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Game-based Technology for Elderly with Memory Disorder: Criteria and Guideline of Mobile Psychotherapy Games

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ABSTRACT

The advancement of technology in healthcare has promoted changes in traditional intervention or treatment of diseases. The utilization of technology via digital games has become one of the alternative interventions for memory disorder which can be considered as supplementary tool to traditional therapeutic methods compared to pharmacological treatments which are not only expensive but also associated with significant adverse effects. Using psychotherapy games as non-pharmacological interventions is more human-centred and have been considered as the best alternative. Although games have been widely used in many domains including entertainment, education and psychotherapy, criteria and guidelines of psychotherapy games particularly for memory-disorder are not clearly defined. This could consequently result in developing ineffective game-based therapy for patients. This article proposes a guideline and criteria that can help in designing and developing psychotherapy games to be utilized in treating memory disorder patients. Combination of systematic literature reviews and interview were employed to acquire the list of criteria needed for psychotherapy games. A total of 25 criteria are identified and have been classified into four main categories are proposed as a guideline. To evaluate the proposed guideline, a Neuro-therapy game is designed and developed using prototyping approach. A significant contribution of this study is the criteria and guidelines for psychotherapy game which will benefit game developers and practitioners who directly involved with psychotherapy programs with memory disorder patients. The proposed criteria and guidelines can be adapted to other psychotherapy domain, such as special needs education therapy, jobs screening, and occupational therapy. Furthermore, this could possibly improve the existing intervention practices by having more accurate measurement through game-based approach.

Keywords:
Digital game technology; elderly; memory disorder; psychotherapy game

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1. Introduction

Current treatment of memory disorder disease includes both pharmacological and non-pharmacological interventions. However, the pharmacological medications available are indeed costly but also highly correlated with severe adverse effects, whereas human-centered non-pharmacological approaches have bee*n considered the safest option [1,2]. Non-pharmacological interventions which is more person centered has been considered as the best choice with no drug's side effects.

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The advancement of technology in healthcare has promoted changes in traditional intervention or treatment of diseases. Among traditional interventions is rehabilitation by focusing on automation of repeating certain movements which require high motivation and acceptability. However, these models of treatment might be exhausting and could cause decreasing in motivation. Thus, electronic games have become one of the alternative interventions which can be considered as supplementary tool to traditional therapeutic methods [3]. A valid high-quality intervention that is not only easy for elderly to use effectively but also has the ability to impact their behaviours needed to help in age-related diseases [4].

Recently, multiple evidences have shown positive impacts in many aspects such as improving child's emotion and behavior [5] and also improving cognitive function towards memory disorder patients involving the game. In simulating the brain to function and re-store memories, psychotherapy by using games affect brain attention, memory, and rapid motor response. While game-based therapy is a promising cure for memory disorder disease, for those suffering from the disease, particularly in Malaysia, it is not yet systematically integrated into the treatment plan. In order to train and simulate their memory, current non-pharmacological therapy only involves training them for basic everyday tasks such as cooking and house chores.

Game-based intervention not only can help in motivating patients during therapies, improvements in physical, sensory and cognitive functions, diagnosis, personalized therapies and remote tracking are also considered [1,6]. In older people, for whom aging-related progressive degeneration in muscle strength and balance control system can lead to motor dysfunction, weakness and falls, they appear to strengthen certain physical health variables. Games also exercise various motor and cognitive skills, such as multidimensional changes, shifting of weight, focus, preparation, decision-making and concentrating [6]. From various previous studies, it has been confirmed that digital games can be used as an intervention for the older adult patients to get improvement from various illness such as memory loss which can be recovered gradually without much stress on the particular patients. Studies show that all types of games or motion-based application have been developed for older people. However, the games developed for memory loss diseases such as Dementia or Alzheimer are only a few.

Although games have been extensively implemented in many domains including entertainment, education and psychotherapy, criteria and guidelines of games for memory-disorder-psychotherapy game are not clearly defined. This could consequently result in developing ineffective game-based therapy for patients. Therefore, there is a need to have a well-defined criteria and guidelines for Memory-Disorder-Psychotherapy game to ensure suitable design of game to-wards offering a proper game-based therapy to be given to memory-disorder patients.

2. Elderly and Memory Disorder Issues

Human lifespan has grown to at least 60 or more and is predicted to hit 900 billion in the next 10 years [7]. Statistics indicate that approximately 62.3% of these elderly people live in Asian countries [8] and it is estimated that the major portion of them will be in their 80s or older. In recent years, the age composition of the population of Malaysia has significantly shifted, with the proportion of the senior citizens (age 60 years or over) and from 1970 to 2010, it had risen from 5.5 percent to 7.9 percent, although the population aged less than 20 years had declined in the same period by 18.3 percent. By 2040, the elderly population is estimated to hit 16.3 percent of the overall population [9].

