applied sciences

MDPI

Article

Designing Personalized Persuasive Game Elements for Older Adults in Health Apps

Yongyan Guo *,†, Tongyao Yuan † and Siyu Yue

School of Art Design and Media, East China University of Science and Technology, Shanghai 200237, China; ytongyao2000@126.com (T.Y.); yuesiyu123@163.com (S.Y.)
* Correspondence: yyguo@ecust.edu.cn
† These authors contributed equally to this work.

Abstract: The use of gamification elements in health apps has been shown to promote healthy behaviors. However, one-size-fits-all gamification strategy does not have the best persuasive effect. Therefore, the aim of this paper was to determine how to select personalized game elements for older adults and use them in health education app design. Firstly, based on the DMC model, the Kano model was used to identify the demand attributes of game mechanisms, and three gamification mechanisms (winning, feedback and reward) preferred by the elderly were selected. Secondly, the corresponding gamification elements were selected by the focus group method, and nine virtual products were generated. Thirdly, the virtual products were rated and conjointly analyzed to obtain the relative importance of gamification mechanisms and the utility values of gamification elements, and a comparative analysis was conducted on four characteristics of older adults: age, gender, personal income, and education. The results obtained the best combination of gamification elements chosen by the elderly under different classifications. Finally, design guidelines on persuasive gamification elements were developed based on the characteristics of older adults, and a modified gamification model was proposed. The results of this study provide suggestions and guidelines for the design of persuasive gamification in health education apps, which will help improve the satisfaction of older adults with health apps.

Keywords: persuasive technology; gamification elements; older adults; health education app; Kano model; conjoint analysis method

Citation: Guo, Y.; Yuan, T.; Yue, S. Designing Personalized Persuasive Game Elements for Older Adults in Health Apps. *Appl. Sci.* **2022**, *12*, 6271. https://doi.org/10.3390/app12126271

Academic Editors: Anton Civit, Manuel Dominguez-Morales and Antonis Billis

Received: 25 May 2022
Accepted: 17 June 2022
Published: 20 June 2022

1. Introduction

With the increased popularity of smartphone use among seniors, mobile health apps have become an important health management tool to help seniors prevent disease [1]. The World Health Organization reports that China is aging at a faster rate than other countries with low and middle income [2]. The rapid demographic changes have made the health of the elderly an important social issue [3]. Research indicated that the percentage of elderly people using smartphones is 60% [4]. Berenguer et al. [5] showed that 39% of middle-aged and elderly people use smartphones to search for health information. Studies have shown that the use of mobile health apps can promote healthy lifestyles and increase public health awareness [6,7].

Persuasive games are a non-coercive intervention method whose main purpose is to change the user's behavior or attitude using various persuasive technologies [8] and strategies [9]. Gamification was defined as the use of game design elements in a non-game environment [10]. Werbach [11] mentioned that gamification could be a style of persuasive design and might be effective in promoting motivation and ability in persuasion. Johnson et al. [12] argued that gamification design strategies can motivate health behavior change and have a positive impact on health. Gamification design has been studied and proven to increase users' intrinsic motivation and positively influence their attitudes

and behaviors [13]. It can lead users to increase their performance and motivation in a subtle game experience [14]. Gamification design has been widely used in the fields of education [15] and health [16], and its use in health applications has become very popular [17]. Although there is a lack of extensive experimental evidence on the effects of gamification designs, some studies indicate that gamification has the potential to positively influence more effective medication adherence and self-management in patients with chronic diseases [18]. Some researchers used gamified mobile medical diabetes apps to help adolescents improve blood glucose monitoring frequency and indicated that the use of gamified rewards was associated with improvements in blood glucose monitoring frequency [19]. Fijačko et al. [20] evaluated the effectiveness of apps that used gamified dentistry to help children with oral self-care.

Behavior change is a complex process. Despite the ability of gamification elements to engage users and motivate their behavior, there is a risk that individuals will lose interest in long-term use of gamified applications [21]. Research generally agrees that different game design elements trigger different motivations [22]. To ensure that serious games meet the expectations of users, they must be designed using a user-centered approach [23]. However, most current gamification designs largely ignore the demographic characteristics of the target users [24] and thus fail to provide appropriate solutions to relevant groups [25]. Therefore, it is necessary to analyze the gamification mechanics and design elements preferred by different users.

To improve the persuasiveness and user satisfaction of health education apps, this paper takes the "People's Health" app (an existing health education application) as an example to explore the combination of gamification elements chosen by older people due to age, gender, education, and income. Section 2 of this paper is a review of related work and literature. Section 3 is the research process, which presents the research methodology and analyzes the preferences of older adults for gamification design elements. Section 4 contains the results of the study, which uses conjoint analysis to segment the preferences for gamification elements among the elderly. Section 5 is a discussion of the results and presents aging health app design suggestions and the modified aging gamification model. Section 6 presents the conclusion and outlook. This paper proposes a method to analyze personalized gamification elements and apply it to the design of health education apps to help improve the health literacy of the elderly population.

2. Related Work

The development of an aging population has led scholars to focus on persuasive gamification design for health issues in older adults. Kappen et al. [26] sought to explore how the use of gamification elements could enhance older adults' motivation and help them perform customized physical activity tasks. Studies have confirmed the positive impact of gamification designs on the health of older users [27], suggesting that there is great potential for gamification strategies to improve the health problems of older adults. However, the elderly population has inconsistent preferences for gamification elements due to their age span and individual differences in background. Studies have shown that some gamification designs using a "one-size-fits-all" strategy do not improve user satisfaction because these designs ignore user differences [28] and user preferences [29,30]. Therefore, to design gamified applications for older people, it is necessary to study their preferences to make the products more attractive and usable, and to better motivate users to achieve their goals [31].

Studies have been conducted to explore older adults' preferences for gamification elements in terms of personality traits, motivation, age, and gender. Koivisto [32] categorized the player types and personality traits of older users to identify gamification strategies preferred by the same player types in order to design more targeted gamification elements for them. Kappen et al. [26,33] investigated the use of gamification elements in physical activity (PA) techniques for older adults and designed gamified PA programs to provide personalized exercise applications for older adults. Vette et al. [34] investigated users' pref-

erences for game content to improve engagement with gamified applications and explored the relationship between different personality traits of older adults and gamification preferences. Shih et al. [35] investigated the selection of effective persuasive design strategies and game design elements by considering the age differences of users during behavioral persuasion. Some scholars have found that there is an effect of older adults' age on the complexity of games and the use of game mechanics [36], and that males and females have different perceptions of gamification strategies [37]. Yuan and Guo explored personalized preferences for gamification elements in terms of the age and gender characteristics of older adults [38]. Abdullahi et al. [39] compared the variability of characteristics such as gender and age in health interventions to propose individualized persuasion strategies. The effects of age, gender and cognitive ability on persuasion strategy sensitivity have also been studied in the literature [40]. Kavita et al. [41] found through qualitative interview studies that in health management, the gamification elements chosen by each older user differed even with the same gamification mechanics.

Factors influencing health literacy among older adults include age, gender, educational background, and income [42]. The existing literature has obtained some results in the study of gamification in older adults. However, few researchers have compared the preferred gamification elements among older adults with respect to four factors (age, gender, income, and educational background). Therefore, the present study sought to fill this gap.

3. Materials and Methods

3.1. Research Questions

The purpose of this study was to answer the following questions.

RQ1: What gamification mechanics and combinations of gamification elements do older adults prefer in health education applications?

RQ2: What are the differences in gamification element selection preferences related to older adult characteristics (age, gender, income, and educational background)?

RQ3: How can gamification design elements be applied to design personalized health app for older adults?

In this study, we used the People's Health application as an example. First, we extracted the gamification mechanisms and elements from the dynamics, mechanics, and components (DMC) pyramid model [43]. Second, to select the gamification elements preferred by the elderly and determine the relative importance of these elements, we used the Kano model [44] and conjoint analysis [45]. Finally, we propose design suggestions and a modified gamification model for the design of health applications for the elderly.

