outer feature was designed to be conveniently carried around communities for the intervention program. Verbally, 'kaban' also means 'suitcase' in Japanese and it means 'better' in Mandarin. Considering many older adults in Taiwan connect with the Japanese language due to their historical background, 'kaban' makes them feel more connected. KABAN! has been implemented in 543 sessions with 12,095 older adults as participants and 216 trained leaders as program instructors from different regions of Taiwan, including urban and rural areas. Both older adults and instructors had minimal or no experience with gamification programs.

Therefore, additional screening and training was implemented on instructors before the intervention. All instructors have undergone initial screening before being selected, with an acceptance rate of around 30. Criteria for screening included the years of experience working in the community, experience as an instructor for older adults, area of expertise, the number of communities they will be able to facilitate the program, and etc. The training for instructors was designed based on the Train-the-Trainer Model, which has been proven to be an effective training strategy (Madah-Amiri et al., 2016; Nakamura et al., 2014; Orfaly et al., 2005; Pearce et al., 2012). A teaching manual with illustrations and videos were also provided. Furthermore, a dedicated social media group was set up for monitoring and advising on issues that occurred before, during, and after the facilitation.

The primary aim of this study was to develop an innovative health literacy gamified-learning intervention for the aging population, which remains scarce in the field of ageing research. Another aim was to investigate how the proposed intervention, KABAN!, influenced participants' health literacy level, quality of life, and emotional states. With the advanced design in educational methods, this study also included instructors' feedback to provide a more integrated evaluation of the implementation of KABAN!.

Method

Sample

Two hundred twenty-one older adults were randomly recruited for this study from six different geographic areas to increase the diversity (age: mean = 71.1, *SD* = 7.1), 87% (*n* = 192) of them are

Table 1. Basic information for instructors who led five or more sessions.

code	Number of programs led (times)	The average number of participants led by the instructors (people)	Willing to serve as an instructor again (%)	Current programs can improve your event leadership skills and confidence (%)
A	8	19	75% Yes	100% Agree
B	8	21	12.5% Yes	100% Agree
C	5	30	100% Yes	96% Agree
D	9	49	100% Yes	77.8% Agree
E	6	15	66.7% Yes	86.7% Agree
F	6	25	16.7% Yes	46.7% Agree
G	5	24	100% Yes	84% Agree
H	5	21	50% Yes	80% Agree
I	18	22	100% Yes	100% Agree
J	11	16	100% Yes	100% Agree
K	6	17	100% Yes	86.7% Agree
L	6	14	58.3% Yes	76.7% Agree
M	5	22	100% Yes	100% Agree
N	6	25	100% Yes	100% Agree
O	5	23	100% Yes	100% Agree
P	7	20	100% Yes	80% Agree
Q	6	14	100% Yes	90% Agree
R	10	17	100% Yes	100% Agree
S	7	22	100% Yes	88.6% Agree
T	7	16	92.9% Yes	94.3% Agree
U	6	14	100% Yes	86.7% Agree
V	6	26	100% Yes	100% Agree

female, and 13% are male ($n = 29$) participants. As for the educational background, 41% of participants reported college or higher level of education. One-third of the participants possessed a high school diploma or equivalent (31%), while 28% reported some school experience (elementary, middle school, or unschooled). As for health education program experience, around 63% of the elder participants attended traditional lecture-based ones before.

Additionally, a total of 22 instructors were selected based on the criteria that they led five or more sessions of KABAN! to gather feedback on the successful and challenging elements of the program. As illustrated in Table 1, the average number of instructor leading times was seven and the average number of participants led by instructors per session was 21. The willingness to serve as an instructor again is on average 85%, and the percentage that KABAN! has improved their facilitation leadership skills and confidence is on average 90%.