In most older adults, memory loss is pervasive and also known as cognitive decline syndrome [10,11]. Many formal researches of cognitive dysfunction have been performed to show the presence

of age-related brain deterioration, such as memory control and ageing [12]. The reduction in cognitive ability that goes with ageing has great consequences on parts of the day, such as independent living, job performance, relaxing and navigation activities [13]. Tan and Azzam suggested that disabilities in older adults are indicated to be primarily preceded by cognitive disability [14].

The earliest affected region of clinical forms of cognitive impairment is memory and executive capacity [15]. Older adults are starting to undergo major changes, such as extreme memory loss, poor response and motion, and are vulnerable to more injuries [16]. In this 21st century, memory disorder-related dis-orders have grown to become the tremendous health concern of the world [16] as the number of cases doubled every 5 years and were assumed to rise continuously. Nearly 35 million individuals faced the issue of cognitive disability in 2010, with Asian countries leading to a significant proportion of dementia patients with almost 9 million new detections each year [15,17]. Standard ageing explicitly led to the development of causes of memory problems by interacting aetiologies that increasingly affect the brain [17].

Elderly persons have the most frequent neurological impairments, particularly dementia and Alzheimer's disease (AD). Alzheimer's Disease (AD) is a neuro-degenerative disorder that causes a loss of connections between neurons mainly due to early deterioration of cerebral circuitry in the form of the most common situation of dementia that affects the older [18,19]. According to Jeon *et al*., [20], AD and dementia is ultimately fatal and is an increasingly significant health problem affecting older adults across the globe. Memory disorder-related disorders have broadly different effects between the individual, increasingly persistent and neuro-degenerative brain that can destroy the mental capacity to recall, such as difficulties contributing to cognitive functional disability [12,20]. For starters, patients will experience difficulties with their everyday lives and routine having difficulty saying what is in their heads, challenging to solve a basic problem and quickly lose disposition rather than the most common symptom of memory loss [17]. When they need to take their prescription, they can forget or recall the list of grocers to do so [21]. This progressive deterioration in memory and neuro-cognitive degenerative contributes to subsequent degradation in social and working memory [22], as well as a rise in health-related costs and a reduction in overall well-being and quality of life whereby leads to risen of death rates [23].

The World Health Organisation has made an urgent appeal to include these diseases in each country's public health agenda because of the significant consequences of the present and potential global number of cases of AD and dementia, with the goal of enhancing (early diagnosis and ensuring improved treatment and support for patients, their families and caregivers [24]. The United Nations and Alzheimer's Disease International are calling for all 10 countries to introduce national dementia plans to I increase public awareness of the disease and minimize stigma, (ii) enhance early diagnosis, and (iii) provide caregivers with improved treatment and assistance. However, it is a crucial concern to find ways to postpone or avoid the clinical progression of dementia, when disease-modifying medication is inadequate and populations are increasingly ageing.

3. Digital Game Technology and Elderly

Innovative combinations of technology and psychological therapy are found in technology-based therapies [25]. To enhance patients' quality of life, non-pharmaceutical therapies are regularly studied and updated; they include programmes to strengthen communication skills, decrease anxiety and stress, and use new technologies [26]. For example, cognitive intervention that is based on technology is provided to senior patients who have suffered brain injury can be beneficial to improve their cognitive qualities [27].

The connection between elderly and the application was enhanced via the use of certain strategies that were utilised during the development of the digital games [28]. Cognitive games seem to be an excellent method for improving older individuals' response time, processing speed, executive function, and global cognition. In reality, there is substantial evidence that older individuals who engage in cognitive training enhance their overall cognitive performance, namely in the areas of executive functions and short-term memory [29].

In a study conducted by Zhunio *et al*., [28], it is found out that elderly people perceived the use of digital game technology as psychotherapy and intended to use it in future by using Technology Acceptance Model (TAM) evaluation. The use of computers, the Internet, and other technological gadgets is on the rise among the senior population. As a consequence of this, mobile gadgets are increasingly becoming objects of personal property for them. Therefore, it is important to include games that may aid in healthcare and cognitive reflexes onto mobile devices that are acceptable for them [30].

Mobile devices offer an exciting new frontier for the development of games for elderly. One of the greatest input technologies, the touchscreens are widely accessible and affordable these days [31]. In comparison to many other ideas, this technology paves the path for games with more natural interactions and less physical activity [32]. In a digital era when technology is essential to accommodate the demands and uniqueness of this demographic group, it is crucial to develop cognitive intervention systems especially digital games [33].

