frontiers | Frontiers in Sustainability

ORIGINAL RESEARCH
published: 25 April 2022
doi: 10.3389/frsus.2022.846774

Research on Incentive Mechanism and Evaluation of Gamification Application for Sustainable Consumption in the Context of China

Shouheng Sun[1,2]*, *Zhenqin Wang*[2], *Qi Wu*[3] *and Weicai Wang*[2]*

[1] Laboratory of Research on New Forms of Consumption, Department of Economics and Administrative Sciences, University of Quebec at Chicoutimi, Saguenay, QC, Canada, [2] School of Economics and Management, University of Science and Technology Beijing, Beijing, China, [3] School of Finance, Hebei University of Economics and Business, Shijiazhuang, China

The gamification of sustainable consumption is receiving more and more attention from both academic and business circles. However, there is still a lack of research on the incentive mechanism and evaluation of gamification design to promote sustainable consumption behavior. Taking the gamified apps that promote sustainable consumption in China as an example, this study attempts to explore the incentive mechanism of gamification application for sustainable consumption by using the "stimulus-organism-response" model. Furthermore, it also constructs an evaluation index system of gamification design for sustainable consumption app and identifies the key factors in the gamification design by using the analytic hierarchy process. The results suggest that gamification apps use game elements and game mechanism frameworks to build a new sustainable consumption context for users, which breaks the boundary between reality and virtuality, and enables users to gain real-life value for their behavior in the virtual world. Moreover, the trust mechanism and socialized contextual experience of the gamified apps further strengthen this sense of connectedness and interaction, and enhance the user's motivation for sustainable consumption. In the gamification design of sustainable consumption app, more attention needs to be paid to the implementation effect behind gamification, that is, to promote the cultivation of public sustainable consumption values and lifestyle. This study advances theoretical and practical understanding of the gamification of sustainable consumption. The results can also be used as a starting base for the development and design of gamified apps in the sustainable consumption field.

Keywords: gamification, sustainable consumption (SC), digital app., sustainability, low-carbon lifestyle, evaluation index system (EIS), analytic hierarchy process (AHP)

OPEN ACCESS

Edited by:
Leila Elgaaied-Gambier, Toulouse Business School, France

Reviewed by:
Tero Jussi Reunanen, Turku University of Applied Sciences, Finland
Anupam Khajuria, United Nations Centre for Regional Development, Japan

***Correspondence:**
Weicai Wang
wtwang@ustb.edu.cn
Shouheng Sun
shouheng.sun1@uqac.ca

Specialty section:
This article was submitted to Sustainable Consumption, a section of the journal Frontiers in Sustainability

Received: *31 December 2021*
Accepted: *28 March 2022*
Published: *25 April 2022*

Citation:
Sun S, Wang Z, Wu Q and Wang W (2022) Research on Incentive Mechanism and Evaluation of Gamification Application for Sustainable Consumption in the Context of China. Front. Sustain. 3:846774. doi: 10.3389/frsus.2022.846774

INTRODUCTION

The network information technology and related digital application have been widely used to impact and change individual consumption practices and lifestyle, among which gamification is one of the most famous ways. Gamification has the characteristics and attributes of games, which can provide users with a game-like experience and make business processes more attractive (Werbach and Hunter, 2020). There is a significant difference between gamification and gaming. The game just stays on the fun level, but gamification must go beyond pure fun. It requires customers to have

fun while also encouraging them to change their behaviors and solve specific problems (Robson et al., 2016). At present, there is no uniform definition of gamification in academic circles, but the definition proposed by Deterding et al. (2011) is generally accepted, that is, gamification is described as the use of game design elements in a non-game context.

Gamification has been successfully applied in many fields. Gamification was initially used primarily in marketing. Specifically, gamification elements have been applied to various marketing campaigns to give online consumers a kind of game experience, in order to increase online consumers' participation in online store marketing activities and further generate corresponding purchase behavior such as applying gamification to advertising to enhance interactivity (Terlutter and Capella, 2013; Bittner and Shipper, 2014; Vashisht et al., 2019; Sreejesh et al., 2021), and applying gamification elements to word-of-mouth recommendations to improve the quality of reviews (Hofacker et al., 2016; Vashisht et al., 2019; Mishra and Malhotra, 2021; Sreejesh et al., 2021). In terms of human resources, gamification design can run through every link in the field of human resources management (Simpson and Jenkins, 2015; Korn et al., 2017). Enterprises can take advantage of the game to recruit staff, implement staff management, enhance the level of employees' skills and professional ethics quality, and boost the enthusiasm of the employees to participate in training (Simpson and Jenkins, 2015; Prasad et al., 2019; Walls, 2021). In the field of education, the application of gamification in the classroom can save manpower, material resources and financial resources, and also can influence students' behavior or attitude to improve their academic performance and learning satisfaction (Dicheva et al., 2015; Kim et al., 2018; Rahardja et al., 2019). In fitness products, gamified design has a significant effect on persuading patients to abide by treatment principles, improving their health status, promoting health cognition and meeting social and emotional needs (Brauner et al., 2013; Cotton and Patel, 2019; Tu et al., 2019). In the application of health management, the design of customization, simulation, self-monitoring, suggestion, individuation, simulation, praise, reward, comparison, competition and cooperation mechanisms can promote the change of users' habits and health behavior (Brauner et al., 2013; Johnson et al., 2016; Cotton and Patel, 2019; Zolfaghari et al., 2021). In addition, examples of gamification can be found in different application areas such as sustainable development, environmentally conscious behavior, enterprise resource planning, production logistics, and supporting innovation processes (Fuentes, 2016; Wanick and Bui, 2019; Warmelink et al., 2020; Werbach and Hunter, 2020).

Driven by digital technology, the realistic context of propagation and communication has been profoundly changed. The birth of VR, AI, big data, and other emerging technologies has provided strong support for the deep integration of information communication and entertainment. Some Gamification apps based on emerging digital technologies to promote public sustainable consumption behavior are gradually growing (Fuentes, 2016; Guillen et al., 2021). These applications integrate social networking and game design concepts to promote interaction between users and products, which can effectively improve users' awareness of eco-environmental protection and promote the change of green attitude and sustainable consumption behavior (Huber and Hilty, 2015; Fuentes, 2016; Mattsson, 2019; Mulcahy et al., 2020). However, the applied research of gamification apps for sustainable consumption is still in its infancy.

Currently, researches on gamification in the field of sustainable consumption mainly focus on the following aspects. Some studies have discussed the technology means for implementing gamification toward individual sustainable consumption, such as the development, testing, and monitoring of mobile applications (apps), Internet of Things, machine learning, big data, wearable technologies, and other augmented reality (AR) and virtual reality (VR) technologies (Huber and Hilty, 2015; Mulcahy et al., 2020; Ashfaq et al., 2021; Guillen et al., 2021). In addition, some scholars have studied the principles, objectives, strategies, and specific game elements of the gamification design, while others have investigated the users' attitudes and willingness to use gamified applications for sustainable consumption from different perspectives and levels (Mattsson, 2019; Piligrimiene et al., 2020; Ashfaq et al., 2021; Luo et al., 2021). However, there is still a lack of research on the incentive mechanism of gamification apps to promote sustainable consumption behavior. In particular, at present, the gamification design for consumption sustainable app has not formed a systematic evaluation index system, which is of great significance to the improvement of game experience and the promotion and use of gamification app for sustainable consumption.

Therefore, taking the gamified apps that promote sustainable consumption in China as an example, this study summarizes and conceptualizes the characteristics and mechanism of the gamification design for sustainable consumption app. It attempts to reveal the incentive process and mechanism of gamification to promote users' sustainable consumption behavior by comprehensively and deeply identifying and analyzing each component of the gamification apps, as well as their respective functions and interaction relations in the system. Furthermore, based on practical cases, this paper also tries to construct the evaluation index system of gamification design for sustainable consumption app, and use analytic hierarchy process (AHP) to identify the key factors in the gamified design for sustainable consumption app. This study not only has certain theoretical significance to supplement the existing research, but also has implications for managers and designers to develop better gamification app to promote the transition of the public to sustainable consumption behavior.