3.2. The DMC Model

The DMC pyramid model (Figure 1) is divided into dynamics level, mechanics level and components level, forming a pyramidal structure [43]. The dynamics level is at the top of the pyramid, which represents the goals of gamification, and plays the role of analysis, prediction and decision making. The dynamic layer in gamification is mainly the intrinsic motivation that promotes user behavior. The mechanics layer is the process and framework layer that drives the game process and user engagement. There are 10 important game mechanisms, including: challenges, opportunities, competition, cooperation, feedback, resource acquisition, rewards, transactions, rounds, and winning status. The component layer is a concrete presentation of the dynamics and mechanics level, which influences the user experience with visual elements. The component layer includes mainly game elements: achievements, avatars, badges, collections, leaderboards, levels, points and 15 other elements. The component level includes but is not limited to the game components shown in Figure 1.

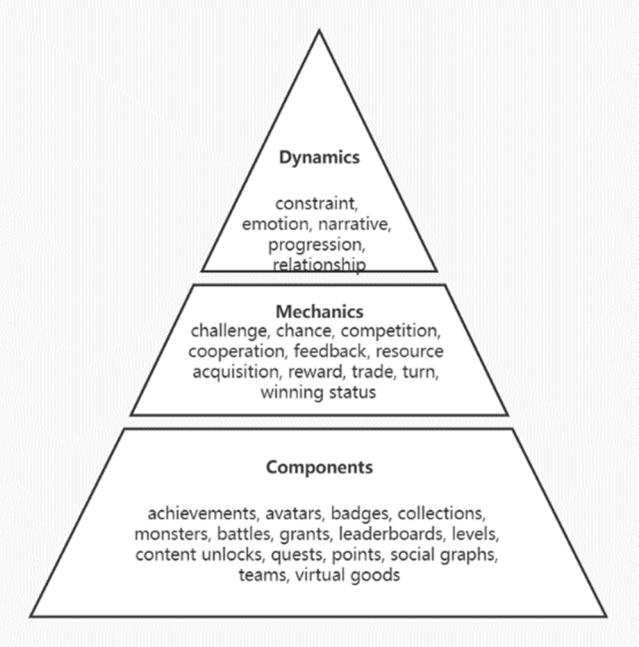

Figure 1. DMC pyramid model.

The DMC pyramid model outlines the structural elements of game design; however, this model has been used primarily for game design and has rarely been applied to research on the gamification design of health apps for older adults. It also does not consider the issue of individualized preferences among older adults. Therefore, this study uses the Kano model, focus group method and joint analysis based on the DMC model to identify the gamification mechanisms and gamification elements preferred by older adults and analyze their relative importance according to their characteristics. Finally, the DMC model was modified to meet the needs of health application design for the elderly.

3.3. Kano Model

The Kano model [43] is a method of identifying factors that lead to user satisfaction. The Kano model can classify needs into four attributes based on user satisfaction: must-be quality (M), one-dimensional quality (O), attractive quality (A), and indifferent quality (I). To maximize the effect of gamification design, Yin et al. [46] used the Kano model to classify the gamification elements in a health app for determining the impact of gamification elements on user satisfaction. Min et al. [47] used conjoint analysis and the Kano model combination to analyze the potential demand attributes of the product.

The formula for the satisfaction factor when this function is provided is:

$$\text{Better/SI} = (\text{A} + \text{O})/(\text{A} + \text{O} + \text{M} + \text{I}) \quad (1)$$

The formula for the dissatisfaction factor when this feature is not provided is:

$$\text{Worse/DSI} = -1 \times (\text{O} + \text{M})/(\text{A} + \text{O} + \text{M} + \text{I}) \quad (2)$$

3.4. Conjoint Analysis Method

Conjoint analysis is a multivariate statistical analysis method that was introduced into the field of consumer behavior research by Green and Rao in 1978 [44]. It has been widely applied to assess consumer preferences and evaluation of products or services, etc. The advantages of the conjoint analysis approach are that (1) the conjoint analysis virtual product contains multiple pieces of information that quantify the magnitude of each attribute and the weight of the level at which the attribute is located in the overall decision; (2) the conjoint analysis approach provides more accurate estimates of the relative

importance of key attributes than using a series of separate survey items; and (3) the conjoint analysis approach is able to minimize the number of experimental samples required while retaining the experimental design [48]. Pleger et al. [49] studied user preferences for public e-service terminals and revealed factors that influence the successful implementation of public e-services. Anand et al. [50] developed a diffusion model to obtain attribute utility values of the user's choice of cell phones through conjoint analysis. Zhang et al. [51] conducted a conjoint analysis of choice-based social media image posting and souvenir purchase preferences. The advantage of conjoint analysis is the ability to assess the utility values of multiple constituent elements, but conjoint analysis has rarely been used in preference studies of gamification elements. The conjoint analysis usually consists of the following steps [52].

(1) Determination of product features and feature levels: Joint analysis starts with the identification of the features of the product or service.
(2) Product simulation: The conjoint analysis considers all the features and feature levels of the product, and uses the orthogonal design method to combine these features and feature levels to generate a series of virtual products.
(3) Data collection: Respondents are asked to evaluate the virtual products, and respondents' preferences for the virtual products are investigated by scoring and ranking, etc.
(4) Calculating the utility of features: Separate the consumer's preference values for each feature and the level of the feature from the collected information, and these preference values are also the utility of the feature.
(5) Product prediction: Utility values are used to predict how consumers will choose from different products and thus decide what should be done.

3.5. Research Framework

Based on the above literature analysis, the research framework of this paper is proposed (Figure 2).

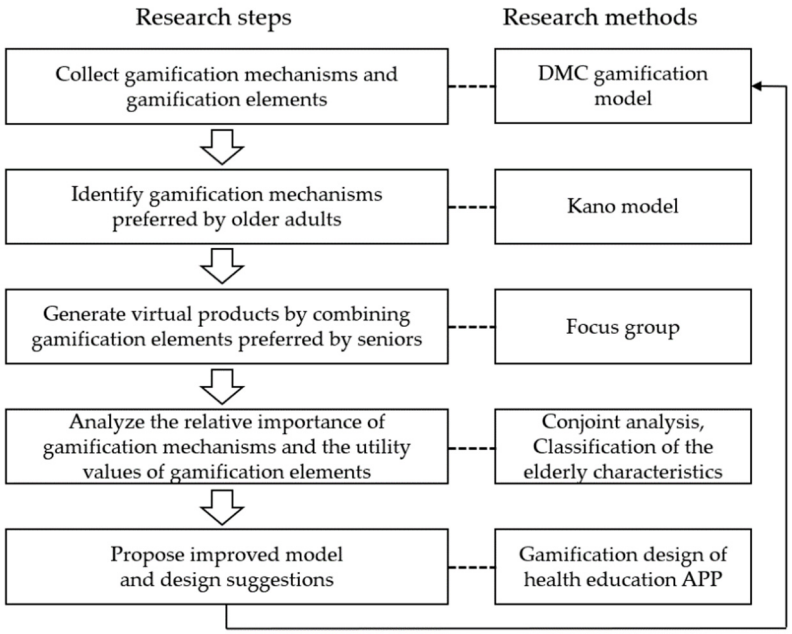

Figure 2. Research framework.

The research steps in this paper are as follows:

(1) Screening the preferred gamification mechanics of the elderly. The demand attributes of gamification mechanisms were identified by the Kano model based on the DMC model.

(2) Investigate the gamification elements preferred by older adults. The virtual products were designed with the gamification elements, and data from user evaluations were collected by the questionnaire.
(3) Calculate the relative importance of game mechanics and the utility value of game elements using conjoint analysis. The preferred gamification elements were analyzed by comparing four characteristics of older adults (age, gender, income, and education).
(4) Propose a modified gamification model and personalized gamification design suggestions for the senior health education app.

4. Results

4.1. Screening the Gamification Mechanics Preferred by the Elderly

In this study, common gamification mechanisms and gamification elements were extracted from the DMC pyramid model. The relevant gamification mechanics (challenge, feedback, competition, reward, punishment, cooperation, and winning status) were selected as the elements to be tested. In this paper, we used the Kano model to identify the functional attributes of the gamification mechanics and then select the gamification mechanics preferred by older adults. The two-factor Kano questionnaire was designed as shown in the following example table (Table 1).

Table 1. Example of Kano two-factor questionnaire.