Serious games are one of the many established, engaging, and accepted methods for examining the impacts of motor-cognitive performance, the transfer of training benefits to untrained activities, and the durability of training gains in individuals with dementia and those who care for them [26]. Majority of studies used serious games in their researches [34–38], while the some others utilised cognitive exercises [39–42]. Due of its contribution to user motivation, the ubiquity of the serious game genre is in line with previous findings that support it as an increasingly popular option for the treatment of cognitive impairment [33].

However, commercially available digital games seldom take into account the needs of older players [31,43]. Thus, there is a need to explore the possibility of using certain methods and measures to assess new digital games, with the goal of enhancing their playability and user experience for older individuals, and proposes a guide with crucial suggestions for inclusion in future game development.

4. Games and Treatments for Memory Disorder

Two current approaches in treating elderly who are suffering with memory disorder are by using pharmacological treatment and non-pharmacological treatment. In most hospitals, pharmacological therapy has been used and medicines (drugs) are administered by physicians to help delay degenerative tissue in the brain for people with memory loss. However, the medication does not appear to function in the very first steps of the disorder, either as a single therapy or combined with anticholinesterase. It seems like its usefulness at the last stage of disability is also minimal [44]. In addition, extreme overdose could lead to a lack of consciousness [45]. Recently, some companies have had to abandon anti-amyloidal drugs due to failures in efficacy and issues with toxicity [46]. Pharmacological treatments are also expensive [1]. Therefore, the non-pharmacological approach requiring psychotherapy with less downside and safer than the prescription treatment is another alternative for curing memory loss disease.

Non-pharmacological therapy is a non-drug procedure that typically takes place in the medical facility and clinics to cure the intended conditions through rehabilitations and therapies [27]. Cognitive therapy applies, according to Sohlberg *et al*., [47], to the therapeutic method of

accelerating or upgrading the capacity of associate individuals to system and use incoming information, thereby allowing exaggerated processing to occur. Many typical non-pharmacological approaches rely on the repetition of such gestures that involve elevated acceptance and inspiration. Nevertheless, conventional measures are expensive in terms of travel fees to recovery facilities, contributing to exhaustion and decreasing the desire to continue treatment [3,48]. Instead of only augmented reality, the use of gaming has a great therapeutic influence on the experience when doing recovery workouts. The high association of success with pre-treatment memory shows that learning and memory using games are more important as an early level of intervention [49]. Game approaches have been shown to have fair advantages in enhancing attention to care and usability in health sectors [50].

Games are a promising invention that can steadily decrease cognitive deterioration for example, the serious game by utilizing virtual reality purposed for assessing cognitive level in aging. Cognitive stimulus and appraisal games are recommended here to be ambient and constantly accessible in the environment [51]. The versatility of personal deployment, the broader range of advantages, and the importance of relaxation mean that game-based care is one of the most successful choices to provide people with memory disorder-related diseases with non-pharmacological therapy [2]. Games have been recorded for healthier and older adults with MCI, according to Wallace *et al*., [52], and the use of computer-based games/therapies currently supports healthy older adults with a clinical aim of retaining or enhancing cognitive capacity.

A new area of study is the use of games as a cognitive testing or rehabilitation method for dementia patients. Increasing research indicates that active involvement in intellectual practices such as reading books and playing games may help minimize the risk of dementia among older adults, likely through boosting cognitive reserve and increasing resistance to stress [10]. Lee and colleagues found that late-life participation in intellectual activities (eg reading books, newspapers, or magazines; playing board games, Mahjong, or card games; and betting on horse racing) was associated with lower risk of incident dementia several years later. Recreational systems are also generally designed to house a small number of applications which are thoughtfully developed such as playing music as well as functional assistance such as reminders for people with dementia[53].

5. Methodology

Due to its suitability, Design Science Research methodology have been adapted in conducting this study [54]. Four main phases have been carried out involving problem awareness and solution planning, the identification of the criteria, a formulation of the guideline, and evaluation as illustrated in Figure 1.

