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Research on the Influencing Factors of Users Fitness Satisfaction - Taking Fitness Games as an Example

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Abstract. Fitness games provide more possibilities for improving individual physical health and contributing to ecological sustainability. However, there is limited research on the user experience of fitness games. In this study, using fitness games as an example, we explore the factors influencing user satisfaction with fitness from the perspective of game attributes and prioritize these factors. The research involves distributing 510 survey questionnaires and constructing a structural equation model to examine the relationships between usefulness, functional quality, playfulness, technical quality, ease-of-use, social interaction, and user satisfaction. The study reveals that the core factors influencing user satisfaction are usefulness and playfulness. Additionally, the other factors mutually influence each other and collectively contribute to users' evaluations of the usefulness and playfulness of the game.

Keywords. fitness games, user satisfaction, healthy, structural equation model

1. Introduction

Although physical fitness plays a crucial role in promoting the psychophysical health of individuals, traditional sports are significantly constrained by the limitations of dedicated sports facilities [1]. The construction and maintenance of sports venues require substantial financial and resource investments [2]. Moreover, professional sports facilities emit pollutants during operation [3]. This renders traditional sports methods incompatible with ecological sustainable development models focused on reducing resource waste and environmental pollution [4]. Therefore, addressing how to simultaneously meet individual fitness needs and promote ecological sustainability is a pressing issue.

However, fitness gaming, as an emerging fitness modality, is gaining widespread popularity due to its characteristics of being independent of specific spatial constraints and effectively encouraging individuals to engage in fitness activities [5]. Current research not only demonstrates the positive fitness effects of fitness gaming [6] but also highlights its significant promotion of individual physical health [7]. Enhancing user satisfaction with fitness gaming, thereby increasing its usage, holds great significance for both personal health and ecological conservation.

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User satisfaction is the subjective evaluation sum of users' experiences during game interactions, serving as the ultimate goal for any technology provider and directly influencing users' willingness to use [8]. However, current research on fitness gaming is primarily focused on technical development, with studies on user experience still in their early stages. Although Wang [9] took the lead in constructing a fitness gaming evaluation scale, there is a lack of further exploration into the relationship between various attributes of fitness gaming and user satisfaction.

Therefore, this study further investigates the correlation between game attributes and user satisfaction, putting forth pertinent developmental recommendations, which can effectively promote the development of fitness gaming and contribute to ecological sustainability.

2. Literature review and hypothesis construction

2.1. User satisfaction

Satisfaction (S) is a fundamental concept in the field of marketing. It represents a general evaluation by consumers of a product or service based on their personal consumption experiences [10]. Currently, numerous theories in the field of marketing, such as the Expectancy-Confirmation Theory [11] and Satisfaction Theory [12], consider satisfaction as a crucial element in studying consumer user experiences and further predicting consumer behavior. In the realm of technological applications, satisfaction is acknowledged as the ultimate goal for any technology provider [8]. Therefore, exploring the influencing factors on fitness gaming satisfaction is of utmost importance for the development of fitness gaming.

2.2. Fitness gaming

Fitness gaming, as an emerging fitness medium, is primarily focused on technological development [13] and practical efficacy exploration [14] in current research. However, there remains a significant gap in research concerning the user experience direction. Despite numerous studies exploring satisfaction of fitness mobile applications [15] and entertainment game [16], there is a necessity for dedicated research on fitness gaming satisfaction. This is due to the unique dual attributes of fitness gaming, combining entertainment and fitness, and its ability to provide users with visual and experiential sensations surpassing those of typical fitness apps [9].

In the field of fitness gaming user experience, Wang [9] has initially summarized the fundamental attributes of fitness gaming: usefulness (U), functional quality (FQ), playfulness (P), technical quality (TQ), ease-of-use (EOU), and social interaction (SI). However, there has not been further exploration of the associations between these elements and satisfaction. Therefore, this study aims to build upon this foundation and further investigate the correlations between each element and user satisfaction, contributing to the enhancement of satisfaction in the fitness gaming experience.

Currently, research has already demonstrated that usefulness [17], functional quality [18], playfulness [19], technical quality [20], ease-of-use [20], and social interaction [21] positively influence user satisfaction. Simultaneously, there are certain influencing relationships among these elements. For instance, ease-of-use positively influences

usefulness [22]; technical quality positively influences functional quality [9]; technical quality positively influences ease-of-use [23]; functional quality positively influences usefulness [24]; social interaction positively influences playfulness [25]; social interaction positively influences functional quality [26]; social interaction positively influences ease-of-use [27]; technical quality positively influences playfulness [28]; technical quality positively influences social interaction [29].