How Users Feel When This Feature Is Provided				
Very useful	More useful	Does not matter	Impractical	Very impractical
◯	◯	◯	◯	◯
How users feel when this feature is not available				
Very useful	More useful	Does not matter	Impractical	Very impractical
◯	◯	◯	◯	◯

Older adults aged 55 years or older with experience in using mobile phone apps were selected for this experiment. All participants were informed of the purpose and significance of the study, and consent was obtained from the study participants. A total of 156 valid questionnaires (71 males and 85 females) were recovered. The better–worse coefficients of the gamification mechanisms were calculated using Equations (1) and (2) (see Table 2). The distribution in Figure 3 identifies the Kano attributes of the seven gamification mechanisms. According to the importance of functional attributes (M > O > A > I) [53], the preferred gamification mechanisms of older users were: winning status, feedback, and reward. Among them, winning status was a must-be attribute, and feedback and reward were one-dimensional attributes.

Table 2. Analysis of Kano questionnaire results.

Gamification Mechanics	Better–Worse Coefficient	Kano Attributes
Challenge	0.1428, 0.1290	Indifferent
Feedback	0.4467, 0.3933	One-dimensional
Competition	0.1712, 0.1369	Indifferent
Reward	0.3377, 0.6623	One-dimensional
Punishment	0.1704, 0.1481	Indifferent
Cooperation	0.2353, 0.2157	Indifferent
Winning status	0.3701, 0.1948	Must-be

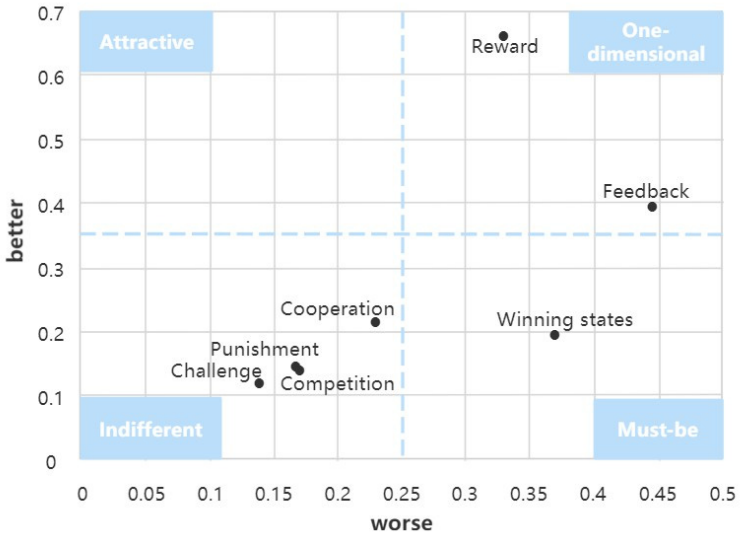

Figure 3. Quartile chart: Better–worse coefficient analysis.

We collected gamification design elements commonly used in existing app applications and categorized them into three gamification mechanisms (winning status, feedback, and reward). In the focus group method, firstly, the purpose of this study was introduced, as well as the basic functions of the health education app and the meaning of the gamification elements. Next, nine older participants were asked to vote on the preferred gamification elements for older adults. Three game mechanisms and nine gamification elements (see Table 3, Figure 4) were finally extracted to build the virtual product.

Table 3. Choose gamification elements for seniors.

Gamification Mechanics	Gamification Elements	Explanation
Winning status	Social sharing	Share personal achievements with familiar people and receive praise.
	Leaderboard	Display the user's ranking in the community.
	Text congratulations	A text pop-up appears to congratulate the user on completing the task.
Reward	Cash reward	Give cash rewards when users complete operational tasks.
	Point reward	Use points as a virtual currency and long-term points to provide exchange rewards.
	Random gift reward	Gift rewards for user actions, where the type and value of the gift are randomized to increase novelty and anticipation.
Feedback	Identity level	The more tasks the user achieves, the higher the status level; feedback on the progress status of the individual.
	Visual feedback	Color change (text or icon) to indicate the user's operation status.
	Graphic feedback	Graphic descriptions of user operations.

Figure 4. Diagram of gamification elements.

4.2. Conjoint Analysis Questionnaire

To reduce the interfering factors of the study, this paper assumed that the health education app product would include three gamification mechanisms—feedback, rewards, and winning status—and that each gamification mechanism would include three gamification elements to form a virtual product prototype. Users would be motivated by a set of gamification elements after completing the daily tasks in the health education app. First, we organized and combined the gamification elements to obtain several virtual products as experimental samples. These attribute level permutations and combinations were able to generate a total of 27 (= 3 × 3 × 3) virtual products. To reduce the number of product combinations, we used the orthogonal module in SPSS to generate nine virtual combined products of gamification elements, as shown in Table 4.

Table 4. Designing nine virtual product prototypes.

Virtual Products	Feedback	Reward	Winning Status
1	Graphic feedback	Point reward	Text congratulations
2	Graphic feedback	Random gift reward	Social sharing
3	Identity level	Cash reward	Text congratulations
4	Identity level	Random gift reward	Leaderboard
5	Identity level	Point reward	Social sharing
6	Visual feedback	Random gift reward	Text congratulations
7	Visual feedback	Cash reward	Social sharing
8	Graphic feedback	Cash reward	Leaderboard
9	Visual feedback	Point reward	Leaderboard

Second, the questionnaire was designed to test users' preferences for the above nine virtual products. The first part of the questionnaire was about the basic information such as age and gender of users. In the second part, the background of the questionnaire was briefly introduced and the meaning of each gamification element was explained. The questionnaire

used a five-point Likert scale to measure users' preference ratings for each virtual product. Likert scales ranged from 1 to 5, indicating very dissatisfied to very satisfied, respectively. In the third section, participants were asked to rate the virtual products. Older adults aged 55 years or older with experience in using mobile phone apps were selected for this experiment. Participants were informed of the purpose of the study and their consent was obtained. A total of 127 questionnaires were distributed, and 103 valid questionnaires were finally returned. The number of questionnaires met the needs of similar studies [47]. Table 5 shows the basic information of the respondents.

Table 5. Basic information of respondents.

Characteristic	Category	Number	Percentage
Gender	Male	45	43.69%
	Female	58	56.31%
Age	55–70 years old	79	76.70%
	>70 years old	24	23.30%
Income (CNY)	<2000	16	15.53%
	2000–5000	52	50.49%
	>5000	35	33.98%
Education	Elementary education (primary school)	19	18.45%
	Secondary education (middle school, high school, vocational high school, etc.)	50	48.54%
	Higher education (university degree or higher)	34	33.01%

Finally, the ratings of the nine virtual products were obtained and the reliability of the questionnaire data was verified using SPSS software. The Cronbach's alpha = 0.886, KMO = 0.903, $p < 0.05$, indicated that the questionnaire had good reliability and validity. The preferences of older adults for different gamification mechanics and gamification elements were analyzed using the conjoint analysis method. Conjoint analysis was conducted using the conjoint module in SPSS software to calculate the relative importance of gamification mechanics and the utility values of gamification elements. In the analysis results, the gamification mechanics with the highest importance and the gamification elements with the highest utility value were selected for the older adults. Finally, the results were categorized and compared by characteristics of the elderly (age, gender, education, and income).

In the next section, we present the results of the analysis, comparing and revealing the preferences of older adults for different gamification mechanisms and gamification elements.

4.3. Conjoint Analysis Method to Analyze Gamification Elements

4.3.1. Overall Conjoint Analysis of the Elderly Population

We validated the questionnaire credibility. The results show the two-tailed test for significance: Pearson's R = 0.869, $p = 0.001$ and Kendall's tau = 0.648, $p = 0.008$. Thus, the two correlation coefficients passed the statistical test.

In Table 6, the gamification mechanisms with the highest relative importance represent the preferences of older adults. Among the three attributes, the winning status was the most important for older adults, at 48.980%. It was followed by reward (40.816%) and feedback (10.204%). This indicates that older adults are very attracted to mechanisms such as winning status and rewards. Therefore, more game design elements of reward and winning status could be included in the gamification design to improve the satisfaction of older adults in using health apps.

Table 6. Utility value of attribute levels for all people.