Gamification interventions

Based on the theoretical background of gamification design and ELT, the motivational factors in KABAN! are composed of achievements, storylines, clear goals, rewards, progress, challenges, team cooperation, team competition, physical cards, physical playboard, and game slogans. The main storyline was adapted to one of the most popular activities among Taiwanese older adults, mountain hiking. KABAN! consists of six stages of challenges created for twenty small activities within 120 minutes long. Instructors and volunteers set up the venue layout in various settings, such as the local community centers, in front of a temple or in any open space areas. They also dressed up like hiking guides with flags, a big mountain trail map, and banners. Each instructor carried one suitcase per session. Each session consisted of 20 to 30 participants with all instructional materials and props packed in a portable suitcase, making it easier to carry around in different communities, including the city and countryside. An immersive experience was implemented throughout the program, including physical exercises, cooking games for nutritional knowledge, social interaction, cognitive training, and oral health care skills. An overview of intervention illustrations is presented in Table 2. Figures are included for better visualization of the intervention. Figure 1 depicts all items that are included in the suitcase, including a program vest, game cards, self-healing meal plate posters, and

Table 2. The healthy ageing suitcase-KABAN! Program structure.

Stage (Duration)	1 st (15 minutes)	2 nd (15 minutes)	3 rd (25 minutes)	4 th (20 minutes)	5 th (5 minutes)	6 th (30 minutes)
Elements	-Social interaction	-Physical exercise -Social interaction	-Oral care skill -Nutritional knowledge -Social interaction	-Physical exercise -Social interaction	-Cognitive stimulation	-Social interaction
Affordances	Theme, challenges, tasks, clear goal, achievement stickers, team cooperation & competition, physical cards & playboard, game slogan					
Storyline/ Theme	House on the Hill	Uncharted Adventure	Cooking and mealtime	More Challenges	Build on the ladders	Hit the Top
Activity	-Introduction -Self-healing concept -Warm-up game -Slogan teaching	-Repelling thieves from logging, -Running away from bee colonies -Paddling a boat to cross a river -Passing through ancient cypresses	-Oral care exercise -Cooking time -Meal preparation	-Face emergency cramp -Step on the single-plank bridge -Group selfies with flowers -Make marks on the road -Climb on the rock	Ladder recovery arithmetic	-Post card drawing for next year's memory -Group picture

There was a 10-minute break between 3rd and 4th stage.

**Figure 1.** The healthy ageing suitcase- KABAN! layout.



Figure 2. The healthy ageing suitcase-KABAN! storyline and program structure.

etc. Following the developers designed structure, the program storyline and supporting images are shown in Figure 2. An additional one-minute clip is also provided for reference (<https://youtu.be/7MsWUUazaOM>).

Study design

This study employed a mixed-method design to evaluate the impact of the intervention on the 1) participants' health literacy, quality of life, and emotion changes before and after the program, and 2) instructors' facilitating reflective notes, successful elements, and challenging situations after facilitation. Participants completed pre-and post-program questionnaires and instructors filled out post-program questionnaires after each session. The collected data were then utilized to compare participants' and instructors' outcomes for convergent analysis. All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional research committee. Informed consent was also obtained from all participants who participated in the study.

Data collection and measurement

Quantitative measurements

We measured participants' health literacy, quality of life, and emotional states before and after the program. A total of three quantitative measurements were utilized in this study.

Health literacy. Health literacy was measured based on the six critical contents from the integrated health promotion concept by multiple choices: 1) two questions about understanding four types of physical exercise, endurance, strength, balance, and flexibility from the National Institute on Aging (NIA) (2020); most people tend to focus on one type of exercise and think they're doing enough.

Table 3. Correct rate of participants' answers to health literacy questions (N = 221).

Health Literacy Questions	Pre-test Correct %	Post-test Correct %
Q1. When you experience emergency cramps or muscle fatigue, which of the following type of exercises can you do?	86.0%	88.7%
Q2. To lift your thighs or strengthen your arms, which of the following exercises can you do?	74.7%	77.4%
Q3. When is the best timing to perform oral exercise?	64.7%	88.7%
Q4. To prevent from sarcopenia, which type of food should you eat more?	86.4%	88.7%
Q5. What kind of food category are corn and pumpkin on the plate?	63.8%	72.9%
Q6. Which of the following way can help stimulate the brain?	42.1%	62.0%

