

Difficulty Leveling for Yoga Asanas Applicable to Level-based Digital Games SuiTabfor Elders

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Abstract. Moderate leisure exercise benefits the health of elders. A previous study by the author found that elders nowadays prefer indoor exercises such as yoga and are willing to play digital games, thus yoga games will be a feasible new way to exercise in the future. Yoga exercise design for elders should involve the consideration of their physical conditions; furthermore, a previous study suggested that level-based games were the recommended digital game design for elders. Therefore, in order to establish the design principles of level-based yoga games suiTabfor elders, this study conducted a literature review and a movement analysis for a deep understanding of the physical conditions of elders and yoga exercise. Ten yoga asanas (postures) suiTabfor elders were selected and their physical benefits were analyzed. With elders' limited strength and balance taken into account, a four-level game that helps elders to perform progressive yoga exercise was finally created. The four-level game design shall be applicable in the future to foster elders' willingness to exercise within a safe range.

Keywords: elders, digital games, Yoga

1. Introduction

Aging is an inevitable natural process. Health promotion and compression of morbidity for elders during their aging process have become the common goal and trend around the world [1]. Elders are normally faced with the challenge of chronic diseases and disabilities. Simons & Andel (2006) proposed that exercise intervention helps to improve the functional fitness of elders and their activities of daily living [2]. It has been medically and clinically proven recently that regular fitness exercise and good life habits prevent people from the threat of premature death, diseases and disabilities [3]. More evidence was provided by many studies that adequate leisure exercise can enhance physical and mental health of elders [4,5]. Thus the introduction of leisure exercise into the daily lives of elders can achieve a healthy aging and slow down the aging process.

The introduction of leisure exercise into the daily lives of elders required consideration of its acceptance and applicability. Chang & Chen (2012) indicated that today elders prefer indoor activities such as Yoga, Tai-Chi, and working out at the gym [6]. Yoga was considered as a leisure exercise that improves the health of elders in previous studies [4, 7, 8, 9], and confirmed to be an effective aid in physical and mental treatment for elders [10]. Therefore the introduction of easy yoga exercise into the daily lives of elders will improve their health and quality of life.

“Having no time for exercise” and “not knowing how to exercise” are the main reasons why elders lack exercise [11]. Since elders tend to have a slower response and motion speed due to the declines in their physical and mental functions, it takes more time for them to learn new things; the lack of prior knowledge may also cause their low confidence. Lan (2009) mentioned that a greater emphasis on basic exercise and the use of step-by-step “spiral curriculum” can increase the effectiveness of learning by allowing elders to practice exercises repeatedly from the easy ones and progress to the difficult ones [12].

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With the arrival of the digital age, a new wave of digital exercise game has arisen. Elders prefer playing digital exercise games to interacting with nature [6]; meanwhile digital somatosensory games are helpful to the health of elders [13, 14, 15, 16]. Among many other learning channels for leisure exercise, digital games greatly increased the elders' willingness to participate. Since level-based digital games are suitable for elders [17], the introduction of creative, level-based yoga digital games into the daily lives of elders will help them to develop regular exercise habits and lead a healthy life. For the above reasons, this study was conducted with the following purposes:

- To understand the physical conditions of elders and the yoga exercises applicable to them;
- To set up difficulty levels for yoga exercises suitable for elders

2. Yoga exercise for elders

2.1. Elders' need for yoga exercise

While elders suffer from the diseases they have their physical functions such as muscular endurance, joint range of motion, mobility and balance decline during the aging process; these factors can influence their performance in activities of daily living [18]. Shih & Hsu (2005) also found that the joint range of motion and balance of elders decrease with age [19]. Yoga exercises such as stretching exercise, breathing exercise, muscle relaxation and meditation can increase the oxygen supply to the brain and body tissues and further improve brain function. By triggering the release of endorphin and dopamine, yoga exercises can also help to relieve pain, reduce stress and increase happiness, and thus produce relaxation to boost mental health [20, 21]. In short, the physical, mental and spiritual benefits of yoga exercises include: (1) reducing anxiety and depression [22]; (2) improving the quality of life [23, 22]; (3) increasing concentration and energy [21]; (4) enhancing strength; (5) enhancing flexibility; and (6) balancing the endocrine system [21].