Attribute	Attribute Level	Utility Value	Relative Importance
Feedback	Visual feedback	−0.03	10.204%
	Identity level	0.010	
	Graphic feedback	−0.06	
Reward	Cash reward	0.42	40.816%
	Point reward	−0.023	
	Random gift reward	−0.019	
Winning Status	Social sharing	0.036	48.980%
	Leaderboard	−0.042	
	Text congratulations	0.006	
	Pearson's R	0.869	$p = 0.001$
	Kendall's tau	0.648	$p = 0.008$

The utility values of each attribute level are shown in Table 6. A higher utility value means that the element has a greater effect on the attribute, while a negative utility value indicates that the element has a negative effect on the attribute. Among the feedback attributes, the utility values of visual feedback, identity level and graphic feedback were −0.03, 0.010 and −0.06, respectively. This indicates that the identity level was most preferred by older adults. Among the reward attributes, older adults preferred cash rewards (utility value of 0.42), while random gift rewards and point rewards produced negative effects. For the winning status attribute, the utility values of gamification elements were ranked as follows: social sharing, text congratulations, and leaderboard.

4.3.2. Conjoint Analysis by Age Classification

A conjoint analysis of two age groups of older adults (55–70 years and ≥71 years) was conducted to compare their preferences for gamification elements. The verification results show that in the data on the 55–70-year-old elderly group, Pearson's R = 0.740 and Kendall's tau = 0.704, and the significance of the two-tailed test was less than 0.05. In the data on the older age group of 71 and above, Pearson's R = 0.975 and Kendall's tau = 0.889, both with two-tailed tests for significance of less than 0.05. This indicated that the model had a high fit and the correlation coefficients passed the statistical test.

In Table 7, there are differences in the preferences of the two age groups regarding the importance of gamification mechanics. The group aged 55–70 preferred the feedback attribute, followed by the winning status and reward attributes, while the group aged 70 and above preferred the reward attribute with 52.542%, followed by the feedback and winning status attributes. Users also had different preferences for gamification elements. Table 7 shows that for the feedback mechanism, the group aged 55–70 years preferred identity level and graphic feedback, while those aged 71 years and older tended to prefer visual feedback and graphic feedback. For the reward mechanism, the 55–70-year-olds tended to prefer point rewards, while those 71 and above preferred cash rewards. For the winning status mechanism, the most popular attribute level was social sharing, regardless of age.

Table 7. Utility value of attribute levels classified by age.

Attribute	Attribute Level	Utility Value	
		(Age 55–70)	(Age > 70)
Feedback	Visual feedback	−0.042	0.125
	Identity level	0.055	−0.139
	Graphic feedback	−0.013	0.014
	Relative importance	46.939%	32.203%
Reward	Cash reward	−0.021	0.250
	Point reward	0.025	−0.181
	Random gift reward	−0.004	−0.069
	Relative importance	22.449%	52.542%
Winning Status	Social sharing	0.03	0.069
	Leaderboard	−0.038	−0.056
	Text congratulations	0.013	−0.014
	Relative importance	30.612%	15.254%
	Pearson's R	0.740 (p = 0.011)	0.975 (p = 0.000)
	Kendall's tau	0.704 (p = 0.004)	0.889 (p = 0.000)

4.3.3. Conjoint Analysis by Gender Classification

In the male group, Pearson's R = 0.860 and Kendall's tau = 0.889, the two-tailed test significance was less than 0.05. In the female group, Pearson's R = 0.975 and Kendall's tau = 0.923, the two-tailed test significance was less than 0.05. This shows that the model had a good fit and the correlation coefficient between the two groups passed the statistical test.

The questionnaire data were analyzed separately for males and females. As seen in Table 8, male and female older adults preferred winning status the most, and the winning status attribute was weighted more heavily in the male group than the female group. Males considered the reward attribute more important than the feedback attribute, while females held the opposite view. As can be seen from Table 8, among the feedback attributes, the male group focused more on graphic feedback, while the female group focused more on identity level. In terms of reward attribute, cash rewards were preferred by older adults, with utility values of 0.074 and 0.017 for males and females, respectively. However, the female group preferred the leaderboard element to demonstrate winning status, with a utility value of 0.034, whereas the male group preferred the social sharing and text congratulations elements with utility values of 0.089 and 0.052, respectively.

Table 8. Utility value of attribute levels classified by gender.

Attribute	Gamification Elements	Utility Value	
		(Male)	(Female)
Feedback	Visual feedback	−0.022	0.011
	Identity level	0.000	0.017
	Graphic feedback	0.022	−0.029
	Relative importance	11.321%	33.333%
Reward	Cash reward	0.074	0.017
	Point reward	−0.044	−0.006
	Random gift reward	−0.030	−0.011
	Relative importance	30.189%	20.833%
Winning Status	Social sharing	0.089	−0.006
	Leaderboard	−0.141	0.034
	Text congratulations	0.052	−0.029
	Relative importance	58.491%	45.833%
	Pearson's R	0.860 (p = 0.001)	0.975 (p = 0.000)
	Kendall's tau	0.889 (p = 0.000)	0.923 (p = 0.001)

4.3.4. Conjoint Analysis by Educational Background

As educational background may affect users' ability and motivation to use health education apps, the samples were classified into three groups based on educational status: primary, secondary, and higher education. Among the three groups, the Pearson's R and Kendall's tau values were both more than 0.7, and the two-tailed test significance values were both less than 0.05. This shows that the correlation coefficients of the questionnaire data for the three groups passed the statistical test and the model had a good fit.

Table 9 shows that in terms of gamification mechanics, groups with primary and secondary education preferred reward attributes with a relative importance of 47.727% and 47.059%, respectively. In terms of gamification elements, the group with primary education preferred visual feedback among the feedback attributes. For those with secondary education, the identity level and graphic feedback had the same utility value, of 0.020. The group with higher educational background liked the identity level feedback the most. As to the reward attribute, both the primary and secondary educated groups preferred cash rewards with the utility value of 0.199 and 0.118, respectively, while the higher educated group preferred random gift rewards. Among the winning status attributes, people with higher education and primary education preferred social sharing with utility values of 0.01 and 0.041, respectively. People with secondary education preferred the leaderboard most with a utility value of 0.127.

Table 9. Utility value of attribute levels classified by educational background.

Attribute	Gamification Elements	Utility Value		
		Primary Education	Secondary Education	Higher Education
Feedback	Visual feedback	0.129	−0.039	−0.029
	Identity level	−0.170	0.020	0.071
	Graphic feedback	0.041	0.020	−0.042
	Relative importance	38.636%	11.765%	22.973%
Reward	Cash reward	0.199	0.118	−0.069
	Point reward	−0.170	0.000	0.018
	Random gift reward	−0.029	−0.118	0.051
	Relative importance	47.727%	47.059%	24.324%
Winning Status	Social sharing	0.041	−0.078	0.111
	Leaderboard	−0.064	0.127	−0.149
	Text congratulations	0.023	−0.049	0.038
	Relative importance	13.636%	41.176%	52.703%
	Pearson's R	0.999 (p = 0.000)	0.965 (p = 0.000)	0.936 (p = 0.000)
	Kendall's tau	1.000 (p = 0.000)	0.837 (p = 0.001)	0.771 (p = 0.002)

4.3.5. Conjoint Analysis by Income

Since economic conditions may affect users' usage motivation, users were classified into three groups based on personal monthly income: below CNY 2000, within CNY 2000–5000, and above CNY 5000. In the three groups, the Pearson's R and Kendall's tau values for the questionnaire data were all more than 0.8, and the significance of the two-tailed test was less than 0.05, indicating that the correlation coefficients all passed the statistical test.

As seen in Table 10, the relative importance of the three attributes differed among the three groups. The feedback attribute was preferred by the groups with a monthly income of less than CNY 2000 or more than CNY 5000, while the group with a monthly income of CNY 2000–5000 preferred the winning status attribute. For the three groups, the importance of reward attributes was 38.462%, 39.535%, and 28.571%, respectively.

Table 10. Utility value of attribute levels classified by personal monthly income.