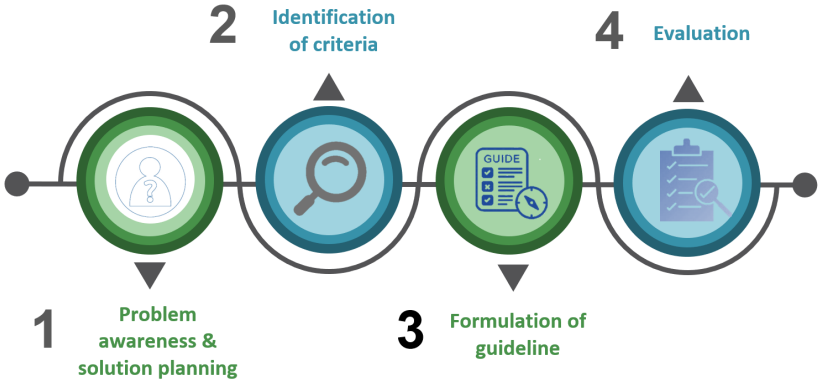


Fig. 1. Four main phases of methodology

5.1 Problem Awareness and Solution Planning

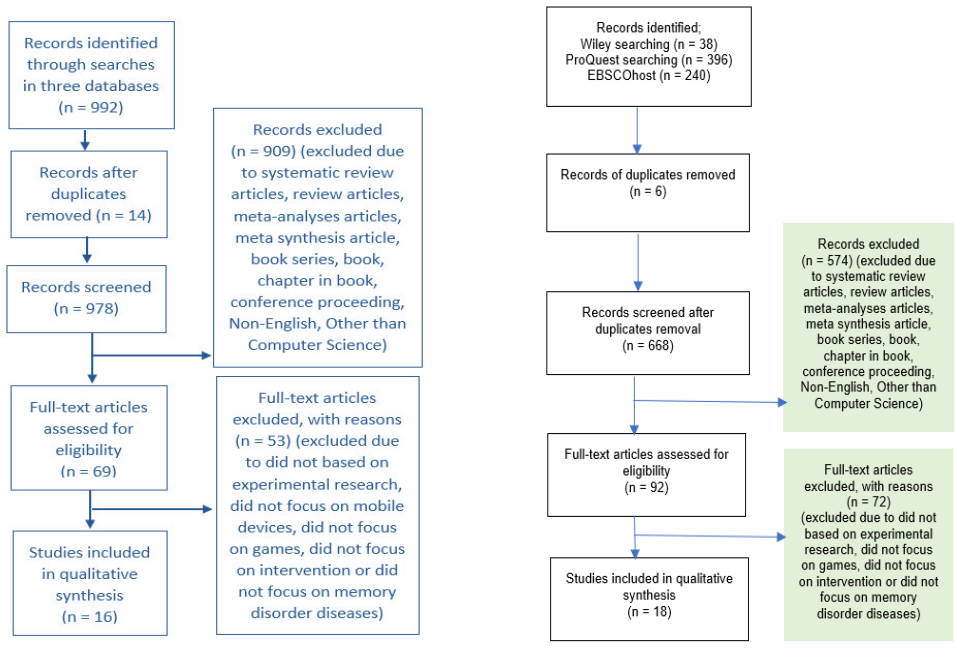
This phase focuses on creating the awareness of the problems and gaps by thoroughly analyzing the previous existing researches that have been conducted on games and applications particularly for elderly. The motivation and effectiveness of elderly

playing games are also studied. Reviews also emphasized on different types of games that can help to improve health of elderly with various kind of illness. It is discovered that there are Exergame, Cognitive training game and serious game were used for treatment and rehabilitation of elderly patients.

Consequently, literatures on guidelines for the development of games that specifically suit elderly with various experience and health conditions were also studied. It is revealed that not much studies have been conducted to produce a proper guideline for designing application and games specifically for the elderly. Deliverables of this phase are the gaps and plan of solutions for this study.

5.2 Identification of Game's Criteria

This phase focused on the acquisition of game criteria for designing and developing psychotherapy games particularly for memory disorder. Three sets of criteria have been acquired through systematic literature reviews (SLR) and series of interview involving 40 elderlies in Changlun, located at the Northern part of Kedah, Peninsular Malaysia. For SLR, two rounds of reviews have been conducted by adapting Preferred Reporting Items Systematic Reviews and Meta-Analysis (PRISMA) approach. Two basic operations performed are the selection of the eligible articles to be reviewed, followed by extraction and analysis of the selected articles. Detail processes involved in the searching are shown in Figure 2.



(a) (b)

Fig. 2. Adapted PRISMA approach performed in SLRs

The first set of the criteria is acquired from a systematic literature review involving three main databases; Scopus, Web of Science and ACM Digital Library. The search has identified 992 articles altogether with 69 papers remain for further selection process, while 909 were excluded due to irrelevancy of the focus [31]. However, only 16 articles are eligible to be included in the review as depicted in Figure 2(a).

Second set of the criteria is acquired from another round of SLR involving three other main databases; Wiley, ProQuest, and EBSCOhost. The search has identified 38, 396, and 240 relevant articles from the databases respectively. However, only 18 articles are purely relevant to be included in this study as depicted in Figure 2 (b). Through two rounds of SLR involving six main databases, 17 and 12 criteria have been identified as listed in Table 1 and Table 2 respectively.

The third set of the criteria has been acquired through face-to-face interview with a group of elderly with the aged of 60 years old and above. Through inter-view, six criteria have been identified as listed in Table 3. These three sets of criteria have been thoroughly analyzed, compared, and classified to formulate a guideline as discussed in the next phase.