This study proposes the following hypotheses for fitness games:

H1: Functional quality positively influences usefulness. H2: Ease-of-use positively influences usefulness. H3: Social interaction positively influences functional quality. H4: Social interaction positively influences ease-of-use. H5: Technical quality positively influences functional quality. H6: Technical quality positively influences ease-of-use. H7: Technical quality positively influences social interaction. H8: Social interaction positively influences playfulness. H9: Technical quality positively influences playfulness. H10: Usefulness positively influences user satisfaction. H11: Playfulness positively influences user satisfaction. H12: Functional quality positively influences user satisfaction. H13: Technical quality positively influences user satisfaction. H14: Ease-of-use positively influences user satisfaction. H15: Social interaction positively influences user satisfaction.

3. Methods

This study employed a cross-sectional research design, inviting 510 participants with good physical health and extensive experience in using fitness games to complete a survey questionnaire, thereby collecting user evaluations. Subsequently, data analysis and structural equation modeling were conducted using Amos 24 software and SPSS 26.0 software.

For the evaluation of fitness gaming attributes, the study utilized the fitness game evaluation scale developed by Wang [9], collecting user perspectives with a Likert 7-point scale. Additionally, for the investigation of user satisfaction, this research used established satisfaction evaluation scales [30-32] to obtain user satisfaction assessments.

4. Results

4.1. Reliability analysis results

Currently, the reliability of each influencing factor is greater than 0.6, and the total correlation values of the correction items are not less than 0.4. This indicates that the collected data has good reliability [33], allowing for subsequent data analysis.

4.2. Exploratory factor analysis results

In exploratory factor analysis, it was observed that each factor could only extract a new factor with an eigenvalue greater than 1, indicating good singularity of the dataset [34]. Furthermore, after conducting an information condensation study, it was found that the Kaiser-Meyer-Olkin (KMO) values were all not less than 0.6, and the Bartlett sphericity

test values were all not greater than 0.05, demonstrating that the dataset is suitable for confirmatory factor analysis.

4.3. Confirmatory factor analysis results

In the confirmatory factor analysis, the factor loading coefficients are currently all greater than 0.5 [35, 36]. Additionally, the AVE values are all greater than 0.36 [37], and CR values are all higher than 0.6 [38]. The analysis items exhibit significance ($p < 0.05$), demonstrating a good correspondence between latent variables and observed variables, and the convergent validity meets the standards. The results shown in table 1.

Table 1. Factor load factor

Factor	Item	Coef.	Std. Error	z	p	Std. Estimate	AVE	CR
Usefulness	U1	1	-	-	-	0.654	0.464	0.722
	U2	1.063	0.083	12.809	0	0.705		
	U3	1.028	0.082	12.535	0	0.685		
Functional quality	FQ1	1	-	-	-	0.684	0.456	0.715
	FQ2	0.786	0.068	11.578	0	0.608		
	FQ3	0.983	0.074	13.36	0	0.73		
Playfulness	P1	1	-	-	-	0.623	0.416	0.68
	P2	0.916	0.089	10.306	0	0.61		
	P3	0.993	0.089	11.143	0	0.698		
Technical quality	TQ1	1	-	-	-	0.643	0.452	0.712
	TQ2	0.972	0.078	12.527	0	0.704		
	TQ3	0.944	0.078	12.057	0	0.668		
Ease-of-use	EOU1	1	-	-	-	0.621	0.392	0.659
	EOU2	1.07	0.099	10.854	0	0.614		
	EOU3	1.061	0.095	11.227	0	0.644		
Social interaction	SI 1	1	-	-	-	0.572	0.364	0.63
	SI 2	1.027	0.11	9.341	0	0.558		
	SI 3	1.164	0.111	10.486	0	0.673		
Satisfaction	ST1	1	-	-	-	0.658	0.456	0.715
	ST2	0.901	0.071	12.653	0	0.657		
	ST3	1.021	0.076	13.457	0	0.708		

In this study, discriminant validity between factors was examined through the square root of the AVE. The square root of the AVE for each factor is greater than the maximum value of its correlation coefficients, indicating that the seven factors synthesized through factor analysis have good discriminant validity. Further analysis using structural equation modeling can be conducted. The results are shown in table 2.

Table 2. Discriminant validity：Square root value of AVE

	U	FQ	P	TQ	EOU	SI	S
U	**0.681**						
FQ	0.51	**0.676**					
P	0.375	0.456	**0.645**				
TQ	0.447	0.547	0.503	**0.672**			
EOU	0.49	0.507	0.451	0.561	**0.626**		
SI	0.454	0.475	0.455	0.513	0.517	**0.603**	
S	0.668	0.548	0.486	0.512	0.54	0.465	**0.675**

4.4. Fitness satisfaction model analysis results

Based on the theoretical hypotheses, this study utilized Amos 24 software for model path analysis, as shown in table 3. Except for H12-H15, the p-values for the remaining hypotheses are all less than 0.05. This indicates that H1-H11 are supported, while the other hypotheses are not supported due to p-values exceeding 0.05, indicating nonsignificant path relationships.

