



ARTICLE



<https://doi.org/10.1057/s41599-026-06640-2>

OPEN

The influence of gamification features in wearable fitness devices on perceived value, device loyalty, and exercise continuance intention: the moderating role of personal innovativeness

Wugeng Chang¹, Yihan Huang² & Daehwan Kim¹✉

This study drew upon gamification and innovation diffusion theories to examine the influence of gamification elements on users' continuance behavioral intentions in the context of sports and fitness while focusing on the moderating effect of personal innovativeness. A survey was conducted, and 500 valid questionnaires were collected from subjects who had experience using smartwatches for exercise in South Korea. A latent moderated structural equations (LMS) modeling analysis was conducted to examine our research model. The results indicated that gamification elements (self-monitoring, goal setting, rewards, and social facilitation) are associated with varying levels on perceived utilitarian and hedonic values, subsequently influencing consumer device loyalty and their continuance exercise intentions. Furthermore, personal innovativeness was found to positively moderate the effect of utilitarian value on device loyalty and continuance exercise intention while negatively moderating the effect of hedonic value on both. This study's results have theoretical implications for the literature on wearable fitness devices and provide developers and businesses with effective directions for improving wearable fitness devices.

¹Pukyong National University, Busan, Republic of Korea. ²Zhengzhou University of Light Industry, Zhengzhou, China. ✉email: dk@pknu.ac.kr

Introduction

Innovative technologies are increasingly enriching the fitness industry while assisting individuals with physical activities or exercise in their daily lives (Tsai et al., 2022). For example, online fitness streaming (Guo and Fussell, 2022), VR/AR in fitness (Maden et al., 2022), social fitness platforms (Yin et al., 2022), and various wearable devices (Tsai et al., 2022) have been found to be effective technological tools to help individuals engage in diverse physical activities. Scholars and practitioners have paid great attention to wearable devices such as smartwatches because they are not only one of the most successful commercialized technologies but also widely diffused in contemporary society (Oh and Kim, 2023). According to a industry market report by Daedal Research (2022), the global wearable device market was estimated at approximately \$62.1 billion in 2021 and is expected to reach approximately \$145.4 billion in 2027.

Interestingly, most wearable devices employ gamification strategies, integrating game elements into non-gaming environments to engage users in target tasks, such as physical activities (Deterding et al., 2011). For instance, Alipay combines walking exercises with gamification by converting users' achieved step goals into virtual currency. Users can use this virtual currency to support charitable activities such as forest conservation and helping underprivileged children. Additionally, they can redeem gifts or participate in games using these virtual coins. In this regard, wearable devices, through the concept of the "quantified self," turn dull and monotonous numbers into gamified elements, making physical activities or exercise more fun and enhancing users' persistence (Stragier et al., 2016). Nonetheless, some recent studies provide contradictory evidence, indicating that while the number of wearable device users continues to increase, one-third of users stop using them within 6 months (Ledger and McCaffrey, 2014). Therefore, identifying specific gamification elements in wearable fitness devices (conceptualizing gamification) and determining which can better enhance their perceived value to consumers becomes a crucial issue in the intensely competitive wearable device market.

Previous studies have investigated gamification strategies and their effects on user behaviors in the context of fitness and physical activities (Feng et al., 2020; Kim et al., 2023; Stragier et al., 2016; Tu et al., 2019). For example, Feng et al. (2020) explored consumer stickiness and loyalty to fitness apps by distinguishing between types of gamification elements that are directly or indirectly related to consumer performance in tasks. Tu et al. (2019) focused on gamified fitness applications' fun and social aspects and investigated their impact on consumers' willingness to continue exercising. Although the existing literature offers useful information for understanding the relationship between the gamification of technologies and user behaviors, several theoretical gaps should be filled to better understand the psychological mechanism of how and which gamification elements of wearable fitness devices affect user behaviors. Specifically, it remains unclear how to conceptualize gamification appropriately in the context of wearable fitness devices. For example, Tsai et al. (2022) focused solely on reward- and competition-based gamification elements in smart wearable devices and examined how these features influence users' continuance intentions. However, their study overlooked other core gamification elements, such as self-monitoring, and did not investigate how these features influence users' intentions to maintain regular exercise behavior. Additionally, little is known about the roles of perceived values, which are regarded as a fundamental determinant of consumers' decision-making for using a service or product, in the relationship between specific gamification elements and user behaviors.

Meanwhile, according to the innovation diffusion theory (Rogers et al., 2014), users with high personal innovativeness have a strong intrinsic motivation to try new technologies, whereas users with low personal innovativeness are more likely to perceive risks associated with new technologies and view them with skepticism (Senali et al., 2023). This implies that personal innovativeness, which refers to an individual's willingness and ability to adopt innovative technologies (Rogers et al., 2014), is likely to modulate the effect of gamification elements on user behaviors. However, the existing literature tends to consider users as a homogeneous group, thereby providing little insight into effective segmentation strategies in the context of wearable fitness devices (Oh and Kim, 2023; Tsai et al., 2022).