Table 1
First set of the criteria identified from SLR

	Criteria	Source		Criteria	Source
1	Simple interface	[34], [55], [56], [48], [57]	2	Easy gameplay	[55], [58], [57], [59], [56]
3	Tap gesture	[34]	4	Help element	[60], [56]
5	Feedback	[34], [48], [61], [62]	6	Incentives rewards	[63], [62]
7	Reminiscence elements	[60], [56], [64], [65], [39]	8	Motivational elements	[34], [55], [66], [61], [57]
9	Avoid complexity & Avoid competition	[34], [55], [60]	10	Simulation-based gameplay	[63], [62], [65]
11	Familiar language	[34], [60], [63]	12	Platform: Touch-based device	[34], [55], [67], [39]
13	Social interaction in game	[63], [62], [65], [66], [64], [56]	14	Gameplay: different challenge level	[60], [63], [62], [65], [64], [56], [61]
15	Interesting gameplay (creates curiosity)	[34], [63], [65], [66], [64], [57], [59], [61]	16	Attractive interface	[67], [48]
17	Ecological element	[57], [48]			

Table 2
Second set of the criteria identified from second round of SLR

	Criteria	Source		Criteria	Source
1	Device: portable	[68]	7	Prior skill	[69], [68]
2	Device: large display	[70]	8	Help	[71]
3	Simple graphic	[69]	9	Clear instructions	[72]
4	Practice mode	[73], [68]	10	complexity increases gradually	[74,75]
5	Familiar scenarios	[76], [69], [75], [77]	11	Puzzle-solving type	[75], [78], [68]
6	Cognitive skill training type	[77], [68], [76]	12	Feedback: auditory visual	[71], [68], [69]

Table 3
Third set of the criteria identified from interview

Criteria		Description	Criteria		Description
1	**Device**: Smart phone is not recommended	Mobile devices with small display are not recommended.	4	**Interface:** Bright colour	The interface design of the game should be bright in colour so the elderly can easily see it
2	**Genre:** Puzzle-solving type	There should be more of puzzle type game (which will make them think and use their brain a lot)	5	**Gameplay:** Single player	The games to be in single player instead of multi-players. This is to not give them too much pressure on discourage them.
3	**Interface:** Large font size: 36	A game with large font size such as 36 is very suitable for elderly - they will be able to see written instructions, feedbacks and tutorials clearly.	6	**Gameplay:** Religion-related	Since most elderly people are more religious-oriented. It is preferable to develop a game that has an element of their religion which help stimulate their brain memories.

5.3 Formulation of Game's Criteria and Guideline

This phase is the core process of the study which emphasizes on formulating a guideline for designing and developing psychotherapy game based on the three sets of the criteria that have been identified in the previous phase. To formulate the guideline, all criteria from the three sets have been thoroughly analyzed. Duplicates of the criteria which exist in the three sets have been removed by remaining only unique criteria. The remaining criteria are then compared and categorized into four main categories; device, interface, game features, and gameplay. Processes involved in formulating the guideline are illustrated in Figure 3.

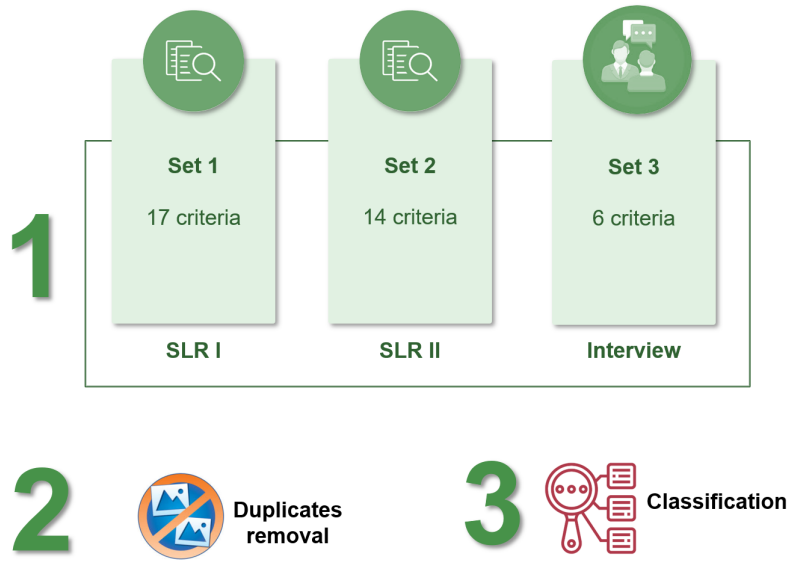


Fig. 3. Processes in formulating game guideline

For second process, it involved the removal of duplicates of the criteria by analyzing similarities exist in the three sets. Removal also involved for cases when some criteria are using different words but are referring to the same criteria. The third step is classification, where all criteria are mapped

into four main categories; device and platform, interface, game feature, and gameplay. The outcome of these processes is covered in Section Six.