MATERIALS AND METHODS

The overall analysis process and framework of this paper are shown below. First, based on the specific elements and use process of gamification app, this study explores the incentive mechanism of gamification application for sustainable consumption by using the SOR model. Secondly, based on the gamification design features and practical application effects of

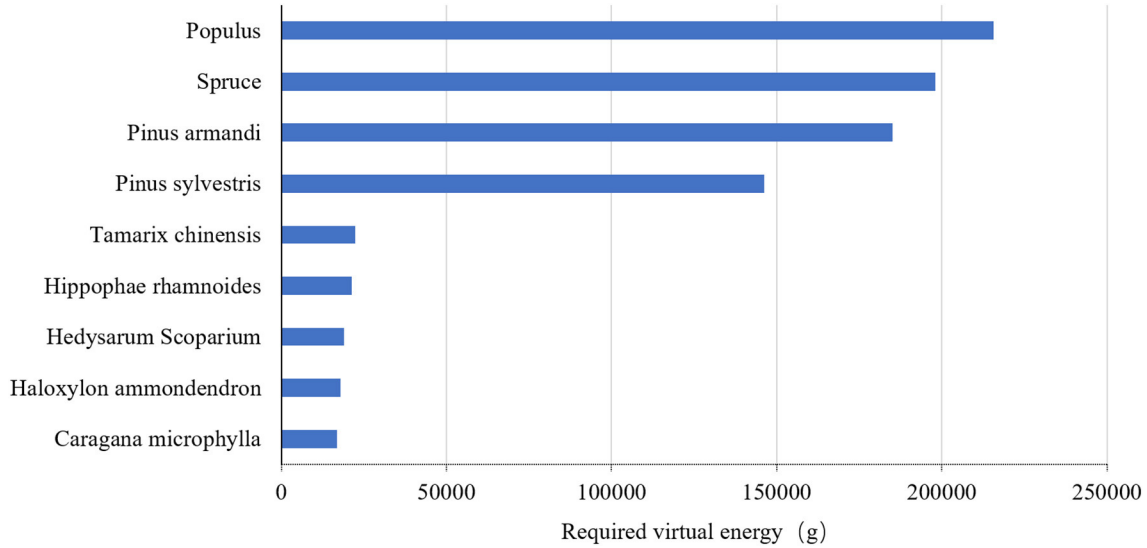

FIGURE 1 | The required virtual energy used to exchange offline real tree species.

sustainable consumption app, an evaluation index system for gamification design is constructed. By using the AHP method, it tries to identify the key factors of the gamification design of sustainable consumer app. The evaluation index system proposed in this paper can not only be applied to identify the gamification design problems in the existing sustainable consumption app, but also can provide references for future gamification design in this field.

Gamification Application for Sustainable Consumption in China

In recent years, China's Internet giants have gradually launched gamification apps to promote the public's transition to sustainable consumption behavior such as Ant Forest launched by Alibaba, and Xiaodu Farm launched by Baidu. They have similar operating processes and incentive mechanisms. Considering the influence and practical application effect of the app, this study takes Ant Forest as an example to study the incentive mechanism of gamification design for sustainable consumption.

Ant Forest uses a gamification strategy to combine low-carbon and sustainable consumption publicity with games, changing the previous propagation mode guided by publicity. This enables the public to better understand sustainable consumption during the entertainment process. In Ant Forest, users can accumulate online virtual energy through offline sustainable consumption behaviors, which can be used to cultivate the virtual tree online. When the virtual tree in the game matures, the corresponding real tree will be planted in the desert. This kind of gamification app is regarded as an innovative practice of propagating green and low carbon concept, and also brings new enlightenment to promote the public's sustainable consumption lifestyle.

The operation process of the gamification app can be roughly divided into 4 steps. First, users enter the mobile app to receive virtual saplings. Users can choose different tree species according to their preferences and goals such as Populus, Spruce, Pinus sylvestris, etc. (see **Figure 1**). The second step is the offline consumption activities of users. The app (Alipay) cooperates with different life service platforms and merchants to provide users with diversified life service scenarios for users. Users complete and record the sustainable consumption behaviors they choose

TABLE 1 | The virtual energy value corresponding to the offline sustainable consumption behavior.

Category	Behavior	The virtual energy value corresponding to each action
Green travel	Walk	≤296 g
	Bike sharing	≤159 g
	Bus	80 g
	Subway	52 g
Reducing travel	Online ticketing	180 g
	Pay utility and gas bills online	262 g
	Online appointment service	277 g
Reducing the use of paper and plastic	Electronic invoice Paperless reading	5 g ≤150 g per day
	Reduce the use of plastic bags, disposable meal boxes	21 g
	Buy and use environmental protection cup	≤600 g
Recycle	Package recycling	37 g
	Green package	40 g
	Second-hand goods recycling	≤9763 g

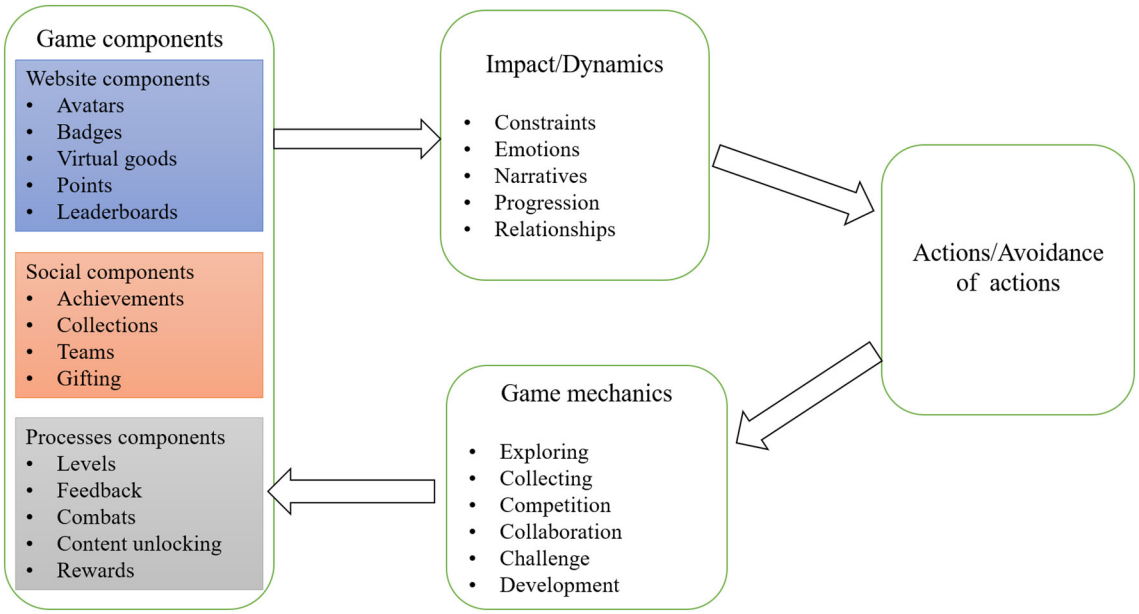

FIGURE 2 | A conceptual model of the impact of gamification on consumer behavior.

to participate in through the app (see **Table 1**). The third step is the accumulation of virtual energy values and the cultivation of virtual trees. Every offline low-carbon sustainable consumption activity corresponds to a certain amount of virtual energy. Users accumulate green energy through a variety of low-carbon sustainable consumption behaviors, and cultivate trees virtually online. The fourth step refers to the feedback from virtual to reality. When the required energy is reached (i.e., the virtual tree online is mature), a corresponding real tree will be planted for the user in the desert area. Ant Forest cooperates with related public welfare foundations, and entrusts offline tree planting projects to professional institutions. Finally, the offline planting task is completed with the help of local farmers and herdsmen, forest farms, or tree planting companies, so as to convert the virtual trees cultivated by users into real trees in a timely manner. The user can choose the planting area, and each tree has a unique number. Users can see real-life photos of the woodland through the satellite and the built-in "camera" of the app to understand the geographic location and growth status of the saplings.