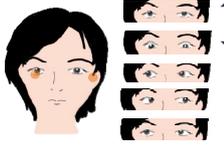
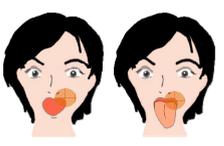
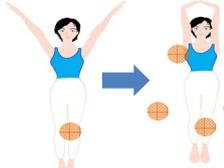
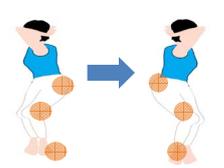
2.2. Yoga exercise suitable for elders

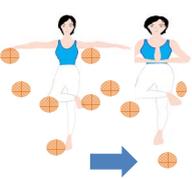
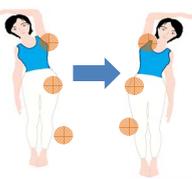
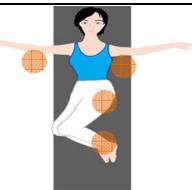
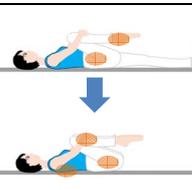
In aspects of preventive medicine and rehabilitation, sports injuries and secondary injuries when performing yoga exercises should be avoided to preserve the biologically positive values they bring to human body [24]. According to a previous study by Chen et al. (2010), a therapist set the limitations of the rehabilitation exercise basing on the physical conditions of the rehabilitant [25]. On the premise that exercise safety for elders was assured, Lu & Tsai (2011) cautiously selected ten easy and safe yoga asanas that can help to activate body functions [11]. These asanas were used in this study as the postures in a digital yoga game suitable for elders. The illustrations of the ten asanas and their physical benefits were shown in Tab1.

3. Difficulty leveling of asanas in yoga games suitable for elders

The body parts used to perform the asanas shown in Tab1 included face, upper limbs, torso, and lower limbs; meanwhile the physical benefits of asanas were improvements in strength, muscle flexibility, joint flexibility, and balance. The physical benefits of the ten yoga asanas and the body parts used were organized into Tab2.

Tab. 1 The illustrations of the ten asanas and their physical benefits

1. Eye movement	Physical Benefits	2. Lion roar	Physical Benefits
	<ul style="list-style-type: none"> ● Strengthening the flexibility and agility of the eyeballs and the subtle muscles around the eyes. ● Straining and relaxing the muscles around the eyes help to eliminate eye fatigue [11, 26, 27]. 		<ul style="list-style-type: none"> ● Increasing jaw flexibility and the strength of cheek and neck muscles; slowing down the loosening of facial skin; and improving chewing ability. ● Enhancing the strength of tongue base [28, 11].
3. Upward arm stretch and heel raise	Physical Benefits	4. Bent knee torso rotation	Physical Benefits
	<ul style="list-style-type: none"> ● Arm stretch can improve the strength of shoulders, stretch intercostal muscles, relax the diaphragm, and spread the spine and upper back muscles. ● Heel raise builds up the strength of lower limbs and balance, and helps to stretch the shoulders and muscles between the ribs as well [29,11]. 		<ul style="list-style-type: none"> ● Improving the strength of upper limbs, shoulder blades, hips and lower limbs. Extending the core muscles in the torso can increase its flexibility and resistance to external impact [3, 11].

5. Tree pose 	Physical Benefits <ul style="list-style-type: none"> ● Increasing the flexibility of the shoulder joints, the strength of the limbs, and balance when standing on one foot. Maintaining the body on the middle line can improve the abdominal and back strength [28,11]. 	6. Lateral bending 	Physical Benefits <ul style="list-style-type: none"> ● Stretching the lateral muscles helps to improve the flexibility of joints and muscles in the lateral torso and the lateral pelvic wall, the stability of the waist, and the ability to twist the waist and legs. Reducing decreasing the tension and pain caused by sedentary work in the lateral chest wall, waist and lateral pelvic wall [3, 11].
7. Right angle pose 	Physical Benefits <ul style="list-style-type: none"> ● Stretching the muscles in the proximal end of upper limbs, back, hips and posterior knees can promote the overall flexibility of back muscles. ● Building up the back strength and spine mobility to prevent or relieve back pain and stiffness in the torso [11]. 	8. Upward-facing dog 	Physical Benefits <ul style="list-style-type: none"> ● Stretching the abdominal muscles, enhancing the flexibility of front torso and the strength of upper limbs [11].
9. Belly twist 	Physical Benefits <ul style="list-style-type: none"> ● Stretching the lateral, lower back, and shoulder blade muscles can improve the flexibility of lateral torso. ● Increasing the strength and flexibility of abdominal muscles; promoting the motility of abdominal digestive organs, which can in turn boost digestion in the stomach and intestines and reduce constipation [11]. 	10. Bellows posture 	Physical Benefits <ul style="list-style-type: none"> ● Improving the flexibilities of the muscles in the anterior knees, lower back and posterior thigh; increasing thigh strength. ● Relieving lower back pain; increasing hip flexibility; reducing stomach bloating and poor gastrointestinal motility [11].