5.4 Evaluation

To ensure that the proposed guideline and the criteria are correctly formulated and suit the target users, prototyping and user experience test have been conducted for evaluation purpose. For the first evaluation method, a psychotherapy game, named as Neuro-therapy has been designed and developed on Android platform [79,80]. Basic design of psychotherapy game is illustrated in Figure 4.

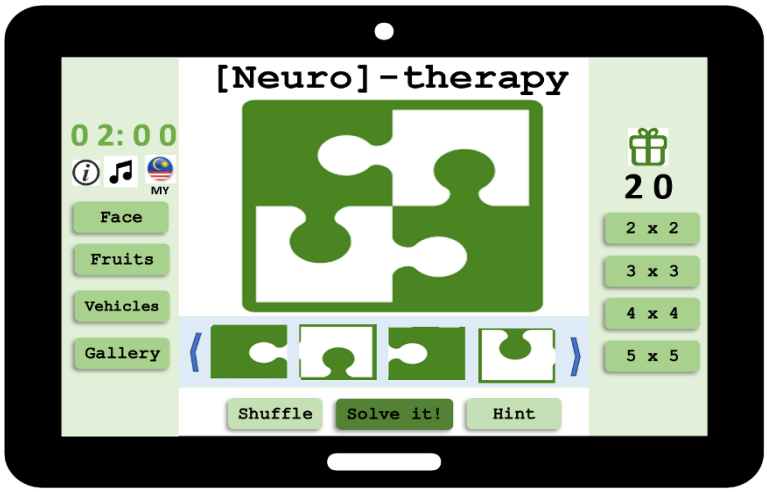


Fig. 4. Basic design of psychotherapy game

All proposed criteria in the guideline have been translated into the design of the proposed game. As a start, four categories of puzzle are included which we believed are close and familiar to elderly; face, fruits, vehicles, and gallery. For gallery, elderly can generate puzzle pieces based on the image stored in the de-vice's gallery. The idea is to allow them to capture any new image or the sur-rounding or family members, store it in the gallery and generate the puzzle pieces. The game will be available in two languages which are English and Malay. Players can switch to these two languages using a single click of the provided button.

While for difficulty of the game, four levels are provided referring to the number of puzzle pieces; 2x2 (4 pieces), 3x3 (9 pieces), 4x4 (16 pieces), and 5x5 (25 pieces). Default size of 2x2 will be displayed once the game is loaded referring to the easiest level of the game. Players will need to drag the puzzle pieces to its puzzle space. Wrong puzzle will be automatically dragged back to the *belt* area storing puzzle pieces. Rewards will be given in bonus point when the puzzle is successfully assembled. This bonus point can be used to buy hints in solving puzzles in the higher levels.

When players stuck with the game, assistance is given through solve it and hint buttons. Hitting solve it button will help the game to assemble the puzzle, while hitting the hint button will open one puzzle to the players, but one point will be deducted. Shuffle button is also provided to allow players to reshuffle the puzzle back if they lost track of focus while playing the game. These features are suggested in assisting the elderly with the game. This basic design of the game is translated into a working game, namely as Neuro-therapy game. Selected interfaces of the game are illustrated in Figure 5.

Fig. 5. Selected interfaces of Neuro-therapy game

The interfaces of Neuro-therapy game show example of puzzle for face and vehicle category for 3x3 and 5x5 puzzle sizes. For each category, number of free royalty images are included and will be generated randomly. Timer is included at the top-left corner of the game to record time taken to solve the puzzle. For this version, two Malay songs are included in the game; *Ulek Mayang* and *Jangan-Tunggu Lama-Lama* composed by using Sonic Pi software.

The game has undergone its functionality and acceptance tests involving 55 respondents among elderly. The game has also been used in series of psychotherapy experiments at *Rumah Seri Kenangan Bedong*, Kedah involving participants who show symptoms of memory disorder. User experience test of the game has focus on seven dimensions; ease of use, usefulness, memorability, satisfaction, enjoyability, accuracy, and overall conclusion of the game. Table 4 depicts the number of measurement items for each dimension and its mean score.

High mean score for all measurement dimensions (>4.0 of total score of 5) shows that users agreed that the game meets their expectation. Hence explained their acceptance of the proposed guideline as well.

6. The Proposed Criteria and Discussions

A finalized set of 25 criteria are proposed as a guideline for psychotherapy game specifically in treating elderly with memory disorder issues. The proposed guideline comprises of for main categories which emphasizing on five criteria to be considered in choosing a device and platform for psychotherapy game, six criteria for designing the interface of the game, six criteria to design the

game features, and eight criteria for the gameplay. The proposed guideline with four categories (and its criteria) are illustrated in Figure 6 while its descriptions are detailed out in Table 4.