SOR Model

The core of the gamification design is the game element. The game element is also the basis for studying the incentive mechanisms of gamified apps for sustainable consumption. For game element, the three-dimensionality of dynamics, mechanics and components proposed by Werbach and Hunter (2015) is the most accepted and widely used classification method for researchers. Constraint, emotion, narrative, progression, and relationship are typical dynamic elements that are integral concepts in gamified systems (Werbach and Hunter, 2015, 2020). Mechanics elements mainly include feedback, cooperation, transactions, challenges, competition, resource acquisition, rewards, etc. (Werbach and Hunter, 2015, 2020). In the process of gamification design, the mechanics elements represent the basic process of promoting gamification and user participation (Werbach and Hunter, 2015, 2020). In addition, components refer to the concrete examples of motivation and mechanics in gamification design, such as points, badges, leaderboards, social graphs, avatars, teams, and virtual goods (Werbach and Hunter, 2015, 2020).

The general pattern of human behavior is "SOR", that is, "stimulus-organism-response" (Jacoby, 2002; Kim et al., 2020). The SOR pattern has been widely used to study consumer motivation and behavior (Chang et al., 2011; Chen and Yao, 2018; Wu and Li, 2018). It argues that consumers' behavior is caused by stimuli, which come from the internal factors (e.g., individual factors in both physiology and psychology) and external environment factors (Chang et al., 2011; Kim et al., 2020). Combining the three-dimensionality of dynamics, mechanics and components of the gamification elements, Gatautis et al. (2016a,b) developed the SOR conceptual model of gamification marketing, as shown in **Figure 2**. In the context of gamification, components elements are used as stimulus factors to change the psychological state of consumers through dynamics elements, thereby further affecting consumers' decision-making and actions (Gatautis et al., 2016a,b). In addition, the mechanics elements of the game are not only directly related to the actions of consumers, but also affect the components elements and continuously generate a new round of stimuli (Gatautis et al., 2016a,b). Based on the specific elements and use process of gamification app, this study explores the incentive mechanism of gamification application for sustainable consumption by using the SOR model.

TABLE 2 | Scale method for the elements.

Factor *i* compared to factor *j*	Quantitative values
Equally important	1
Slightly important	3
Obviously important	5
Strongly important	7
Extremely important	9
The middle value of two adjacent judgments	2, 4, 6, 8

AHP Method

The AHP is a kind of hierarchical weight decision analysis approach proposed by professor Satie in the early 1970s by applying network system theory and multi-objective comprehensive evaluation method (Saaty, 1988, 1990). As a combination of qualitative and quantitative, systematic and hierarchical analysis methods, it has good practicability and effectiveness in dealing with decision-making and evaluation problems and has been widely used in economic planning and management, energy policy and distribution, market evaluation and product development, and other fields (Sun et al., 2017; Darko et al., 2019; Dos Santos et al., 2019; Rajak and Shaw, 2019; Yucesan and Kahraman, 2019). The whole analysis process of AHP can be divided into four steps.

(1) Build a hierarchical model

The purpose of this step is to construct a hierarchical structure diagram for decision-making goals or evaluation indexes at different levels according to their interrelationships (Taherdoost, 2017).

(2) Construct a judgment matrix

The judgment matrix is constructed by pairwise comparison method and 1–9 comparison scale for factors in the same layer which belong to (or influence) each factor in the upper layer (Vaidya and Kumar, 2006; Taherdoost, 2017). The elements of the judgment matrix are shown in Equation (1).

$$E_{ij} = \frac{1}{E_{ji}} \tag{1}$$

With E_{ij} referring to the importance of factor i relative to factor j. The scale method for judging matrix elements is shown in **Table 2**.

(3) Weight vector calculation and consistency test

The eigenvector corresponding to the largest eigenvalue (i.e., λ_{max}) of the judgment matrix is normalized. The elements of the normalized eigenvector correspond to the weights of the indicators at the same level. The determination of the weight vector requires a consistency test, and the consistency index (CI) can be calculated by Equation (2).

$$CI = \frac{\lambda_{max} - n}{n - 1} \tag{2}$$

With λ referring to the eigenvalue of the judgment matrix, n referring to the order (dimension) of the judgment matrix. $CI = 0$ means that E is a completely consistent judgment matrix. The smaller the CI, the greater the consistency, that is, the smaller the judgment error caused by the calculation of the index weight by using the eigenvector (Saaty, 1990; Sun et al., 2017). The smaller CI is, the better consistency is. In other words, using the eigenvector corresponding to the maximum eigenvalue as the weight vector of the compared factor will lead to a small judgment error. In order to measure the size of CI, the random consistency index RI is introduced, as shown in Equation (3).

$$RI = \frac{CI_1 + CI_2 + \ldots + CI_n}{n} \tag{3}$$

RI is related to the order of the judgment matrix. In general, the greater the order of the matrix, the greater the probability of random deviations from consistency. Based on CI and RI, the final result of the consistency test, that is, the consistency ratio (CR), can be calculated by Equation (4).

$$CR = \frac{CI}{RI} \tag{4}$$

As a rule, if $CR < 0.1$, the consistency test is passed, otherwise there is no satisfactory consistency of the judgment matrix (Saaty, 1990; Taherdoost, 2017).

(4) Sequencing for all indicators

This process is carried out sequentially from the highest level to the lowest level. First, it calculates the relative importance (weighted value) of all factors at a certain level to the highest level. Then, the all the indicators are sorted according to their weight values.

Evaluation Index System Construction and Data Collection

Evaluating the gamification design in gamification application projects can provide service providers with gamification design standards, improve the overall quality of games and user experience, so as to provide support for the healthy and sustainable development of gamification products. Existing studies on gamification design evaluation generally adopt a combination of qualitative and quantitative methods with different emphases (Sun et al., 2017; Rajak and Shaw, 2019; Yucesan and Kahraman, 2019). Some studies focus on the overall goals, content, and principles of gamification design, emphasizing the impact, value, and significance of gamification design (Terlutter and Capella, 2013; Landers et al., 2018; Ashfaq et al., 2021; Zolfaghari et al., 2021). Some studies focus on

TABLE 3 | Evaluation index system of gamification design for sustainable consumption app.

First grade index	Second grade index	Description	References
Overall principles and objectives (A)	Scenario design (A1)	The context and context of the game matches the content, tasks, and requirements of sustainable consumption to meet the purpose of promoting sustainable consumption.	Mattsson, 2019; Mulcahy et al., 2020; Piligrimiene et al., 2020; Warmelink et al., 2020; Guillen et al., 2021; Luo et al., 2021
	Logic of content (A2)	The logical structure and the content of the game are clear and conform to the rules of user cognition.	
	Clarity of objectives (A3)	The user has a clear understanding of the game's goals and content	
	Value proposition (A4)	Users are able to see the social and environmental impact of individual sustainable consumption behavior, perceive the value of their own contributions, and have a clear sense of mission.	
The interactive experience of the game (B)	Immersed feeling (B1)	Users can immerse themselves in the game and have a multi-sensory experience.	Deterding et al., 2011; Harms et al., 2015; Werbach and Hunter, 2015; Fuentes, 2016; Robson et al., 2016; Dastjerdi et al., 2019; Ashfaq et al., 2021; Guillen et al., 2021
	Sense of achievement (B2)	Users can achieve self-worth and gain self-acceptance in the game.	
	Artistic sense (B3)	Multimedia elements are integrated into the game, and the picture or situation is well designed to provide users with a good art appreciation experience.	
	Social interaction (B4)	Games can meet users' needs for sociability and community belonging. Users can communicate, compete and cooperate with each other.	
	Perceived controllability (B5)	Users can have sufficient autonomy to control the game according to their needs, such as choosing the difficulty of the game, the path, the type of reward, and the way of cooperation or competition.	
	Entertainment (B6)	Games are fun and bring pleasure to users.	
	Incentive mechanism (B7)	The material and non-material rewards provided by the game can stimulate the user's desire to continue participating.	
System support (C)	System stability (C1)	The system is stable and reliable in operation and has strong fault tolerance.	Lazarro, 2004; Kapp, 2012; Palmer et al., 2012; Rajak and Shaw, 2019; Toda et al., 2019; Kawanaka et al., 2020
	Ease of use (C2)	The game is easy for users to operate and use, suitable for everyone to participate anytime, anywhere.	
	Timeliness of response (C3)	The system provides timely feedback and effectively responds to user operations.	
	The friendliness of the interface (C4)	The interface design satisfies the user's cognition and psychology, the design is beautiful, the operation is clear, the user can get a more comfortable and convenient use experience.	
	Openness and collaboration (C5)	The system is open to all potential users and supports open sharing to promote multi-topic participation and cooperation.	
Trust system (D)	Personal privacy (D1)	Users' transaction data and personal information will be well protected from abuse.	Seufert et al., 2016; Ramadan, 2017; Dastjerdi et al., 2019; Aparicio et al., 2021
	Credibility of the content and statement within the app (D2)	The claims and information about green and sustainable consumption in the app are scientific and objective, and there is no exaggeration or misleading of consumers.	
	Trust in app's operation and motivation (D3)	The platform itself has a good reputation. Users believe that using apps can really help improve the ecological environment.	
	Real feedback (from virtual to real) (D4)	The online and offline scenes are consistent, authentic, and visible, encouraging users to use the app for a long time.	