However, research has shown that it's important to get all four types of exercise due to their individual benefits. 2) One question about oral care practices is aligned to the 8020 goal (retaining at least 20 teeth at 80 years old and beyond) (Ishii, 2005; Saito et al., 2020; Yamanaka et al., 2008). Teeth are a vital organ and influence our nutrition intake, communication with others, and balance capability. In addition, chewing ability could affect brain circulation and delay the onset of dementia. 3) two questions about balanced diet and nutritional knowledge based on MyPlate, which is the current nutrition guide published by the USDA's Center for Nutrition Policy and Promotion (U.S. Department of Agriculture, 2020) and Taiwan Ministry of Health and Welfare (Health Promotion Administration, 2019), highlighting the importance of six major food groups, including grains, proteins, vegetables, fruits, dairy, and nuts. Every type is crucial for our daily nutrition, and it is under current dietary recommendations., and 4) one question about cognitive stimulation practice through simple arithmetic calculations, which showed more active brain circulation than complex arithmetic calculation (Kawashima et al., 2004; Nouchi et al., 2021; Uchida & Kawashima, 2008). All questions were assessed with face validity based on six experts' evaluations (see Table 3).

Quality of life. The EuroQol Visual Analogue Scale (EQ-VAS) (Brooks, 1996; Group, 1990; Kim et al., 2018; Sach et al., 2006) was used to measure the quality of life. Due to its intuitive and straightforward approach to evaluating a person's overall health condition, it is one of the widely used quality of life assessments in primary care. The EQ-VAS is a vertical visual analog scale with a range of 0 to 100; 0 represents the worst self-perceived life quality, and 100 implies the best self-perceived life quality. The respondents draw a line on the ruler directly, and the corresponding score represents their self-reported life quality that day.

Emotional states. The Positive and Negative Affect Schedule Short Form (PANAS-SF) was utilized to calculate participants' self-reported emotional states or feelings. The 10-item PANAS-SF questionnaire consists of two subscales that measure positive (PA) and negative affect (NA), with different words that describe feelings and emotions; both emotions are evaluated independently (Larsen & McGraw, 2011; Larsen et al., 2001; Tang et al., 2020). A 5-point Likert scale was used for scoring, with one being 'very slightly or not at all' and five being 'extremely' (Watson et al., 1988). The construct reliability was assessed using Cronbach's Alpha. Based on our pre-intervention sample, the positive affect scale with five items ($\alpha = .873$) and the negative affect scale with five items ($\alpha = .788$) were found reliable. Similarly, the post-intervention results on each scale also reported strong reliability (PA: $\alpha = .897$; NA: $\alpha = .827$).

Qualitative measurements

Moreover, we collected instructors' reflective notes during facilitation, such as participants' feedback, KABAN's strengths and weaknesses, personal experience, and individual growth. Several general questions about facilitation skills, self-confidence, and stimulating innovative thinking were recorded on a 4-point Likert scale.

Data analysis

Quantitative data analysis

The quantitative data analysis of the current study included descriptive statistics and multivariate analysis of variance (MANOVA) analysis of dependent samples. Among them, descriptive statistics presented the age of the participants, mean, standard deviation of the variables, and a separate analysis of the accuracy rate for health literacy questions pretest and posttest. A dependent sample of MANOVA analysis examined the pre-and post-test differences of all variables, considering the potential influence of all variables simultaneously.

Qualitative data analysis

The qualitative data analysis of the current study used a constant comparison method to analyze how instructors perceive changes in participants' emotions, health literacy, and their quality of life.

Results

This section starts with an overview of the data distribution. The quantitative data for this study included 221 samples. Table 3 shows the correct rate of participants' answers to health literacy questions; Table 4 shows the descriptive statistics of the mean and standard deviation of the variables. Table 5 presents the results of the MANOVA analysis.

Descriptive statistics

To present the data distribution for the current study, descriptive statistics for all quantitative variables were measured. In the descriptive statistics section, the range, mean, and standard deviation of all measured variables are shown in Table 4. According to Table 4, the standard deviation of the pretest of health literacy and quality of life has a lower value than the posttest results. In contrast, the standard deviations of positive and negative emotions in the pre-test were higher than those in the post-test. Participants were offered six multiple-choice statements about health literacy, which targeted physical functional ability, nutritional knowledge, oral care skills, and cognitive abilities; the change in gained knowledge is statistically significant.