Table 4
Dimensions of user experience test

	Dimensions	Measurement items	Mean score
1	Ease of use	▪ The game is simple to use ▪ Easy to Read characters in screen ▪ Easy to follow activities in the game ▪ Able to easy understand instructions	4.50
2	Usefulness	▪ Illustrations are helpful ▪ Help messages are helpful ▪ The game is useful	4.53
3	Memorability	▪ The game activities are predictable ▪ Easy to recognize pictures ▪ levels of the puzzle are relevant ▪ Remember previous memories during game	4.50
4	Satisfaction	▪ Game's setting/ design is attractive ▪ Game's look is likeable ▪ Satisfied with the diversity of task ▪ Game provides feedback & reinforcement	4.34
5	Enjoyability	▪ Content of the game is engaging ▪ Use the game willingly anytime ▪ Fun to use the game	4.45
6	Accuracy	▪ Use of terms is consistent ▪ Game speed is fast ▪ Rewards match the task given ▪ Sufficient time to correct the puzzle pieces ▪ Lost due to lack of concentration	4.22
7	Overall conclusion	▪ Content of the game is flexible to use ▪ Flow of performing tasks is satisfying ▪ Gameplay is easy and user friendly ▪ It is wonderful using the game	4.32

Portable tablet with tab gesture and large screen is proposed as the best device for psychotherapy game specifically for elderly. Researchers claimed that tablet is the easy platform for elderly with large screen compared to other digital devices [34,39,55,67]. Although [81] have suggested design for mobile phone application which is elderly friendly, findings from our interview show that smartphones are not recommended as a device for psychotherapy game.

Interactive and attractive interface plays an important role in accommodating elderly to interact and play the game. To ensure good interactions between elderly and the game, six elements of interface are suggested. Simple interface with bright and contrast colour are recommended considering their vision conditions [34,48,55–57,59,82]. For example, black and white or green and white. Input from interview suggested font size of 36 to be used in the game. Detail descriptions of the criteria are depicted in Table 5.