TABLE 4 | Questionnaire for the evaluation of sustainable consumption gamification applications.

Dear experts,

Please compare the importance of the two indicators and fill in the corresponding cell with a "√". Scores range from 1 (equally important) to 9 (extremely important).

Items	1	2	3	4	5	6	7	8	9
Overall principles and objectives									
Scenario design **compared to** logic of content									
Scenario design **compared to** clarity of objectives									
Scenario design **compared to** value proposition									
Logic of content **compared to** clarity of objectives									
Logic of content **compared to** value proposition									
Clarity of objectives **compared to** value proposition									
The interactive experience of the game									
Immersed feeling **compared to** sense of achievement									
Immersed feeling **compared to** artistic sense									
Immersed feeling **compared to** social interaction									
Immersed feeling **compared to** controllability									
Immersed feeling **compared to** entertainment									
Immersed feeling **compared to** incentive mechanism									
Sense of achievement **compared to** artistic sense									
Sense of achievement **compared to** social interaction									
Sense of achievement **compared to** perceived controllability									
Sense of achievement **compared to** entertainment									
Sense of achievement **compared to** incentive mechanism									
Artistic sense **compared to** social interaction									
Artistic sense **compared to** perceived controllability									
Artistic sense **compared to** entertainment									
Artistic sense **compared to** incentive mechanism									
Social interaction compared to perceived controllability									
Social interaction **compared to** entertainment									
Social interaction **compared to** incentive mechanism									
Perceived controllability **compared to** entertainment									
Perceived controllability **compared to** incentive mechanism									
Entertainment **compared to** incentive mechanism									
System support									
System stability **compared to** ease of use									
System stability **compared to** timeliness of response									
System stability **compared to** the friendliness of the interface									
System stability **compared to** openness and collaboration									
Ease of use **compared to** timeliness of response									
Ease of use **compared to** the friendliness of the interface									
Ease of use **compared to** openness and collaboration									
Timeliness of response **compared to** the friendliness of the interface									
Timeliness of response **compared to** openness and collaboration									
The friendliness of the interface **compared to** openness and collaboration									
Trust system									
Personal privacy **compared to** credibility of the content and statement within the app									
Personal privacy **compared to** trust in app's operation and motivation									
Personal privacy **compared to** real feedback (from virtual to real)									
Credibility of the content and statement within the app **compared to** trust in app's operation and motivation									
Credibility of the content and statement within the app **compared to** real feedback (from virtual to real)									
Trust in app's operation and motivation **compared to** real feedback (from virtual to real)									

the dimension of gamification design, taking into account the factors that affect users' interactive experience (human-human interactive and human-machine interactive experience) such as artistic sense, immersed feeling, sense of achievement, perceived controllability, entertainment, social interaction, and incentive mechanism (Bittner and Shipper, 2014; Zuckerman and Gal-Oz, 2014; Piligrimiene et al., 2020; Guillen et al., 2021). In addition, in the game design of sustainable consumption projects, due to the openness and collaboration attribute of the project itself, a large number of users with different backgrounds conduct a variety of operation behaviors such as search, communication, and evaluation within the system, which puts forward higher requirements for the friendliness of the interface, the timeliness of response, and the stability and ease of use of the system (Sever et al., 2015; Cotton and Patel, 2019; Toda et al., 2019; Zolfaghari et al., 2021). Therefore, system support is selected as a first-grade index of the game design evaluation system. Finally, in the digital age, trust is the foundation of all development. The normal operation and growth of all digital businesses and platforms are inseparable from the support of trust mechanisms (Ramadan, 2017; Aparicio et al., 2021; Ashfaq et al., 2021). The game design of an app for sustainable consumption projects is no exception. With that in mind, this study selects the trust system as a first-grade evaluation index, including four secondary indexes such as personal privacy, the credibility of the content and statement within the app, trust in app's operation and motivation, and the real feedback (from the feedback in the virtual world to real-world feedback). The details about the evaluation index system of gamification design for sustainable consumption apps are presented in **Table 3**.

In order to ensure the scientificity and preciseness of the research, this study invites sustainable consumption researchers, industry personnel who have deeply participated in the design of gamification and sustainable consumption app as group decision-making experts. The questionnaire was designed according to the evaluation index system in **Table 3**. During the construction of the indicator system and the design of the questionnaire, 4 University professors in related research fields and 3 experts from the gamification research institute were invited to participate in the evaluation and improvement through emails and face-to-face interviews to ensure the scientificity and rationality of the evaluation index system and questionnaire. Finally, we designed a nine-point Likert-type scale questionnaire containing 4 first-grade indicators and a total of 43 measurement items. The details of the questionnaire are presented in **Table 4**.

The questionnaire was created and distributed using the Wenjuanxing platform (https://www.wjx.cn), which is the most widely used online survey, assessment, voting platform in China. The respondents were experts, academics, designers, and developers in the field of gamification design and application. This study used a simple snowball sampling technique. First, the questionnaire link was shared with the 8 selected experts through WeChat. These experts then send the link to other experts and scholars in the field of gamification field they recommend. A total of 40 questionnaires were distributed in this study. After excluding 5 blank questionnaires and 3 questionnaires with missing key data, 32 valid questionnaires were used for further analysis.

RESULTS

Incentive Mechanism of Gamification App for Sustainable Consumption

This study takes Ant Forest as an example to study the incentive mechanism of gamification design for sustainable consumption using the SOR model. The details are presented in **Figure 3**. For Ant Forest, the main game component elements are the virtual green energy value, and virtual tree, social graph, and a variety of life scene settings. The main game dynamics elements mainly include Emotions, Progression, and Relationships. Progression refers to the accumulation of energy and the cultivation of saplings is a long-term growth process. The nurturing process enables users to develop an emotional attachment. In particular, when enough energy is accumulated to convert the virtual tree into an actual tree, this will bring a sense of accomplishment to the user. The relationship emphasizes the social network construction in the app and the interaction between users, which can to a large extent strengthen the gamified interpersonal interaction experience and user stickiness. The mechanics elements of the Ant Forest are competition and cooperation. It constructs a new sustainable consumption situation for users, breaks the boundary between reality and virtuality, and enables users' behavior in the virtual world to obtain real value. As to the users can obtain resources (energy value) through competition and cooperation. Particularly, the mapping feedback between the virtual tree and the real tree breaks the boundary between reality and virtuality, and enables users to obtain real value for their behavior in the virtual world. According to the SOR model (see **Figures 2**, **3**), in the Ant Forest, virtual energy values, virtual trees, social graphs, and daily life scenes are stimulus factors for gamification design. These game components elements influence and change the psychological state of users under the impact of dynamics elements such as emotions, progression, and relationships, thereby prompting them to participate in sustainable consumption behavior. The mechanism of competition and cooperation in gamification affect the components elements and continuously generate a new round of stimuli.