Attribute	Gamification Elements	Utility Value		
		<2000	2000–5000	>5000
Feedback	Visual feedback	0.174	0.002	−0.092
	Identity level	−0.201	0.009	0.108
	Graphic feedback	0.028	−0.011	−0.016
	Relative importance	46.154%	6.977%	50.000%
Reward	Cash reward	0.174	0.066	−0.054
	Point reward	−0.139	−0.043	0.060
	Random gift reward	−0.035	−0.024	−0.006
	Relative importance	38.462%	39.535%	28.571%
Winning Status	Social sharing	0.028	0.060	0.003
	Leaderboard	−0.076	−0.088	0.041
	Text congratulations	0.049	0.028	−0.044
	Relative importance	15.385%	53.488%	21.429%
	Pearson's R	0.992 (p = 0.000)	0.890 (p = 0.001)	0.987 (p = 0.000)
	Kendall's tau	0.971 (p = 0.000)	0.807 (p = 0.002)	0.836 (p = 0.001)

As to the feedback attribute, visual feedback had the highest utility value in the group with income of less than CNY 2000. Identity level feedback had the highest utility value among those earning more than CNY 2000. In terms of rewards, cash rewards (0.174) had the highest utility value among those with an income of less than CNY 5000, while points rewards (0.060) had the highest utility value among those with an income of CNY 5000 or more. In the winning status attribute, the most preferred gamification elements varied in each group. For the group with low income, the element with the highest utility value was text congratulations (0.049). For the group with middle income, the element with the highest utility value was social sharing (0.060). For those with higher income, the element with the highest utility value was the leaderboard (0.041).

4.3.6. Summary of the Conjoint Analysis Results

This paper ranked the preferences for gamification mechanics and gamification elements according to the classification characteristics of older users. Based on the results of the above conjoint analysis, we summarized the recommended gamification mechanics (Table 11) and the optimal combination of gamification elements (Table 12) for different categories of elderly users.

Table 11. Recommended gamification mechanics for older adults with different characteristics.

Characteristic	Category	Gamification Mechanics Recommendation
Overall	103 subjects	Winning Status, Rewards, Feedback
Age	55–70 years old	Feedback, Winning Status, Reward
	>70 years old	Reward, Feedback, Winning Status
Gender	Male	Winning Status, Reward, Feedback
	Female	Winning Status, Feedback, Reward
Educational background	Elementary education	Reward, Feedback, Winning Status
	Secondary education	Reward/Winning Status, Feedback
	Higher education	Winning Status, Reward/Feedback
Personal monthly income (CNY)	<2000	Feedback, Reward, Winning Status
	2000–5000	Winning Status, Reward, Feedback
	>5000	Feedback, Reward/Winning Status

Table 12. The optimal combination of gamification elements for different characteristics of older adults.

Characteristic	Category	Feedback	Rewards	Winning Status
Overall	103 subjects	Identity level	Cash reward	Social sharing
Age	55–70 years old	Identity level	Point reward	Social sharing
	>70 years old	Visual feedback	Cash reward	Social sharing
Gender	Male	Graphic feedback	Cash reward	Social sharing
	Female	Identity level	Cash reward	Leaderboard
Educational background	Elementary education	Visual feedback	Cash reward	Social sharing
	Secondary education	Identity level/Graphic feedback	Cash reward	Leaderboard
	Higher education	Identity level	Random gift reward	Social sharing
Income (CNY)	<2000	Visual feedback	Cash reward	Text congratulations
	2000–5000	Identity level	Cash reward	Social sharing
	>5000	Identity level	Point reward	Leaderboard

5. Discussion

5.1. Discussion of Study Results

Compared to the existing literature, this study expanded the number of participants and performed a more disaggregated evaluation of older adult characteristics. Three gamification mechanisms preferred by older adults and the importance of nine gamification elements were analyzed using the Kano model and conjoint analysis. For the research question RQ1, the results showed that the gamification mechanisms (challenge, competition, punishment, and cooperation) were indifferent attributes (I) in the health education application for older adults. The reason for this may be the existence of psychological barriers among older adults who fear that competitive mechanics may damage the image of the individual. The overall preferred gamification mechanisms for older adults were winning status (M), reward (O), and feedback (O). The relative importance of these three gamification mechanisms in the conjoint analysis method was 48.980%, 40.816%, and 10.204%, respectively (Table 6). It was suggested that the winning status attribute was preferred for persuading users. This result suggested that older adults seek a sense of accomplishment

and that gamification elements should satisfy their need for feedback on progress and success [54]. Corresponding to these three mechanisms, the most preferred combinations of gamification elements among older adults were: social sharing, cash rewards, and visual feedback. Kappen et al. [33] proved that older adults preferred social sharing with peers. In addition, self-determination theory (SDT) [55] divides motivation into intrinsic and extrinsic motivation. Cash reward is an extrinsic motivation. Sources of cash rewards can be provided with advertising and sponsorship by product companies targeting older users. However, studies have shown that too much of these rewards could be harmful. Therefore, cash reward strategies can quickly attract the interest of older users in the early stages of use, but intrinsic motivation should be stimulated in long-term use. Social sharing and incentives from close friends or family members may be more likely to motivate older users intrinsically [56]. Design suggestions: In the universal module, social sharing strategies should be designed for older users and their friends and relatives, such as likes, visitor interaction records, and messages from those who care, to meet the social needs of older people through peer support.

For the research question RQ2, the ranking of utility value based on conjoint analysis revealed the individualized preferences among of older adults for gamification elements.

(1) Analysis by age characteristics. The results of the study (Table 7) show that lower-aged seniors (55–70 years old) preferred feedback mechanisms (46.939%), while higher-aged seniors (70 years old and above) preferred reward mechanisms (52.542%); and, in terms of gamification elements, they preferred status level feedback and cash rewards, respectively. The reason may be that the lower-aged seniors focused more on their personal social image, while the higher-aged seniors focused more on practical benefits. Design suggestions: Various virtual levels should be used to motivate the younger seniors, such as giving identity authentication and increasing the corresponding usage rights. Financial rewards should be used for the older seniors, such as issuing red packet rewards, or using points to exchange with gifts, etc.

(2) Analysis by gender characteristics. Table 8 shows that both males and females preferred the winning status mechanism with a relative importance of 58.491% and 45.833%, respectively. However, males preferred the social sharing element and females preferred the leaderboard element. This indicates that female seniors were happy to show their status in a group, while male seniors felt pressured to display their personal status on the leaderboard because they were afraid of failing and would be embarrassed about it. Male older adults prefer to share personal achievements through socializing with friends and gaining appreciation. This indicates that females are susceptible to virtual gamification elements, and this finding is similar to that of other researchers [37], indicating the credibility of the results of this study. Design suggestions: Different winning status mechanisms should be used in the design for males and females to meet the psychological needs of older adults. In addition, designers should design cash rewards for male users and status level feedback for female users.

(3) Analysis by educational background. Educational background not only limits the comprehension ability and prevalence of use of health education apps by older users [41], but also affects users' preferences for game elements. The results of the study showed (Table 9) that those in the group with less than secondary educational background were more interested in cash reward, which is a material persuasion element. The group with higher education preferred social sharing on the winning status mechanism, which is a spiritual persuasion element. Design suggestions: Cash rewards or red packet rewards should be used for users with a primary education background, followed by graphic feedback. For users with a secondary education background, a leaderboard element is recommended in addition to designing cash rewards. Multiple social sharing elements should be used for users with higher education background, followed by rewards of random gifts and status rank feedback.

(4) Analysis by monthly income. Income affects human needs to some extent. The results of the study (Table 10) indicate that both groups with low income and high income

preferred feedback mechanisms with a relative importance of 46.154% and 50.000%, respectively. However, low-income people preferred visual feedback, which is a utility functional need, while high-income people preferred status rank feedback, which is a need to satisfy self-esteem psychology. The group with middle income preferred the winning status mechanism (53.488%), preferred the social sharing element, and wanted to receive praise from friends for their winning status. According to Maslow's hierarchical needs theory [57], as income increases, users' needs change from functional needs to social and self-esteem needs, and users tend to show their personal status as their income grows. Design suggestions: Visual feedback elements should be designed for low-income groups, followed by cash rewards. Social sharing in winning status should be designed for middle-income groups, followed by cash rewards. Status level feedback should be designed for higher income groups, followed by point rewards and leaderboards.