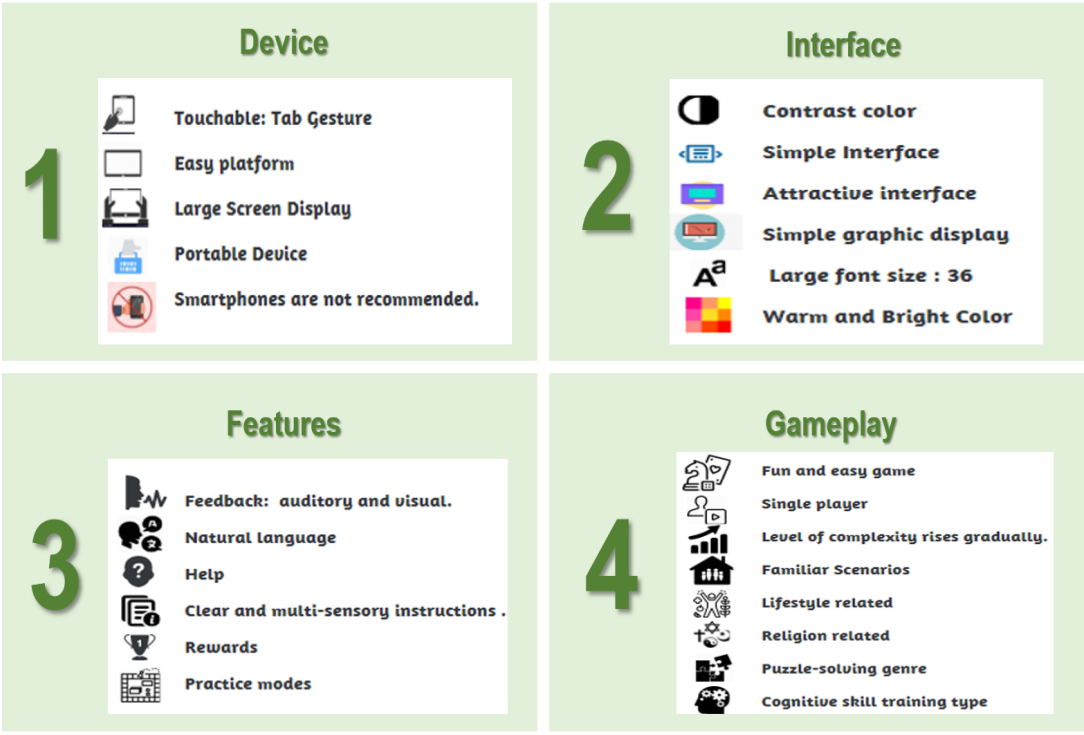


Fig. 6. The Proposed Guideline

Table 5
The proposed criteria

Criteria	Description	Source
1. Device		
Tab gesture: touchable	Tap gesture which is touchable with fingertip allow easy interaction between user and games	[34]
Easy platform	▪ Easy platform such as tablet is portable allow user to use for repeating activities. ▪ Tablets are easy to use and engaging. ▪ Tablet allows both hands to interact directly with the display with touch interaction.	[34,55,83], [84]
Large display	Large display or screen size such as tablets fits elderly people's visual abilities.	[70]
Smart phone is not recommended	Smartphone and other mobile devices with small display are not recommended.	Interview
Portable	▪ Portable devices can be easily carried around without any inconvenience. ▪ Portable devices are lightweight, portable, and easy to sanitize after each use.	[68], [67]
2. Interface		
Contrast colour	Use contrast colours to distinct them and correctly discerning a figure and the background (using different colours for objects and improve the object outline thickness using shader)	[48]
Simple	Avoid complex interface that will cause confusion and distraction from focusing on the tasks	Interview

Large font size: 36	Large font size such as 36 is very suitable for elderly patients. This is because they will be able to see written instructions, feedbacks and tutorials clearly.	Interview
Attractive	Use suitable luminosity to attract players to the game	[48]
Simple graphic & display	Graphic display should be simple but colourful enough to attract them.	[69]
Warm & bright colour	Dark and pastels colours should be avoided (difficult to be distinguished by elderly) red, orange and yellow are best seen by elderly to get their attention and ensure a good visibility.	[48], Interview
3. Gameplay		
Fun	Old gamers play games to relax and have fun and value choice, enjoyment and meaningful	[66]
Easy	Elderly prefers easy gameplay due to their limited understanding and executive memory, but it must be challenging enough not to feel bored after a particular time.	[85]
Single player	It is preferable for the games to be in single player instead of multi-players (not to give them too much pressure on discourage them)	Interview
Lifestyle-related	Elements of simulation of everyday life in the games help elderly to remember their life especially those with limited physical movements and motor skills.	[65]
Religion-related	Since most elderly people are more religious-oriented, it is preferable to develop a game that has an element of their religion which help stimulate their brain memories.	Interview
Genre: Puzzle-solving type	A game for memory disorder patients should include puzzle solving task that can help improve concentration and also reduce the symptoms of their disease.	[75], [68,78]
Genre: Cognitive skill training type	Various tasks and missions in the game should be designed, whereby it corresponds in training of several different types of cognitive skills	[68,77], [76]
Reminiscence: Familiar scenarios	A game for elderly memory disorder patients should include familiar scenarios as a form of gameplay whereby users can carry out various task and interactions with the element of the scenario. Familiar scenario and autobiographical activities like watching and sharing experiences of old photos, exploring punctum photographs allows an emotional connection and engagement to be formed with the user.	[69,76], [75], [77], [39]
Level of complexity increases gradually	Difficulty or difficulty choices should be expanded progressively and not at a high pace with the option of gaming in recovery games for patients with memory deficiency. This is to avoid discouraging users from using the game, which will ultimately help them develop their abilities and conditions.	[74,75]
Ecological	Effective use of ecological allows at least a significant reduction (maybe elimination) of the learning time leads to greater enthusiasm and can improve engagement of the players in the game.	[48]
4. Features		
Feedback: auditory visual	auditory feedback section to advise users on what to do whenever they have problems or got stuck	[68,71], [69]
Natural language	Games or elderly should be in language that users familiar. It will indirectly motivate the user to continue engage with the game	[63]
Practice mode	The game for elderly patients should provide a form of practice modes to help them familiarize with the game setting	[73], [68]
Help	Help should be prompted consistently when user experience difficulties (when user take too much time to move the next step) to keep them in the game.	[71], [48]
Rewards	Provide rewards to encourage players to play the games repeatedly	[62]

7. Conclusion

A set of criteria and a design guideline for psychotherapy games have been successfully formulated and evaluated. A significant contribution of this study is the criteria and guidelines for psychotherapy game which will benefit game developers, practitioners, and educationist who directly involved with psychotherapy programs with memory disorder patients. This study also proposed Neuro-therapy, an appropriate design of digital game that follow gamification concept, friendly to target audience, and elderly acceptance.

The proposed criteria and guidelines can be adapted to other psychotherapy domain, such as special needs education therapy, jobs screening, and occupational therapy. Furthermore, this could possibly improve the existing intervention practices by having more accurate measurement through game-based approach. The outcome of this study could contribute in improving the quality of life among memory disorder patients. Future works might consider different type of evaluation involving psychotherapy experiments using intelligent manners.

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