Ant Forest inculcates eco-environmental protection and green consumption concepts to users in a popular and interesting form, and stimulates sustainable consumption to a certain extent. In terms of user participation, the platform has set up multiple scenarios and multiple types of tree species to attract users. The focus of work and task of gamification at this stage is to identify and construct various scenes of daily life, and record and quantify the low-carbon sustainable consumption behaviors with green energy values. According to the tree planting strategy on the Ant Forest platform, users can convert carbon emission reductions into online green energy through various methods such as green travel, reducing travel, reducing the use of paper and plastic, and other high-efficiency energy

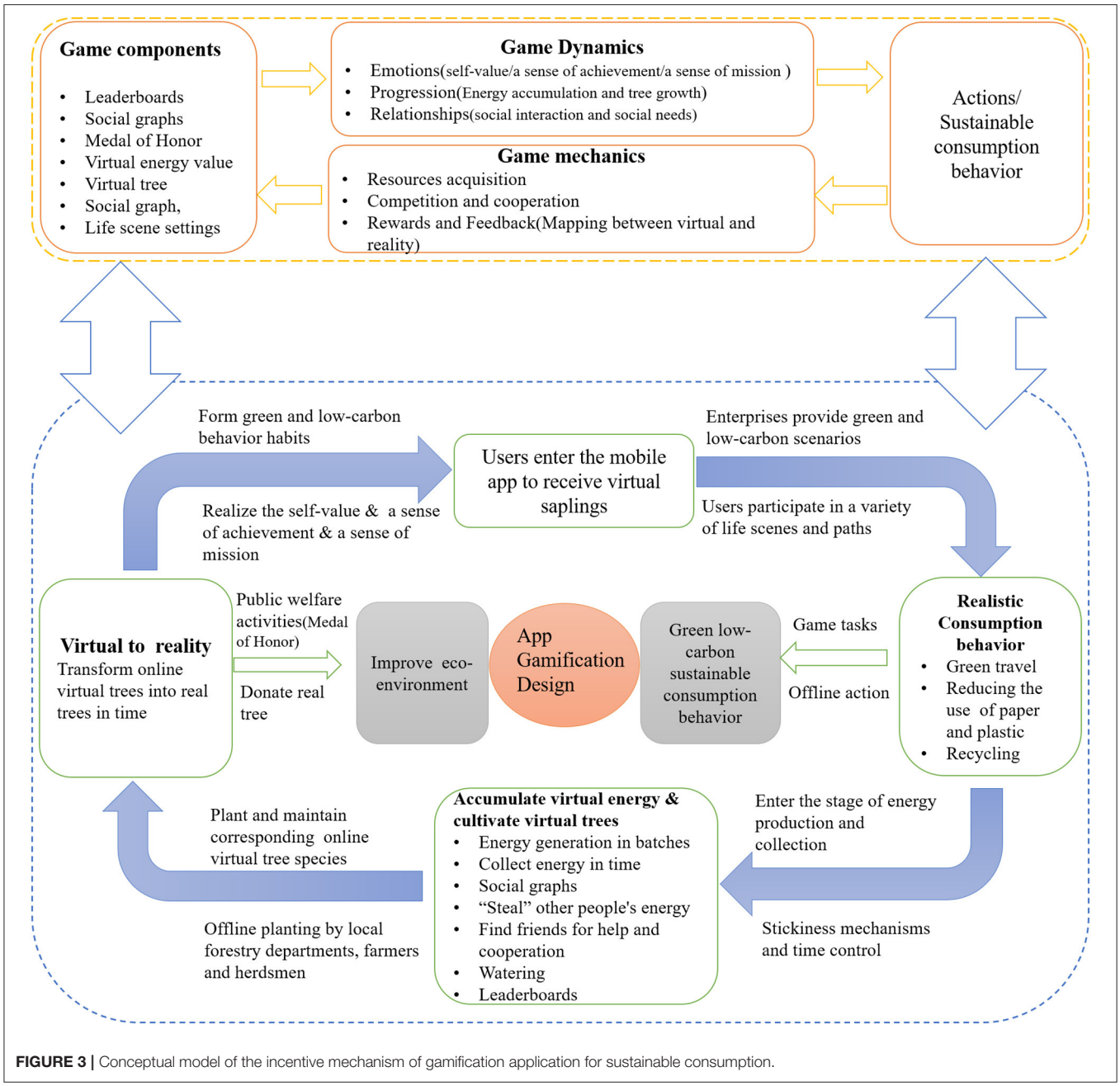

FIGURE 3 | Conceptual model of the incentive mechanism of gamification application for sustainable consumption.

saving and recycling behavior. Ant Forest has also cooperated with China Beijing Environment Exchange (CBEEX) and other institutions to develop a set of algorithms for calculating carbon emission reductions corresponding to low-carbon behaviors in different scenarios. Meanwhile, the platform makes full use of the interactivity of social networks to increase user engagement. Users can either give their energy to their friends through "watering", or go to their friends' forests to collect more green energy to help their saplings grow as quickly as possible. Ant Forest provides a variety of cooperation scenarios such as a family tree, love tree, classmate forest, colleague forest, friend tree, and so on. Users can use the energy obtained from co-watering to co-plant trees such as Pinus sylvestris, Huashan pine, spruce, and Populus euphratica that require higher energy values.

In sum, Ant Forest connects online and offline scenes, combines commerce, social interaction, low-carbon behavior, and public welfare, attracts users to participate in eco-environment protection and sustainable consumption activities through entertainment, and cultivates the public's green and low-carbon life concept. The core driving force of Ant Forest is mission, ownership, and social interaction. The game design theme is planting trees, and users can donate saplings through their public welfare behavior and consumption. During the game,

TABLE 5 | The weight coefficients of the four first grade indicators.

First level	*w*	λ	CI	RI	CR
A	19.80%	4.14	0.05	0.90	0.05
B	29.72%				
C	13.59%				
D	36.88%				

TABLE 6 | The weight coefficients of the second-grade indicators.

Indicators	*w*	λ	CI	RI	CR
A					
A1	25.65%	4.22	0.07	0.90	0.08
A2	13.15%				
A3	21.35%				
A4	38.85%				
B					
B1	7.90%	7.57	0.09	1.32	0.07
B2	9.08%				
B3	10.80%				
B4	19.45%				
B5	11.82%				
B6	15.40%				
B7	25.54%				
C					
C1	12.38%	5.38	0.09	1.12	0.08
C2	21.10%				
C3	27.53%				
C4	10.62%				
C5	28.37%				
D					
D1	25.62%	4.25	0.08	0.90	0.09
D2	16.47%				
D3	18.57%				
D4	39.34%				

users can not only gain rewards but also realize the sublimation of self-value, which is also in line with the value goal of the product itself.

In addition, it cultivates user behaviors and habits by virtue of the built-in social chain and rich social gameplay of app products, so as to achieve the goal of improving user stickiness.

Evaluation for Gamification Design of Sustainable Consumption App

Based on the survey data and the AHP method, the weight coefficients of the evaluation indicators are presented in **Tables 5**, **6**. It can be seen from **Tables 5**, **6** that CR values of all judgment matrices are <0.1, that is, all matrices have passed the consistency test and have satisfactory consistency. After passing the consistency test, the weight coefficients of each indicator of the gamification design evaluation system of sustainable consumption app were calculated by multiplying the weights of the index at all levels layer by layer. The detailed results are shown in **Figure 4**.

As shown in **Table 4**, The weight coefficients of four first-grade indicators overall principles and objectives (A), the interactive experience of the game (B), system support (C), trust (D) are 19.80, 29.72, 13.59, and 36.88%, respectively. It can be found that the importance of trust and interactive experience in the gamification design of an app for sustainable consumption is higher than that of the overall principles and objectives and the system support.

At the level of first-grade indicator of the trust system (D), the weight coefficients of four second grade indicators personal privacy (D1), the credibility of the content and statement (D2), trust in app's operation and motivation (D3), and real feedback (D4) are 25.62, 16.47, 18.57, and 39.44%, respectively. It can be seen that providing real feedback and protecting personal privacy are the most important factors in the game design of sustainable consumption app projects.