In summary, this paper examined the personalized game elements for older adults when using health education apps. It was found that the gamification mechanics and elements preferred by older adults differed with different characteristics. Even if two user groups preferred the same gamification mechanics, the gamification elements they preferred might be different. Younger seniors and seniors with higher education and income levels have an open mind, are more interested in self-management of their health, and are more likely to be driven by intrinsic motivation. Older seniors and seniors with lower education and income levels are more focused on perceived usefulness and are more likely to be driven by extrinsic motivation. Women are more susceptible to emotional factors than men [58]. Therefore, personalized gamification elements should be used to better meet the needs of users. In the health app design, it is suggested to use the gamification elements with relevant characteristics based on the information content of the module (Tables 11 and 12). This result expands the ideas for gamification design and research.

For research question RQ3, we propose the following modified gamification model (Figure 5) and design practice (Figure 6).

Dynamics: constraints, emotion, narrative, progress, relationships

Factors	Age, gender, education, income		
Mechanics	Winning Status	Feedback	Reward
Components	• Social Sharing • Leaderboard • Text congratulations	• Identity levels • Visual feedback • Graphic feedback	• Cash reward • Point reward • Random gift reward

Figure 5. The modified gamification model for older users.

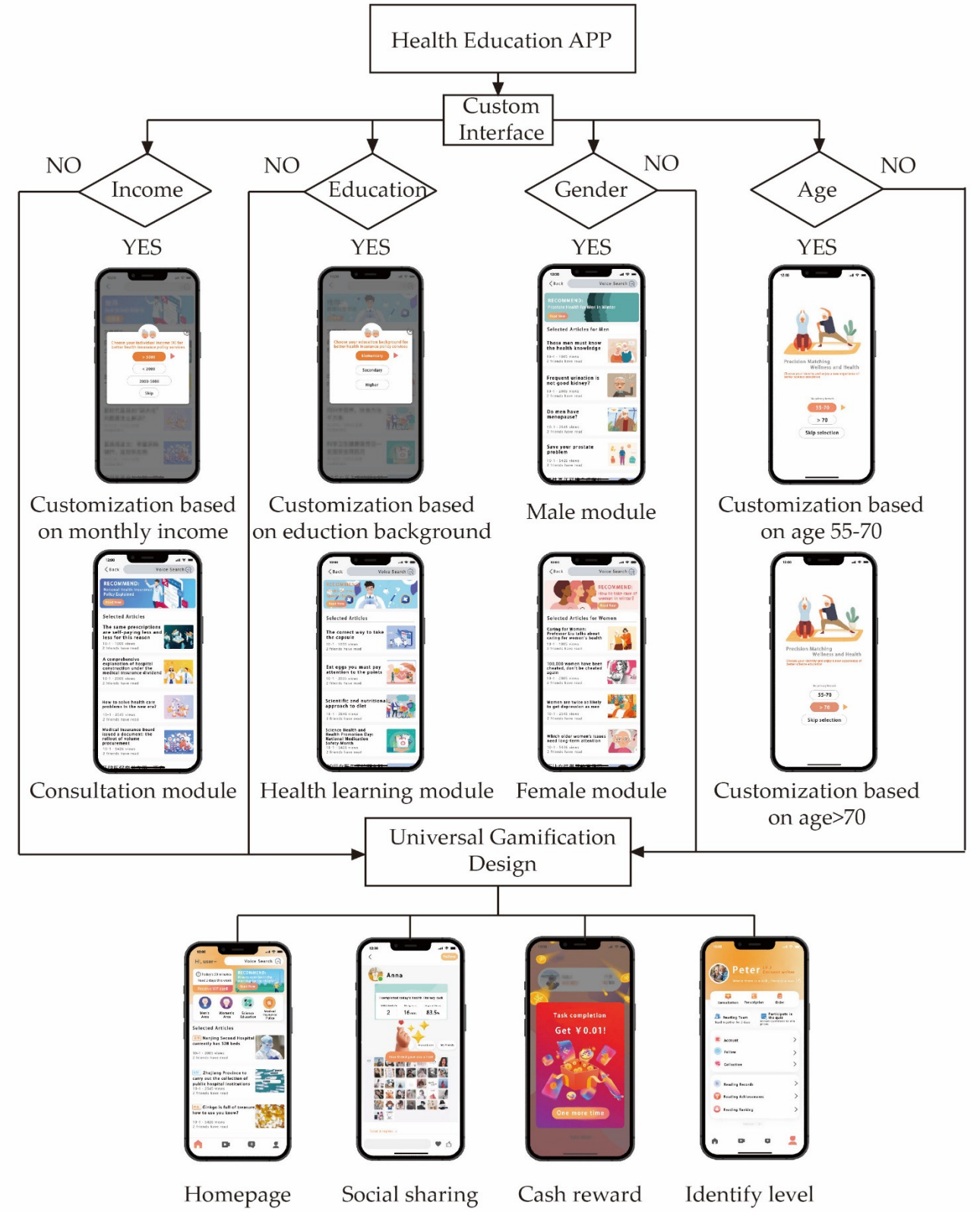

Figure 6. Information architecture of health education app design for the elderly.

5.2. DMC Pyramid Improvement Model for Aging

Based on the above research results, this paper formulated a modified gamification model of DMC for the elderly. The new model retains the three-layer structure, which includes a dynamics layer, mechanics layer, and component layer. In the design of health

apps for the elderly, the following modified model is proposed to improve design efficiency (Figure 5).

(1) The mechanism layer is simplified. The modified model is facilitated design applications for older users. There are three main gamification mechanisms preferred by the elderly, namely winning status, reward, and feedback. Winning status means the user demonstrates the status of personal victory. Reward means some achievements and benefits brought by the user through actions or operations. Feedback means that the progress of the operation is displayed to the user during the operation, so that the user can understand the process.
(2) The relationship between the mechanism layer and components layer was established. In this paper, the mechanism layer includes feedback, reward, and winning status. The component layer is the visual representation of the mechanism layer. The nine gamification elements are classified by the three mechanisms: social sharing, leaderboard, and text congratulations are the elements of winning status; cash rewards, point reward, and random gift rewards are the elements of the reward mechanism; and visual feedback, identity level, and graphic symbol feedback are the elements of the feedback mechanism.
(3) In the designed application, the recommended gamification elements should be adopted according to four characteristics of the elderly (age, gender, monthly income, and educational background). The selection of elements for practical applications can refer to Table 12.

The steps for applying the model to design are as follows: (1) select research objectives for older users; (2) analyze which influencing factor is more related to the information content; (3) customize the information interfaces with the influencing factors and recommend the preferred gamification elements; (4) build the personalized information architecture and design the interactive prototype.

To demonstrate the application process of the model proposed in this study, we designed a gamified health education app for the elderly. The information architecture and part of the interface are shown in Figure 6. To improve user satisfaction, it is suggested that the system use the recommended gamification elements in different information contexts according to the corresponding influencing factors. For example, it is suggested that the mission game module be customized for age, the health information push module be customized for gender; the health learning module be customized for educational background; and the consultation module be customized for income level. If the user does not select any customization method, the system displays the universal module.

6. Conclusions

6.1. Research Conclusions and Contributions

Gamification design is a form of behavioral persuasion that is widely recognized to promote user motivation. The purpose of this paper was to study how to use personalized gamification elements in designing a health education app for older adults. As a conceptual study, the main conclusions and contributions of this paper are as follows. First, this paper provided a comprehensive, quantitative research method for studying user-preferred gamification elements. The attributes of the gamification mechanisms preferred by the elderly were identified through the Kano model, and it was found that the overall preferred gamification mechanisms for older adults were winning status, rewards, and feedback. The relative importance of each gamification mechanism was obtained using conjoint analysis, and the optimal gamification elements were selected based on attribute levels. For the three mechanisms, the most preferred combinations of gamification elements for older adults were social sharing, cash rewards, and visual feedback. The conjoint analysis method was based on the relative comparison of combined elements to obtain users' evaluations of the gamification elements. This method was more objective and precise than evaluating each gamification element individually. Second, this paper found that the gamification elements preferred by older users also differed under the influence of four

factors (age, gender, income, and educational background) (Tables 11 and 12). Third, this paper presented suggestions for personalized game design for older adults and a modified gamification model. To avoid a "one-size-fits-all" approach, we showed the application of the research results to the design through practical cases. This study will help to customize the persuasive gamification elements in health app designs for older adults according to their characteristics, thus improving the effectiveness of persuasion. This study not only serves as a complement to the development of related literature, but also provides useful suggestions and references for similar designs in the future.