Pre-test and post-test comparisons of the dependent variable

In order to present whether the intervention of the protocol designed in the current study is effective, we tried to explain the pre and posttest differences via MANOVA results. As shown in Table 5, the results indicated significant effects on four dependent variables (Wilks' lambda = 0.66, $F = 22.74$, $p < .001$). Furthermore, the results of ANOVA clearly indicate that health literacy [$F(1, 220) = 55.04$, $p < .001$, $\eta^2 = 0.20$], positive emotion [$F(1, 220) = 10.27$, $p < .01$, $\eta^2 = 0.05$] and quality of life [$F(1, 220) = 25.98$, $p < .001$, $\eta^2 = 0.11$] have significant differences between pretest

Table 4. Descriptive statistics of quantitative measurements (N = 221).

Variables	Mean	SD	MIN	MAX
1. Age	71.07	7.14	55	106
2. Health literacy (Pre-test)	4.18	1.27	0	6
3. Positive emotion (Pre-test)	14.68	4.56	5	25
4. Negative emotion (Pre-test)	8.99	3.40	5	24
5. Quality of life (Pre-test)	78.82	15.13	0	100
6. Health literacy (Post-test)	4.78	1.17	1	6
7. Positive emotion (Post-test)	15.48	4.71	5	25
8. Negative emotion (Post-test)	8.77	3.60	5	24
9. Quality of life (Post-test)	83.47	12.39	30	100

Table 5. MANOVA and ANOVA results.

Wilks' Lambda (λ)/F	ANOVA (F)	Pre-test M (SD)/ Post-test M (SD)
0.66/22.74***	Health literacy	55.04***
	Positive emotions	10.27**
	Negative emotions	1.33
	Quality of life	25.98***
		4.18 (1.27) / 4.78 (1.17) 14.68 (4.56) / 15.48 (4.71) 8.99 (3.40) / 8.77 (3.60) 78.82(15.13) / 83.47 (12.39)

** $p < .01$, *** $p < .001$.

and post-test. Among them, the pre-test score ($M = 4.18$, $SD = 1.27$) of health literacy is significantly higher than the post-test score ($M = 4.78$, $SD = 1.17$), the pre-test score ($M = 14.68$, $SD = 4.56$) of positive emotion is significantly higher than the post-test score ($M = 15.48$, $SD = 4.71$), and the pre-test score ($M = 78.82$, $SD = 15.13$) of quality of life is higher than the post-test score ($M = 83.47$, $SD = 12.39$). Finally, negative emotions did not differ significantly between pre-test and post-test scores. Overall, most variables showed significant differences, which indicates a visible benefit of the intervention in the current research protocol.

Qualitative data analysis

The instructors shared their experiences and findings from paper surveys while leading the program. The survey content focused on constructive input of the program itself, how the participants changed throughout the intervention, and what could be improved afterward.

Positive aspects of KABANI!

The current program uses the context of mountain climbing to increase participants' willingness to engage in physical activity. Instructors reported that this motivates older adults to naturally learn about exercise, oral hygiene, and nutritional balance in a fun and stress-free situation; also seen as an advantage of game-based learning. At the same time, the participants were also excited and enjoyed the innovative design of the activities and layout of the intervention.

Older adults had fun with the current activity and said they truly experienced the joy of mountain climbing! (T)

The older adults said they haven't climbed a mountain for a long time. Today's activity reminded them of hiking when they were young, and they could see blue skies, white clouds, tall trees, and an endless field of vision. They were so happy! (S)

The design of the situation is in line with the feeling of hiking. The activities were immersive and packed with enjoyment and suitable exercise. (A)

It can be found from the above qualitative survey results that the gamified learning method assists the learning of older adults. Specifically, realistic situational design helps older adults use a practical and familiar experience as a starting point to enter the activities we designed. Such design starting point also allowed older adults to do physical activities more naturally. In conclusion, proper and trained guidance assisted older adults in improved participation throughout the program. The entertaining activities and encouragement promoted their learning of health literacy and positive emotions. In addition, the health-related knowledge they learned in the program helped them apply it in their daily lives. The instructor also pointed out the following statements:

For older adults, it is good to design the teaching aids as plates, which can especially reflect whether the diet at home is balanced. (V)

The current program can help older adults identify some food categories that are commonly misunderstood and learn about nutrition that can be shared at home! (A)

Difficulty in creativity tasks for older adults

In the current study, the performed static activities of the proposed intervention included writing and drawing. Although these activities are less physically demanding, they have relatively high demands on creativity and expression. However, creativity exercises were seemingly a burden or a challenge for some older adults who are unfamiliar with these tasks. Based on the collected response, some instructors provided following feedbacks:

The older adults were less interested in drawing, and politely refused by saying that they can't draw! (B)

When it came to the time to draw, the older adults began to appear shyer and more reserved, with a few older adults expressing difficulties. (C)

Most older adults say they can't draw. (H)

In terms of drawing, it seemed that because older adults have less experience with drawing, several participants were afraid to draw. (R)

Taken together, older adults may feel repulsed from activities that involve expressive creativity. Therefore, we believe that this may relate to the reasoning behind participants' negative emotions not being significantly reduced after the intervention.

Discussion

The main purpose of this study was to investigate the proposed health promotion intervention, KABAN!, and determine its effect on health literacy, positive emotions, and quality of life among older adults. KABAN! aimed to improve the health literacy of older participants via a holistic intervention. The empirical findings show that the proportion of health knowledge, positive emotions, and subjective quality of life significantly increased after the game-based intervention. The instructors' feedback was also constructively collected. Therefore, it is evident to claim that the proposed intervention, KABAN!, is an effective method on yielding older adults to live a healthful and positive later life.

KABAN! and its effectiveness

As mentioned in the literature review, game-based learning is proven to have plausible benefits in motivation and engagement via active learning (Cuevas-Lara et al., 2021). The proposed intervention successfully enhanced participants' health literacy knowledge, positive emotions, and quality of life. Compared to the pretest results, health literacy significantly improved after intervention, which is consistent with similar interventions in the past (Pardasani et al., 2018). From what is known, an increased older adults' health literacy will likely raise their awareness of maintaining physical health and the capability to make appropriate health decisions. Health literacy should be promoted regardless of their education level. An intervention like KABAN! can provide older adults a pathway to physical well-being regardless of their education level.

In addition, game-based health learning interventions like KABAN! provide more comprehensive benefits for the psychosocial aspects. As shown in the results, it has successfully raised positive emotions and subjective quality of life after the intervention. Previous findings in the literature also supported the idea that many learning activities have shown positive outcomes among older adults (Gilmour, 2012; Yamashita et al., 2018). This study provides additional support that through the experience of holistic health interventions, the older participants gain knowledge skills and mental positivity. On the other hand, negative emotions showed insignificant differences pre-and post-intervention, which opened the possibility of floor effect (where most participants reported lower negative affect from the beginning). The potential occurrence of floor effect in testing negative emotions has also been found in past literature (Langeslag & Surti, 2017; Shallcross et al., 2010);

thus, additional experimental testing is required to confirm this post hoc explanation. Positive learning experiences encourage subsequent learning, and continuing to learn is the key to maintaining health benefits (Moll et al., 2015). Consistent with previous literature on game-based learning (Koivisto & Malik, 2021), an innovative and cost-effective invention like KABAN! provides community-dwelling elders the motivation to attend, incentives to engage, and the persistence to develop healthy habits.

Instructors' feedback on KABAN!

The instructors' feedback reported that the intervention itself is motivating and engaging for the older participants. However, they pointed out that some responded with less enthusiasm during the creativity task. As Flood and Phillips (2007) pointed out, older adults are usually reluctant to engage in endeavors that demand creativity, such as drawing or painting. The experienced difficulty on creativity task corresponds to the concept that creativity is constructed as a productive process that forms value via innovation (Burns et al., 2015). While preliminary, this finding suggests that activities that involve creativity may need further training and fostering before being initiated. If creativity is not stimulated, the advantage of gamification learning may become a disadvantage.