At the level of first-grade indicator of the interactive experience (B), incentive mechanism (25.54%) and social interaction (19.45%) have high weight coefficients, followed by entertainment (15.40%) and perceived controllability (11.82%), while the weight coefficients of artistic sense (10.80%), sense of achievement (9.08%), immersed feeling (7.90%) in the game design are the lowest.

Among the four indicators of overall principles and objectives (A), value proposition (38.85%) is considered to be the most important, and its weight coefficient is much greater than that scenario design (25.65%), clarity of objectives (21.35%), and logic of content (13.15%).

As to the system support (C), the weight coefficients of the openness and collaboration, timeliness of response, ease of use, system stability, and the friendliness of the interface are 28.37, 27.53, 21.10, 12.38, and 10.62%, respectively. It can be seen that gamified design of sustainable consumption app pays more attention to openness and collaboration, timeliness of response, and the ease of use.

Figure 4 presents all the weight coefficients of the evaluation index of gamification design for sustainable consumption app. It can be seen that the real feedback (14.51%), personal privacy (9.45%), value proposition (7.69%), and incentive mechanism (7.59%) are the most critical factor in the design and development process of gamification apps for sustainable consumption. In addition, the credibility of the content and statement (6.07%), trust in the app's operation and motivation (6.85%), social interaction (5.78%), scenario design (5.08%), and entertainment (4.58%) are also important factors that cannot be ignored.

It is worth noting that the overall ranking of the secondary index weight under the two dimensions of game interactive experience and system support are relatively low. This indicates that in the game design of sustainable consumption apps, games are only a form of representation and an auxiliary means to trigger users' participation motivation, rather than the focus of the design.

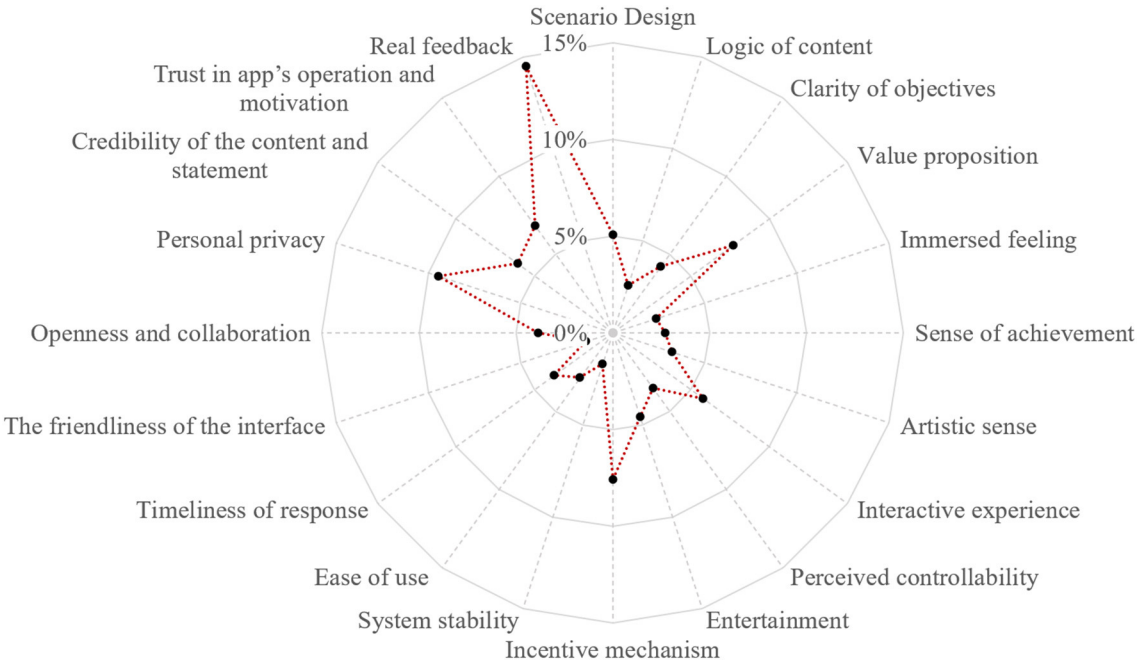

FIGURE 4 | Gamification design evaluation index weights for sustainable consumption app.

DISCUSSION AND CONCLUSIONS

Taking the gamified apps that promote sustainable consumption in China as an example, based on the specific elements and use process of gamification app, this study explores the incentive mechanism of gamification application for sustainable consumption by using the SOR model. Furthermore, it also constructs an evaluation index system of gamification design for sustainable consumption app and identifies the key factors in the gamification design by using the analytic hierarchy process. The contributions of this study are as follows.

Gamification app for sustainable consumption can be characterized as "multiple behavioral scene settings, online and offline and the virtuality and reality combination, multi-party participation and cooperation". It uses technological innovation and gamification design to objectively and truly quantify the impact of daily low-carbon sustainable consumption behavior of the public. Specifically, gamification apps link the public's daily low-carbon and sustainable consumption behavior with eco-environment protection and public benefit activities (e.g., planting trees in Ant Forest), and adopt a combination of online and offline virtual and actual practices to stimulate the public's enthusiasm for practicing green, low-carbon and sustainable consumption. This is of great significance in promoting the public's transition to green and sustainable consumption behavior.

The core driving force of the gamification app for sustainable consumption is the mission, ownership, and social interaction. During the game, users can not only gain rewards through sustainable consumption behavior, but also realize the sublimation of self-value, which is also in line with the value goal of the product itself. In addition, it cultivates user behaviors and habits by virtue of the built-in social chain and rich social gameplay of app products, so as to achieve the aim of improving user stickiness.

The evaluation index system includes four main dimensions: overall principles and objectives, game interactive experience, system support and trust system, with a total of 20 sublevel evaluation indexes. The trust system and game interactive experience dimension are given a large weight, which is mainly reflected in secondary indicators such as real feedback, protection of personal privacy, incentive mechanism and social interaction. This shows that how to ensure and improve the trust mechanism and the interactive experience brought by gamification design is the focus of gamification design for sustainable consumption app. At the same time, the openness and cooperation, ease of use, and timeliness of response of the system support dimension are the basis for the effective operation of the gamified app of sustainable projects. The value proposition and scenario design in the overall principles and objectives dimension are important driving forces to promote public participation and enhance user stickiness.

It is worth noting that in the game design of sustainable consumption app, games are only a form of representation and an auxiliary means to trigger users' participation motivation, rather than the focus of the design. More attention is paid on the implementation effect behind gamification, that is, to promote the cultivation of public sustainable consumption values and lifestyle. Therefore, in the process of gamification design of sustainable consumption apps, it is necessary to strengthen the representation of gamification elements and the construction

of trust system by relying on scenarios setting, pay attention to improving system quality and interactive experience, and improve relevant functions and mechanisms of the gamification.

The Sustainable Development Goals (SDGs) set by the United Nations General Assembly in the 2030 Agenda have been widely recognized and promoted around the world. As one of the 17 SDGs, responsible consumption and production has been an important development direction in China's transition to sustainability in recent years. In the consumer sector, although the government, media, enterprises, and non-governmental organizations have made great efforts to publicize and advocate low-carbon lifestyle and sustainable consumption behaviors, this kind of persuasive one-way publicity is difficult to fully mobilize the public's willingness to actively participate. Moreover, there is also greater uncertainty in the implementation of specific actions. Gamification apps based on digital technologies have opened a promising path to promote the transition to sustainability. It integrates eco-environmental protection information with games, makes use of the sharing and interactive characteristics of social media, and attracts users to participate in sustainable consumption behavior in a fun and gamified way. This can better stimulate the interest of users to participate, and allow the public to subtly accept the concept of sustainable consumption and apply it to life practice. This study advances theoretical and practical understanding of the gamification app of sustainable consumption. The results can also be used as a starting base for the development and design of gamified apps in the sustainable consumption field. The index evaluation system proposed in this paper can not only be used to evaluate the application effect of existing gamification app, but also provide a reference framework for designers to develop better gamified app products to promote public sustainable consumption behavior.