6.2. Limitations and Future Work

This paper has some limitations. First, this study analyzed only limited gamification mechanics and user-selected gamification elements, and could not cover all situations. Virtual product prototypes were used in the tests, which may have led to differences between test results and the use of real mobile apps. Second, this study could not guarantee the use of the test results in a broader population due to the limited number of testers. Third, the study of elderly people's preferences for game elements was conducted using four factor categories with the conjoint analysis method, but there is a lack of research on the use of multiple factors. In future work, we will use real apps for testing and expand the geographical range and number of elderly subjects to prove the general applicability of this study. Future research will study the preferences of older adults with multiple factors of gamification elements and test the effectiveness of persuasive gamification designs.

Author Contributions: Conceptualization, Y.G. and T.Y.; methodology, Y.G. and T.Y.; investigation, T.Y. and Y.G.; formal analysis, T.Y.; visualization, T.Y. and Y.G.; writing—original draft preparation, T.Y. and Y.G.; writing—review and editing, Y.G. and S.Y.; supervision, Y.G. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Ministry of Education Humanities and Social Sciences Foundation of China, grant number (17YJCZH055).

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board of East China University of Science and Technology (protocol code: ECUST-2022-071).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Not applicable.

Acknowledgments: The authors would like to thank all the anonymous referees for the comments and suggestions, which have helped to improve the paper.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Fang, E.F.; Xie, C.; Schenkel, J.A.; Wu, C.; Long, Q.; Cui, H.; Aman, Y.; Frank, J.; Liao, J.; Zou, H.; et al. A research agenda for ageing in China in the 21st century (2nd edition): Focusing on basic and translational research, long-term care, policy and social networks. *Ageing Res. Rev.* **2020**, *64*, 101174. [CrossRef] [PubMed]
2. China Country Assessment Report on Ageing and Health. Available online: https://www.who.int/publications-detail-redirect/9789241509312 (accessed on 1 January 2022).
3. Ye, P.; Jin, Y.; Er, Y.; Duan, L.; Palagyi, A.; Fang, L.J.; Li, B.Q.; Ivers, R.; Keay, L.; Tian, M.Y. A scoping review of national policies for healthy ageing in mainland China from 2016 to 2020. *Lancet Reg. Health-West. Pac.* **2021**, *12*, 100168. [CrossRef] [PubMed]
4. Busch, P.A.; Hausvik, G.I.; Ropstad, O.K.; Pettersen, D. Smartphone usage among older adults. *Comput. Hum. Behav.* **2021**, *121*, 106783. [CrossRef]
5. Berenguer, A.; Goncalves, J.; Hosio, S.; Ferreira, D.; Anagnostopoulos, T.; Kostakos, V. Are smartphones ubiquitous? An in-depth survey of smartphone adoption by seniors. *IEEE Trans. Consum. Electron.* **2017**, *6*, 104–110. [CrossRef]
6. John, P. Smartphone applications for patients' health and fitness. *Am. J. Med.* **2016**, *129*, 11–19.
7. Huang, G.; Ren, Y. Linking technological functions of fitness mobile apps with continuance usage among Chinese users: Moderating role of exercise self-efficacy. *Comput. Hum. Behav.* **2020**, *103*, 151–160. [CrossRef]
8. Fogg, B.J. Persuasive technology: Using computers to change what we think and do. *Ubiquity* **2002**, *2002*, 763957. [CrossRef]

9. Orji, R.; Mandryk, R.L.; Vassileva, J. Selecting Effective Strategies for Tailoring Persuasive Health Games to Gamer Types. In Proceedings of the GRAND 2014, Ottawa, ON, Canada, 14–16 May 2014.
10. Deterding, S.; Dixon, D.; Khaled, R.; Nacke, L. From Game Design Elements to Gamefulness: Defining "Gamification". In Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments, New York, NY, USA, 28 September 2011; pp. 9–15.
11. Werbach, K. *Defining Gamification: A Process Approach, Persuasive Technology*; Springer International Publishing: Cham, Switzerland, 2014; pp. 266–272.
12. Johnson, D.; Deterding, S.; Kuhn, K.A.; Staneva, A.; Stoyanov, S.; Hides, L. Gamification for health and wellbeing: A systematic review of the literature. *Internet Interv.* **2016**, *6*, 89–106. [CrossRef]
13. Treiblmaier, H.; Putz, L.M. Gamification as a moderator for the impact of intrinsic motivation: Findings from a multigroup field experiment. *Learn. Motiv.* **2020**, *71*, 101655. [CrossRef]
14. Giráldez, V.A.; Sanmiguel-Rodríguez, A.; Álvarez, O.R.; Navarro-Patón, R. Can gamification influence the academic performance of students? *Sustainability* **2022**, *14*, 5115. [CrossRef]
15. Dichev, C.; Dicheva, D. Gamifying education: What is known, what is believed and what remains uncertain: A critical review. *Int. J. Educ. Technol. High. Educ.* **2017**, *14*, 9. [CrossRef]
16. Gentry, S.V.; Gauthier, A.; Ehrstrom, B.L.; Wortley, D.; Lilienthal, A.; Car, L.T.; Dauwels-Okutsu, S.; Nikolaou, C.K.; Zary, N.; Campbell, J.; et al. Serious gaming and gamification education in health professions: Systematic review. *J. Med. Internet Res.* **2019**, *21*, e12994. [CrossRef]
17. Lister, C.; West, J.H.; Cannon, B.; Sax, T.; Brodegard, D. Just a fad? Gamification in health and fitness apps. *JMIR Serious Games* **2014**, *2*, e3413. [CrossRef] [PubMed]
18. McCallum, S. Gamification and serious games for personalized health. *Stud. Health Technol. Inform.* **2012**, *177*, 85–96.
19. Cafazzo, J.A.; Casselman, M.; Hamming, N.; Katzman, D.K.; Palmert, M.R. Design of an mhealth app for the self-management of adolescent type 1 diabetes: A pilot study. *J. Med. Internet Res.* **2012**, *14*, e2058. [CrossRef]
20. Fijačko, N.; Gosak, L.; Cilar, L.; Novšak, A.; Creber, R.M.; Skok, P.; Štiglic, G. The effects of gamification and oral self-care on oral hygiene in children: Systematic search in app stores and evaluation of apps. *JMIR Mhealth Uhealth* **2020**, *8*, e16365. [CrossRef] [PubMed]
21. Sarker, U.; Kanuka, H.; Norris, C.; Raymond, C.; Yonge, O.; Davidson, S. Gamification in nursing literature: An integrative review. *Int. J. Nurs. Educ. Scholarsh.* **2021**, *1*, 18. [CrossRef] [PubMed]
22. Sailer, M.; Hense, J.U.; Mayr, K.S.; Mandl, H. How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. *Comput. Hum. Behav.* **2017**, *69*, 371–380. [CrossRef]
23. Carrión-Toro, M.; Santorum, M.; Acosta-Vargas, P.; Aguilar, J.; Pérez, M. Iplus a user-centered methodology for serious games design. *Appl. Sci.* **2020**, *10*, 9007. [CrossRef]
24. Gamecho, B.; Silva, H.; Guerreiro, J.; Gardeazabal, L.; Abascal, J. A context-aware application to increase elderly users compliance with physical rehabilitation exercises at home via animatronic biofeedback. *J. Med. Syst.* **2015**, *39*, 135. [CrossRef]
25. Sardi, L.; Idri, A.; Fernández-Alemán, J.L. A systematic review of gamification in e-Health. *J. Biomed. Inform.* **2017**, *71*, 31–48. [CrossRef] [PubMed]
26. Kappen, D.L.; Mirza-Babaei, P.; Nacke, L.E. Technology facilitates physical activity through gamification: A thematic analysis of an 8-week study. *Front. Comput. Sci.* **2020**, *2*, 530309. [CrossRef]
27. Koivisto, J.; Malik, A. Gamification for older adults: A systematic literature review. *Gerontologist* **2021**, *61*, e360–e372. [CrossRef] [PubMed]
28. Toda, A.; Oliveira, W.; Shi, L.; Bittencourt, I.I.; Isotani, S.; Cristea, A. Planning Gamification Strategies Based on User Characteristics and DM: A Gender-Based Case Study. In Proceedings of the 12th International Conference on Educational Data Mining, Montreal, QC, Canada, 2–5 July 2019; pp. 438–443.
29. Hanus, M.D.; Fox, J. Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. *Comput. Educ.* **2015**, *80*, 152–161. [CrossRef]
30. Santos, A.C.G.; Oliveira, W.; Hamari, J.; Rodrigues, L.; Toda, A.M.; Palomino, P.T.; Isotani, S. The relationship between user types and gamification designs. *User Model. User-Adapt. Interact.* **2021**, *31*, 907–940. [CrossRef]
31. Vette, F.; Tabak, M.; Hermens, H.J.; Vollenbroek, M. Mapping Game Preferences of Older Adults: A Field Study towards Tailored Gamified Applications. In Proceedings of the 10th Nordic Conference on Human-Computer Interaction, Oslo, Norway, 29 September–3 October 2018; pp. 93–101.
32. Kuo, C.M.; Chen, H.J. The Gamer Types of Seniors and Gamification Strategies toward Physical Activity. In *International Conference on Human-Computer Interaction*; Zhou, J., Salvendy, G., Eds.; Springer: Cham, Switzerland, 2019; pp. 177–188.
33. Kappen, D.L.; Nacke, L.E.; Gerling, K.M.; Tsotsos, L.E. Design Strategies for Gamified Physical Activity Applications for Older Adults. In Proceedings of the 49th Hawaii International Conference on System Sciences, Washington, DC, USA, 5–8 January 2016.
34. Vette, A.F.A.; Weering, M.; Tabak, M.; Vollenbroek-Hutten, M.M.R. Exploring Personality and Game Preferences in the Younger and Older Population: A Pilot Study. In Proceedings of the International Conference on Information and Communication Technologies for Ageing Well and e-Health, Rome, Italy, 21 April 2016; pp. 99–106.
35. Shih, L.H.; Jheng, Y.C. Selecting persuasive strategies and game design elements for encouraging energy saving behavior. *Sustainability* **2017**, *9*, 1281. [CrossRef]