Tab. 2 The physical benefits of the ten yoga asanas

Position	Body Part Asana name	Face			Upper limbs			Torso			Lower limbs			
		Strength	Muscle flexibility	Joint flexibility	Strength	Muscle flexibility	Joint flexibility	Strength	Muscle flexibility	Joint flexibility	Strength	Muscle flexibility	Joint flexibility	Balance
Standing	Eye movement	v	v											
	Lion roar	v	v	v										
	Upward arm stretch and heel raise				v				v		v			v
	Bent knee torso rotation				v				v	v		v		
	Tree pose				v		v	v	v		v		v	v
	Lateral bending					v		v	v	v				
	Right angle pose					v		v	v	v		v		
Lying	Upward-facing dog				v			v	v	v				
	Belly twist							v	v	v				
	Bellows posture								v		v	v	v	v

Chiu (2008) proposed that leisure games suiTabfor elders should be level-based games designed with moderate difficulty and simple gameplay, and can be paused and resumed at any moment [18]. Game levels were designed in accordance with the leveling difficulties of yoga postures in this study. Since the earliest occurred declines in elders were those in “strength” and “balance” [25], the yoga asanas that required the use of strength and balance were considered more difficult for elders. The strength decline in elders mainly lies in the area from the upper limbs to lower limbs; thus the more strength or balance from these parts a yoga asana required, the more difficult it would be. The strength and balance the ten yoga asanas required were demonstrated in Tab3 and the difficulties were sorted in increasing order.

Tab. 3 The difficulty levels of the ten asanas

Level	Yoga asana	Strength					Balance		Total
		Face	Upper limbs	Torso	Lower limbs	Total	Balance		
1	Eye movement	v				1		0	
	Lion roar	v				1		0	
2	Lateral bending		v			1		0	
	Right angle pose			v		1		0	
	Belly twist			v		1		0	
3	Upward-facing dog		v	v		2		0	
	Bellows posture				v	1	v	1	

4	Upward arm stretch and heel raise	v		v	2	v	1
	Bent knee torso rotation	v	v	v	3		0
	Tree pose	v	v	v	3	v	1

Tab.3 showed the difficulty levels of yoga asanas;

- Level 1: “Eye movement” and “Lion roar”. Since only the facial strength was required, they were the easiest exercises for elders.
- Level 2: “Lateral bending”, “Right angle pose” and “Belly twist”. As shown in Tab2, strength in one body part was required for each of these asanas.
- Level 3: “Upward-facing dog” and “Bellows posture”. Strength and balance in two body parts were required in difficulty level 3.
- Level 4: “Upward arm stretch and heel raise”, “Bent knee torso rotation” and “Tree pose”. These need strength and balance in various parts, thus they are the most difficult ones for elders.

4. Conclusions

Helping elders to positively face the challenge of aging is a critical issue under the situation of global aging. Regular exercise during the aging process can be beneficial to elders. With the motive of raising elders’ willingness to exercise and the health benefits they obtain, this study conducted a literature review and a movement analysis for a deep understanding of the physical conditions of elders and yoga exercise; and in turn established the design principles of level-based yoga games suiTabfor elders. The results were as follows:

- Yoga exercises suiTabfor elders
 - a. Elders’ needs and the difficulty of yoga asanas should be carefully considered. The ten asanas proposed in the literature were light yoga exercises suiTabfor elders. The illustrations of the ten asanas and their physical benefits were demonstrated in this study.
 - b. Literature review showed that the design of yoga exercises must be rehabilitation-oriented basing on the needs of the rehabilitant; and that the earliest occurred declines in elders were those in the strengths of limbs and torso, and balance. Therefore an analysis of the muscles used in yoga asanas and their physical benefits can reveal the difficulty of a specific yoga asana.
- Difficulty leveling of asanas in yoga games suiTabfor elders.

A level-based digital game can increase the elders’ willingness to exercise. This study proposed a 4-level yoga game design suiTabfor elders according to the difficulty levels of yoga asanas.

- a. Level 1: “Eye movement” and “Lion roar”.
- b. Level 2: “Lateral bending”, “Right angle pose” and “Belly twist”.
- c. Level 3: “Upward-facing dog” and “Bellows posture”.
- d. Level 4: “Upward arm stretch and heel raise”, “Bent knee trunk rotation” and “Tree pose”.

Level-based yoga games designed with progressive difficulty allow elders to safely exercise with higher willingness. The approach of difficulty leveling in this study can be used as the basis for other leisure exercises suiTabfor elders.

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