In addition, it is crucial to recognize the critical roles of teachers and instructors in influencing learners' uptake, motivation, and adherence (Hawley-Hague et al., 2016), which contributed to the success of KABAN!. One of the unique factors of KABAN! was recruiting a group of trained instructors to facilitate the implementation. While the program itself was delivered in non-digital formats on-site, the communication and training process of the instructors occurred via transmedial modes. In addition, peer discussions between the intervention researchers and instructors promoted reciprocal learning among one another. The components mentioned above are critical to the success of KABAN!, and can be integrated into similar game-based learning interventions targeted toward older adults.

This paper has investigated the integration of gamification components and holistic health interventions aimed at older adults, which led to a positive promotion of knowledge skills, mental wellbeing (positive emotions), and subjective quality of life. Promoting health awareness and literacy via a boardgame-designed intervention like KABAN! creates accessibility for most older adults, regardless of where they're located or what equipment they have on hand. Constructive feedback and support from well-trained instructors also significantly contributed to the effectiveness and enjoyability of this intervention. As the aging population expands, additional gamification learning designs like KABAN! should be customized and catered to the older population and their specific needs (physically and mentally). Overall, the combination of results supports the conceptual premise that KABAN! is a competent and cost-effective game-based intervention, and this alternative strategy for promoting health literacy should be seen as a valuable addition to existing interventions.

Limitations and implications

While the proposed study successfully revealed its contribution to game-based learning for older adults, there were some limitations. This study was conducted in community centers; therefore, the targeted participants were mostly socially active seniors. Since this paper did not further examine the effect of KABAN! among older adults who are less socially involved, it may limit the findings from being generalized to the entire aging population in Taiwan. Though this investigation presented fruitful results, it was also limited by only including the Taiwanese population; hence it is unclear whether the proposed intervention can be as effective in other cultures. In addition, although the older population generally has fewer years of formal education than the younger generation (Duffin, 2020; Ministry of Education, 2018), the study participants demonstrated higher education attainment than the average, which may result in better results for the program. In the future, we would suggest recruiting a more diverse education attainment group for more understanding. Furthermore, the research did not employ a controlled experimental research methodology; instead of the actual effects

of gamification, the results of the proposed gamified intervention were examined as a whole (Koivisto & Hamari, 2019). Similar interventions applied in different cultural or environmental conditions would further clarify the findings through a controlled experiment method. In addition, collecting the instructors' feedback provided fruitful insights into the intervention and its effectiveness. A focus group discussion among the instructors may be applied in the future to gain an in-depth understanding of the implementation of game-based learning for older adults.

For future research, by broadening and deepening the health literacy knowledge, KABAN! could expand its curriculum into a progressive learning session that would take place for a longer duration. The natural degradation (cognitive and physical aging) of the older adults may affect the effectiveness of the intervention. On the other hand, reinforced gamification elements and knowledge learning through repetitive practices may potentially enhance the game-based learning experience. Future research could also explore the lasting period of KABAN! and how it will influence the participants' learning and behavior changes. With further modifications to fit local preferences, there are potential chances for KABAN! to be applied in other countries. For example, the food cards that deliver nutritional knowledge may need adjustments to fit locally preferred food. Due to older adults' high heterogeneity in health literacy knowledge, especially when taking rural and urban differences into account, another potential application of KABAN! could be an investigation of rigorous training on age-appropriate teaching strategies and facilitation techniques for potential instructors.

Conclusion

Health literacy is a critical topic in healthcare discussions and equipping all older adults with proficient health literacy skills remains an ongoing task for all nations. The present study was designed to enhance older adults' health literacy and knowledge through game-based learning. This study determined the effect of KABAN! through the older adults' and instructors' feedback, and strongly supported the idea that older adults' health literacy can be enhanced through effective gamification learning designs. The increase in positive emotions and subjective quality of life through KABAN! revealed that older adults are motivated and engaged in increasing their health literacy via a holistic game-based health intervention. This paper has also highlighted the significant role of instructors in the investigation's success, along with their constructive feedback on the intervention design itself. Interventions like KABAN! allow older adults to improve health knowledge and awareness while providing them the opportunity to engage socially, which will likely make a difference in the aging community. Adequate health literacy will positively affect the older population's potential to maintain a health-promoting lifestyle, and supportive health literacy interventions are capable of contributing to this endeavor.

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