However, there are still some limitations in this study. First, based on the specific gamification elements and use process of gamification app, this study explores the impact mechanism of gamification apps for sustainable consumption by using the SOR model. However, the research on the mechanism of gamification apps for sustainable consumption based on the SOR model is still somewhat simplified. In particular, this study only makes a general classification of game elements, but does not make a specific analysis of individual elements. Therefore, more detailed and rigorous empirical studies are needed in the future. In addition to the SOR model, more theoretical models and frameworks can be used to study the mechanism of gamification apps for sustainable consumption. Secondly, because the gamification app of sustainable consumption is still in the early development stage, there is not much empirical evidence to refer to in the process of constructing the evaluation index system. With the development and growth of gamification apps of sustainable projects, the entire evaluation index system can be continuously improved, and its effectiveness can also be verified by more practical application examples. Finally, the empirical analysis of this paper is based on a small sample. In the future, this study will be repeated with a larger sample and with actual users of these gamified applications. In particular, further exploration of the cognitive differences between sustainable consumption researchers, gamification designers, and actual users is a very worthy direction of research.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors.

AUTHOR CONTRIBUTIONS

SS and ZW contributed to the conceptualization, empirical analysis, and first draft of the manuscript. QW helped with research design and data collection and processing. WW contributed to supervision, project management, research design, resources, and revising the draft. All authors contributed to the article and approved the submitted version.

REFERENCES

Aparicio, M., Costa, C. J., and Moises, R. (2021). Gamification and reputation: key determinants of e-commerce usage and repurchase intention. *Heliyon* 7, e06383. doi: 10.1016/j.heliyon.2021.e06383

Ashfaq, M., Zhang, Q., Ali, F., Waheed, A., and Nawaz, S. (2021). You plant a virtual tree, we'll plant a real tree: understanding users' adoption of the Ant Forest mobile gaming application from a behavioral reasoning theory perspective. *J. Clean. Prod.* 310, 127394. doi: 10.1016/j.jclepro.2021.127394

Bittner, J. V., and Shipper, J. (2014). Motivational effects and age differences of gamification in product advertising. *J. Consum. Mark.* 31, 391–400. doi: 10.1108/JCM-04-2014-0945

Brauner, P., Valdez, A. C., Schroeder, U., and Ziefle, M. (2013). "Increase physical fitness and create health awareness through exergames and gamification," in *International Conference on Human Factors in Computing and Informatics* (Maribor: Springer), 349–362.

Chang, H.-J., Eckman, M., and Yan, R.-N. (2011). Application of the Stimulus-Organism-Response model to the retail environment: the role of hedonic motivation in impulse buying behavior. *Int. Rev. Retail. Distrib. Consum. Res.* 21, 233–249. doi: 10.1080/09593969.2011.578798

Chen, C.-C., and Yao, J.-Y. (2018). What drives impulse buying behaviors in a mobile auction? The perspective of the Stimulus-Organism-Response model. *Telemat. Inform.* 35, 1249–1262. doi: 10.1016/j.tele.2018.02.007

Cotton, V., and Patel, M. S. (2019). Gamification use and design in popular health and fitness mobile applications. *Am. J. Heal. Promot.* 33, 448–451. doi: 10.1177/0890117118790394

Darko, A., Chan, A. P. C., Ameyaw, E. E., Owusu, E. K., Pärn, E., and Edwards, D. J. (2019). Review of application of analytic hierarchy process (AHP) in construction. *Int. J. Constr. Manag.* 19, 436–452. doi: 10.1080/15623599.2018.1452098

Dastjerdi, A. M., Kaplan, S., de Silva, J. A., Nielsen, O. A., and Pereira, F. C. (2019). Use intention of mobility-management travel apps: the role of users goals, technophile attitude and community trust. *Transp. Res. Part A Policy Pract.* 126, 114–135. doi: 10.1016/j.tra.2019.06.001

Deterding, S., Dixon, D., Khaled, R., and Nacke, L. (2011). "From game design elements to gamefulness: defining "gamification"," in *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments* (Tampere), 9–15.

Dicheva, D., Dichev, C., Agre, G., and Angelova, G. (2015). Gamification in education: a systematic mapping study. *J. Educ. Technol. Soc.* 18, 75–88. Available online at: http://www.jstor.org/stable/jeductechsoci.18.3.75

Dos Santos, P. H., Neves, S. M., Sant'Anna, D. O., de Oliveira, C. H., and Carvalho, H. D. (2019). The analytic hierarchy process supporting decision making for sustainable development: an overview of applications. *J. Clean. Prod.* 212, 119–138. doi: 10.1016/j.jclepro.2018.11.270

Fuentes, C. (2016). "Play a game, save the planet! Gamification as a way to promote green consumption," *in The Business of Gamification*, eds M. Dymek and P. Zackariasson (New York, NY: Routledge), 166–182.

Gatautis, R., Banyte, J., Piligrimiene, Ž., Vitkauskaite, E., and Tarute, A. (2016a). The impact of gamification on consumer brand engagement. *Transform. Bus. Econ.* 15, 173–191.

Gatautis, R., Vitkauskaite, E., Gadeikiene, A., and Piligrimiene, Z. (2016b). Gamification as a mean of driving online consumer behaviour: SOR model perspective. *Eng. Econ.* 27, 90–97. doi: 10.5755/j01.ee.27.1.13198

Guillen, M., G., Hamari, J., and Quist, J. (2021). "Gamification of Sustainable Consumption: a systematic literature review," in *Proceedings of the 54th Hawaii International Conference on System Sciences* (Hawaii), 1345.

Harms, J., Biegler, S., Wimmer, C., Kappel, K., and Grechenig, T. (2015). "Gamification of online surveys: design process, case study, and evaluation," in *IFIP Conference on Human-Computer Interaction* (Bamberg: Bamberg: Springer), 219–236.

Hofacker, C. F., De Ruyter, K., Lurie, N. H., Manchanda, P., and Donaldson, J. (2016). Gamification and mobile marketing effectiveness. *J. Interact. Mark.* 34, 25–36. doi: 10.1016/j.intmar.2016.03.001

Huber, M. Z., and Hilty, L. M. (2015). "Gamification and sustainable consumption: overcoming the limitations of persuasive technologies," in *ICT Innovations for Sustainability. Advances in Intelligent Systems and Computing, Vol 310*, eds L. Hilty, and B. Aebischer (Cham: Springer). doi: 10.1007/978-3-319-09228-7_22

Jacoby, J. (2002). Stimulus-organism-response reconsidered: an evolutionary step in modeling (consumer) behavior. *J. Consum. Psychol.* 12, 51–57. doi: 10.1207/S15327663JCP1201_05

Johnson, D., Deterding, S., Kuhn, K.-A., Staneva, A., Stoyanov, S., and Hides, L. (2016). Gamification for health and wellbeing: a systematic review of the literature. *Internet Interv.* 6, 89–106. doi: 10.1016/j.invent.2016.10.002

Kapp, K. M. (2012). *The Gamification of Learning and Instruction: Game-Based Methods and Strategies for Training and Education*. San Fransisco, CA: John Wiley and Sons.

Kawanaka, S., Matsuda, Y., Suwa, H., Fujimoto, M., Arakawa, Y., and Yasumoto, K. (2020). Gamified participatory sensing in tourism: an experimental study of the effects on tourist behavior and satisfaction. *Smart Cities* 3, 736–757. doi: 10.3390/smartcities3030037

Kim, M. J., Lee, C.-K., and Jung, T. (2020). Exploring consumer behavior in virtual reality tourism using an extended stimulus-organism-response model. *J. Travel Res.* 59, 69–89. doi: 10.1177/0047287518818915

Kim, S., Song, K., Lockee, B., and Burton, J. (2018). "What is gamification in learning and education?," in *Gamification in Learning and Education* (Springer), 25–38.

Korn, O., Brenner, F., Börsig, J., Lalli, F., Mattmüller, M., and Müller, A. (2017). "Defining Recrutainment: a model and a survey on the gamification of recruiting and human resources," in *International Conference on Applied Human Factors and Ergonomics* (Los Angeles, CA: Springer), 37–49.