Table 3. Summary table of model regression coefficients

Hypotheses	X	→	Y	Non-standard loading coefficient	SE	z (CR)	p	Path coefficient	Test result
H1	FQ	→	U	0.446	0.096	4.623	0.000	0.458	Valid
H2	EOU	→	U	0.487	0.129	3.779	0.000	0.371	Valid
H3	SI	→	FQ	0.509	0.18	2.827	0.005	0.362	Valid
H4	SI	→	EOU	0.5	0.144	3.477	0.001	0.48	Valid
H5	TQ	→	FQ	0.589	0.151	3.904	0.000	0.496	Valid
H6	TQ	→	EOU	0.39	0.116	3.364	0.001	0.443	Valid
H7	TQ	→	SI	0.669	0.075	8.904	0.000	0.793	Valid
H8	SI	→	P	0.308	0.141	2.176	0.030	0.298	Valid
H9	TQ	→	P	0.449	0.12	3.727	0.000	0.515	Valid
H10	U	→	S	0.676	0.102	6.648	0.000	0.699	Valid
H11	P	→	S	0.297	0.116	2.559	0.010	0.232	Valid
H12	FQ	→	S	0.103	0.11	0.935	0.35	0.109	Invalid
H13	TQ	→	S	-0.032	0.17	-0.189	0.85	-0.029	Invalid
H14	EOU	→	S	0.285	0.209	1.368	0.171	0.224	Invalid
H15	SI	→	S	-0.218	0.206	-1.06	0.289	-0.164	Invalid

5. Discussion

5.1. Discussion of results

H1 and H2 are both supported, indicating that the ease-of-use and functional quality of fitness games have a positive impact on their usefulness. In other words, if the operation of a fitness game is simpler and the presentation of functions is more appropriate, users are more likely to evaluate the game as useful.

H3 and H4 are supported, as well as H5 and H6. This indicates that during the user experience phase of fitness gaming, the technical quality and social interaction of the game positively influence users' perceptions of game functional quality and ease-of-use. This suggests that only fitness games with a high level of technological sophistication can encourage users to better experience the preset functions of the game and understand the preset rules, allowing users to quickly learn how to use the fitness game. Simultaneously, effective communication among different game users can help users perceive the quality of functions better, and interaction among peers is an effective method to reduce the difficulty of game operation. Additionally, H7 is also supported, indicating that the technical quality of fitness games positively influences the social interaction within the game, emphasizing the importance of technical quality in creating social interaction in the game.

H8 and H9 are supported, indicating that the playfulness of the game is simultaneously positively influenced by social interaction and technical quality. This suggests that the higher the social engagement and the technological sophistication of the fitness game, the more users can experience the enjoyment of the game.

H10 and H11 are supported, while H12-H15 are not. This indicates that during the user experience phase of fitness gaming, only usefulness and playfulness can directly influence user satisfaction. The other factors cannot directly impact user satisfaction. Usability and social interaction need to indirectly influence user satisfaction through playfulness, while functional quality and technical quality need to indirectly influence user satisfaction through usefulness. As mentioned earlier, satisfaction is the subjective evaluation sum of users' game interaction experience. Based on the fact that satisfaction is only influenced by usefulness representing practical value and playfulness representing emotional value, it can be inferred that satisfaction evaluation can be divided into two parts: the practical value and emotional value of the product. The other factors form the basis for users to assess usefulness and playfulness in the game. By comparing the path coefficients between usefulness and satisfaction with the path coefficients for playfulness, it can be observed that the path coefficient for usefulness is 0.699, greater than the path coefficient for playfulness, which is 0.232. This suggests that, despite satisfaction being an emotional subjective evaluation [39], the practical value of fitness games remains the most important.

Meanwhile, in terms of practical value, the path coefficient between functional quality and usefulness, both secondary factors, is greater than that of ease-of-use. In terms of emotional value, the path coefficient between technical quality and playfulness, both secondary factors, is greater than social interaction. Moreover, the importance of usefulness is greater than playfulness, indicating the relationship between each factor and satisfaction as follows: Usefulness > Playfulness > Functional quality > Ease-of-use > Technical quality > Social interaction.