36. Gerling, K.M.; Schulte, F.P.; Smeddinck, J.; Masuch, M. Game Design for Older Adults: Effects of Age-Related Changes on Structural Elements of Digital Games. In *Entertainment Computing—ICEC 2012*; Herrlich, M., Malaka, R., Masuch, M., Eds.; Springer: Berlin/Heidelberg, Germany, 2012; Volume 7522, pp. 235–242.
37. Denden, M.; Tlili, A.; Essalmi, F.; Jemni, M.; Chen, N.-S.; Burgos, D. Effects of gender and personality differences on students' perception of game design elements in educational gamification. *Int. J. Hum.-Comput. Stud.* **2021**, *154*, 102674. [CrossRef]
38. Yuan, T.; Guo, Y. Gamification Design of Health Apps for the Elderly Based on the Kano Model and Conjoint Analysis Method. In *Human Aspects of IT for the Aged Population. Supporting Everyday Life Activities*; Gao, Q., Zhou, J., Eds.; Springer: Cham, Switzerland, 2021.
39. Abdullahi, A.M.; Orji, R.; Kawu, A.A. Gender, age and subjective well-being: Towards personalized persuasive health interventions. *Information* **2019**, *10*, 301. [CrossRef]
40. Abdullahi, A.M.; Oyibo, K.; Orji, R.; Kawu, A.A. The influence of age, gender, and cognitive ability on the susceptibility to persuasive strategies. *Information* **2019**, *10*, 352. [CrossRef]
41. Radhakrishnan, K.; Baranowski, T.; O'Hair, M.; Fournier, C.A.; Spranger, C.B.; Kim, M.T. Personalizing sensor-controlled digital gaming to self-management needs of older adults with heart failure: A qualitative study. *Games Health J.* **2020**, *9*, 304–310. [CrossRef]
42. Liu, Y.; Wang, Y.; Liang, F.; Chen, Y.; Liu, L.; Li, Y.; Yao, H.; Chu, Q. The health literacy status and influencing factors of older population in xinjiang. *Iran. J. Public Health* **2015**, *44*, 913–919. [PubMed]
43. Werbach, K.; Hunter, D. *The Gamification Toolkit: Dynamics, Mechanics, and Components for the Win*; Wharton School Press: Philadelphia, PA, USA, 2015.
44. Kano, N.; Seraku, N.; Takahashi, F.; Tsuji, S. Attractive quality and must-be quality. *J. Jpn. Soc. Qual. Control* **1984**, *14*, 147–156.
45. Green, P.E.; Srinivasan, V. Conjoint analysis in consumer research: Issues and outlook. *J. Consum. Res.* **1978**, *5*, 103–123. [CrossRef]
46. Yin, S.; Cai, X.; Wang, Z.; Zhang, Y.; Luo, S.; Ma, J. Impact of gamification elements on user satisfaction in health and fitness applications: A comprehensive approach based on the Kano model. *Comput. Hum. Behav.* **2022**, *128*, 107106. [CrossRef]
47. Min, S.H.; Kim, H.Y.; Kwon, Y.J.; Sohn, S.Y. Conjoint analysis for improving the e-book reader in the Korean market. *Expert Syst. Appl.* **2011**, *38*, 12923–12929. [CrossRef]
48. Knudsen, J.K.; Havens, J.R. Using conjoint analysis to study health policy changes: An example from a cohort of persons who use drugs. *Int. J. Drug Policy* **2021**, *98*, 103425. [CrossRef]
49. Pleger, L.E.; Mertes, A.; Rey, A.; Brüesch, C. Allowing users to pick and choose: A conjoint analysis of end-user preferences of public e-services. *Gov. Inf. Q.* **2020**, *37*, 101473. [CrossRef]
50. Anand, A.; Bansal, G.; Aggrawal, D. Choice based diffusion model for predicting sales of mobile phones using conjoint analysis. *J. High Technol. Manag. Res.* **2018**, *29*, 216–226. [CrossRef]
51. Zhang, J.; Wei, X.; Fukuda, H.; Zhang, L.; Ji, X. A Choice-based conjoint analysis of social media picture posting and souvenir purchasing preference: A case study of social analytics on tourism. *Inf. Process. Manag.* **2021**, *58*, 102716. [CrossRef]
52. Chen, L. Research on consumer preference of remanufactured products based on conjoint analysis method. *Shanghai Manag. Sci.* **2020**, *42*, 46–53.
53. Ho, H.H.; Tzeng, S.Y. Using the Kano model to analyze the user interface needs of middle-aged and older adults in mobile reading. *Comput. Hum. Behav.* **2021**, *3*, 100074. [CrossRef]
54. Tabak, M.; Vette, F.; Dijk, H.; Vollenbroek-Hutten, M. A game-based, physical activity coaching application for older adults: Design approach and user experience in daily life. *Games Health J.* **2020**, *9*, 215–226. [CrossRef] [PubMed]
55. Deci, E.L.; Ryan, R.M. Motivation, Personality, and Development within Embedded Social Contexts: An Overview of Self-Determination Theory. In *The Oxford Handbook of Human Motivation*; Ryan, R.M., Ed.; Oxford University Press: Oxford, UK, 2012; p. 1e59.
56. Tizuka, M.M.; Clua, E.W.G.; de Castro Salgado, L.C. Investigating m-Health Gamification Rewards Elements for Adults 50+. In Proceedings of the 2020 IEEE 8th International Conference on Serious Games and Applications for Health (SeGAH), Vancouver, BC, Canada, 12–14 August 2020.
57. Maslow, A.H. A theory of human motivation. *Psychol. Rev.* **1943**, *50*, 370–396. [CrossRef]
58. Chen, C.X.; Feng, L.N.; Li, S.X. The correlation between socioeconomic status and health self-management in the elderly. *Int. J. Nurs. Stud.* **2014**, *1*, 410–415. [CrossRef]