Landers, R. N., Auer, E. M., Collmus, A. B., and Armstrong, M. B. (2018). Gamification science, its history and future: definitions and a research agenda. *Simul. Gaming* 49, 315–337. doi: 10.1177/1046878118774385

Lazarro, N. (2004). "Why we play games: four keys to more emotion without story," *in Game Developer's Conference*, San Jose, CA, 1–4.

Luo, X., Ono, K., and Watanabe, M. (2021). Encouraging seller participation in online sustainable consumption using white hat and black hat gamification motivates seller behavior. *J. Sci. Des.* 5, 105–114. doi: 10.11247/jsd.5.1_1_105

Mattsson, V. (2019). *Gamifying Sustainability: How Can Gamification be Utilized to Promote Sustainable Consumption?* Helsinki: Aalto University.

Mishra, S., and Malhotra, G. (2021). The gamification of in-game advertising: examining the role of psychological ownership and advertisement intrusiveness. *Int. J. Inf. Manage.* 61, 102245. doi: 10.1016/j.ijinfomgt.2020.102245

Mulcahy, R., Russell-Bennett, R., and Iacobucci, D. (2020). Designing gamified apps for sustainable consumption: a field study. *J. Bus. Res.* 106, 377–387. doi: 10.1016/j.jbusres.2018.10.026

Palmer, D., Lunceford, S., and Patton, A. J. (2012). The engagement economy: how gamification is reshaping businesses. *Deloite Rev.* 11, 52–69.

Piligrimiene, Ž., Žukauskaite, A., Korzilius, H., Banyte, J., and Dovaliene, A. (2020). Internal and external determinants of consumer engagement in sustainable consumption. *Sustainability* 12, 1349. doi: 10.3390/su12041349

Prasad, K. D. V., Rao, D., and Vaidya, D. R. (2019). Gamification and resource pooling for improving operational efficiency and effective management of human resources: a case study with an ecommerce company. *Int. J. Manag.* 10, 76–87. doi: 10.34218/IJM.10.6.2019.008

Rahardja, U., Aini, Q., Graha, Y. I., and Tangkaw, M. R. (2019). Gamification framework design of management education and development in industrial revolution 4.0. *J. Phys.* 1364, 12035. doi: 10.1088/1742-6596/1364/1/012035

Rajak, M., and Shaw, K. (2019). Evaluation and selection of mobile health (mHealth) applications using AHP and fuzzy TOPSIS. *Technol. Soc.* 59, 101186. doi: 10.1016/j.techsoc.2019.101186

Ramadan, Z. (2017). The gamification of trust: the case of China's "social credit." *Mark. Intell. Plan.* 36, 93–107. doi: 10.1108/MIP-06-2017-0100

Robson, K., Plangger, K., Kietzmann, J. H., McCarthy, I., and Pitt, L. (2016). Game on: engaging customers and employees through gamification. *Bus. Horiz.* 59, 29–36. doi: 10.1016/j.bushor.2015.08.002

Saaty, T. L. (1988). "What is the analytic hierarchy process?," in *Mathematical Models for Decision Support* (Berlin; Heidelberg: Springer), 109–121.

Saaty, T. L. (1990). How to make a decision: the analytic hierarchy process. *Eur. J. Oper. Res.* 48, 9–26. doi: 10.1016/0377-2217(90)90057-I

Seufert, M., Burger, V., Lorey, K., Seith, A., Loh, F., and Tran-Gia, P. (2016). Assessment of subjective influence and trust with an online social network game. *Comput. Human Behav.* 64, 233–246. doi: 10.1016/j.chb.2016.06.056

Sever, N. S., Sever, G. N., and Kuhzady, S. (2015). The evaluation of potentials of gamification in tourism marketing communication. *Int. J. Acad. Res. Bus. Soc. Sci.* 5, 188–202. doi: 10.6007/IJARBSS/v5-i10/1867

Simpson, P., and Jenkins, P. (2015). Gamification and human resources: an overview. *Bright. Bright. Bus. Sch.* 1–6.

Sreejesh, S., Ghosh, T., and Dwivedi, Y. K. (2021). Moving beyond the content: the role of contextual cues in the effectiveness of gamification of advertising. *J. Bus. Res.* 132, 88–101. doi: 10.1016/j.jbusres.2021.04.007

Sun, H., Wang, S., and Hao, X. (2017). An Improved Analytic Hierarchy Process Method for the evaluation of agricultural water management in irrigation districts of north China. *Agric. Water Manag.* 179, 324–337. doi: 10.1016/j.agwat.2016.08.002

Taherdoost, H. (2017). Decision making using the analytic hierarchy process (AHP); a step by step approach. *Int. J. Econ. Manag. Syst.* 2, 147–153. Available online at: https://ssrn.com/abstract=3224206

Terlutter, R., and Capella, M. L. (2013). The gamification of advertising: analysis and research directions of in-game advertising, advergames, and advertising in social network games. *J. Advert.* 42, 95–112. doi: 10.1080/00913367.2013.774610

Toda, A. M., Oliveira, W., Klock, A. C., Palomino, P. T., Pimenta, M., Gasparini, I., et al. (2019). "A taxonomy of game elements for gamification in educational contexts: Proposal and evaluation," in *2019 IEEE 19th International Conference on Advanced Learning Technologies (ICALT)* (Maceió: IEEE), 84–88.

Tu, R., Hsieh, P., and Feng, W. (2019). Walking for fun or for "likes"? The impacts of different gamification orientations of fitness apps on consumers' physical activities. *Sport Manag. Rev.* 22, 682–693. doi: 10.1016/j.smr.2018.10.005

Vaidya, O. S., and Kumar, S. (2006). Analytic hierarchy process: an overview of applications. *Eur. J. Oper. Res.* 169, 1–29. doi: 10.1016/j.ejor.2004.04.028

Vashisht, D., Royne, M. B., and Sreejesh, S. (2019). What we know and need to know about the gamification of advertising: a review and synthesis of the advergame studies. *Eur. J. Mark.* 53, 607–634. doi: 10.1108/EJM-01-2017-0070

Walls, P. J. (2021). Investing in human capital: achieving organizational competitiveness through gamification. *ENDLESS Int. J. Futur. Stud.* 4, 1–7. doi: 10.54783/endless.v4i1.34

Wanick, V., and Bui, H. (2019). Gamification in Management: a systematic review and research directions. *Int. J. Serious Games* 6, 57–74. doi: 10.17083/ijsg.v6i2.282

Warmelink, H., Koivisto, J., Mayer, I., Vesa, M., and Hamari, J. (2020). Gamification of production and logistics operations: status quo and future directions. *J. Bus. Res.* 106, 331–340. doi: 10.1016/j.jbusres.2018.09.011

Werbach, K., and Hunter, D. (2015). *The Gamification Toolkit: Dynamics, Mechanics, and Components for the Win*. Philadelphia, PA: University of Pennsylvania Press.

Werbach, K., and Hunter, D. (2020). *For the Win, Revised and Updated Edition: The Power of Gamification and Game Thinking in Business, Education, Government, and Social Impact*. Philadelphia, PA: University of Pennsylvania Press.

Wu, Y.-L., and Li, E. Y. (2018). Marketing mix, customer value, and customer loyalty in social commerce: a stimulus-organism-response perspective. *Internet Res.* 28, 74–104. doi: 10.1108/IntR-08-2016-0250

Yucesan, M., and Kahraman, G. (2019). Risk evaluation and prevention in hydropower plant operations: a model based on Pythagorean fuzzy AHP. *Energy Policy* 126, 343–351. doi: 10.1016/j.enpol.2018.11.039

Zolfaghari, M., Shirmohammadi, M., Shahhosseini, H., Mokhtaran, M., and Mohebbi, S. Z. (2021). Development and evaluation of a gamified smart phone mobile health application for oral health promotion in early childhood: a randomized controlled trial. *BMC Oral Health* 21, 1–9. doi: 10.1186/s12903-020-01374-2

Zuckerman, O., and Gal-Oz, A. (2014). Deconstructing gamification: evaluating the effectiveness of continuous measurement, virtual rewards, and social comparison for promoting physical activity. *Pers. Ubiquitous Comput.* 18, 1705–1719. doi: 10.1007/s00779-014-0783-2

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.