5.2. Design and management recommendations

This study comprehensively explored the relationships between various factors and user satisfaction based on the fundamental attributes of fitness games, as well as prioritized the attributes in gaming. In addition to contributing to the research on the user experience of fitness games, this study provides theoretical support for the development and sustainable growth of related enterprises. Drawing on the research findings and the requirements of the era for sustainable development, the study proposes the following design and operational strategies.

Usefulness and playfulness, being able to directly influence user satisfaction in the experience, are the most critical elements in the process of fitness game interaction. Therefore, game producers and designers must prioritize meeting these two aspects.

In terms of usefulness, current research indicates that timely feedback confirmation is an effective way to help users perceive usefulness [30]. Therefore, fitness games should be equipped with devices to detect users' personal body data and the standard level of fitness movements. This enables users to perceive changes in their bodies after each fitness session. Additionally, on the software side, the game should provide regular fitness reports or notifications to make users clearly aware of the fitness effects of using the game and allow them to feel their own growth. In terms of game mechanics, multiple levels or a leveling-up mechanism should be implemented [40]. This not only promotes

users' continuous use but also creates a sense of progress for users through the growth of in-game characters.

Simultaneously, users can enhance their perception of usefulness through the shaping of functional quality and ease of use. For example, providing professional fitness action demonstration videos or tutorials helps users understand how to exercise correctly and effectively. Incorporating fitness-related knowledge within the game, such as knowledge cards or incorporating fitness guidelines as game rules, can unintentionally educate users. Assisting users in setting realistic fitness goals and encouraging them to follow through is crucial. The game should offer a diverse range of fitness activities to cater to various user preferences. When it comes to fitness game equipment, it should meet the diverse needs of users for different fitness activities while striving to simplify the complexity of the devices to minimize the learning curve. Additionally, during the gameplay, it is advisable to reduce excessive background introductions and provide options to skip narratives, simplifying the overall gaming experience.

In terms of playfulness, the game can opt for collaborations with well-known games or story IDs to use them as the background for the game. This approach helps users quickly accept and understand the game. Additionally, the character movements in the game should be well-integrated with users' fitness actions, giving specific meaning to fitness movements. This enables users to unconsciously complete fitness tasks during the progression of the game story. The level of physical activity in the game should also be appropriately arranged, because there is research suggesting that moderate physical activity can effectively regulate individual emotions, promoting a relaxed mood [41].

Simultaneously, the game can enhance playfulness through the shaping of technical quality and social interaction. For instance, incorporating various team games, establishing family fitness records, encouraging participation from family and friends, and enhancing game playfulness through collaboration and competition with other users. Moreover, the game can leverage VR or AR technology to use beautiful natural environments as the game's background. This not only creates a more immersive and playful experience for users but also reduces their reliance on specialized fitness facilities. This, in turn, indirectly diminishes the need for constructing such facilities, contributing to a reduction in resource waste.

Furthermore, in the current era where sustainability is a prevailing theme, fitness games can integrate environmental conservation activities, such as tree planting and the construction of ecological parks, with fitness movements. This not only enhances the enjoyment of fitness but also helps cultivate users' awareness of environmental protection.

6. Conclusion

6.1. Research conclusion

This study employed a structural equation modeling approach to construct a model for user satisfaction in fitness gaming, determining the relationships among various influencing factors and prioritizing their importance in the user experience. The conclusions drawn from the analysis are as follows:

- User experience satisfaction is primarily assessed from two perspectives: usefulness, representing the practical value of the game, and playfulness, representing emotional value for users. Usefulness is influenced by the game's

functional quality and ease of use, while playfulness is influenced by technical quality and social interaction.

- Comparison of path coefficients reveals that usefulness is the core factor influencing user satisfaction in contrast to playfulness.
- Secondary factors affecting user satisfaction also exhibit mutual influences, with technical quality positively impacting functional quality and ease of use, while social interaction positively influences functional quality and ease of use.
- The prioritization of importance among factors in user satisfaction in fitness gaming is as follows: Usefulness > Playfulness > Functional Quality > Ease-of-use > Technical Quality > Social Interaction.

6.2. Limitations and prospects

This study explores the correlation between various fitness elements and user satisfaction based on the existing literature on user perception of fitness game experiences. From this exploration, relevant design and management suggestions are proposed, providing valuable insights for future research on fitness games. However, the study has certain limitations. The factors investigated in this study primarily stem from the attributes of fitness games themselves. External environmental conditions of users and their personal psychological characteristics, such as self-efficacy, social concern, personal pursuits, and societal responsibilities for ecological conservation, may also play crucial roles in influencing user satisfaction with fitness game usage. These aspects have not been thoroughly addressed in this study. Therefore, future research could further integrate relevant theoretical models from psychological and behavioral studies to explore additional factors affecting user satisfaction and enhance the understanding of user experiences in fitness games.

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