To fill the void in the existing literature, this study aimed to specifically conceptualize gamification in the domain of wearable fitness devices and investigate the structural relationship between various gamification elements, consumer perceived values (utilitarian and hedonic values), and user behaviors (device loyalty and exercise intention with wearable devices). Furthermore, it examined the moderating role of personal innovativeness in such structural relationships. By investigating these dynamics in the context of wearable fitness devices, the current study is expected to contribute to the existing literature on wearable devices and user behaviors and offer practical implications for practitioners developing optimal human-media interaction environments.

Theoretical background and hypothesis development

Gamification elements of wearable fitness devices. Defined as "the use of game design elements in non-game contexts" (Deterding et al., 2011), gamification is a popular trend in modern society that blends engaging mechanics with selected functionality in environments that are often considered boring. Scholars acknowledge the considerable impact of gamification on user experiences and behaviors in various domains such as exercise and health (Hassan et al., 2019; Johnson et al., 2016; Tsai et al., 2022), education (Putz et al., 2020, Rohan et al., 2021), the workplace (Landers et al., 2017), online banking (Baptista and Oliveira, 2017), mobile applications (Aydinliyurt et al., 2021) and e-commerce (Aparicio et al., 2021; Feng et al., 2019; Xu et al., 2023). While gamification has garnered widespread attention across various domains, the diverse requirements of users in different fields result in distinct gamification needs and expectations (Hamari and Koivisto, 2015a). This diversity has led to a mixture of inconsistent dimensions and measurement criteria for the concept of gamification in the existing literature (Palmer et al., 2012; Yin et al., 2022). Therefore, accurately conceptualizing gamification in the domain of wearable fitness devices emerges as a critical issue.

This research provides a brief summary and overview of the literature related to the concept of gamification or gamification elements in prestigious academic journals in the field of management information systems (MIS) and marketing over the past decade. Our primary focus is on the fitness domain; however, due to the limited number of eligible articles, we have also considered other relevant fields. We employed Boolean searches using keywords such as "gamification," "gamification elements," "gamification dimensions," "consumer continuous usage intention and behavior," "user satisfaction," "loyalty," and "device loyalty" and their synonyms to retrieve relevant articles from scientific networks and literature databases. This initial search allowed us to identify 20 highly cited articles from 2013. We classified the literature based on gamification dimensions/elements, research contexts, variables of interest (including mediators and moderators), and research methods (see Table 1).

Table 1 Existing literature on gamification.

Source	Dimensions	Context	Mediator	Moderator	Dependent variable	Methods
Kapen and Nacke (2013)	Motivated behavior (layer intrinsic motivation, extrinsic motivation); Game experience layer (actions, challenges, achievements); Game design process layer (interface, mechanics, models, principles); Perceived layer of fun (Fun) Reward/ Feedback	Game app	-	-	-	Qualitative research
Mitchell et al. (2017)	Intrinsic elements (Goals, challenges, progression, achievements, choice/options, quests, social sharing); Extrinsic elements (badges, rewards, points, incentives, leaderboards); Feedback elements (Calorie tracker, step-counters, distance traveled, daily notifications, time spent, heart rate, breathing rate, sleep cycle sound inputs, weight loss indicator, physical form-checker gait/posture-checker)	Fitness	-	-	Continue use	Qualitative research Quantitative research
Kapen et al. (2017)	Intrinsic elements (Goals, challenges, progression, achievements, choice/options, elements (badges, rewards, points, incentives, leaderboards); Feedback elements (Calorie tracker, step-counters, distance traveled, daily notifications, time spent, heart rate, breathing rate, sleep cycle sound inputs, weight loss indicator, physical form-checker gait/posture-checker)	Fitness	-	Age	Motivation for PA; Facilitating goals for PA; Continuance of PA	Quantitative research
Tsay et al. (2018)	Feedback and rewards; Social connection	Education	-	-	Class attendance; Behavioral engagement outcomes; Academic performance Intention to continue use	Quantitative research
Tu et al. (2019)	App with game elements focusing on social value/emotional value	Fitness	-	-	Intention to continue use	Quantitative research
Xi and Hamari (2019)	Immersion; Achievement; Social elements	Social network	-	-	Intrinsic need satisfaction (Autonomy; Competence; Relatedness) User continuance intention	Quantitative research
Feng et al. (2019)	Immersive Gamification elements; Social Gamification elements	E-commerce	Expectation confirmation; Perceived Usefulness; Satisfaction	-	Class attendance; Behavioral engagement outcomes; Academic performance Intention to continue use	Quantitative research
Feng et al. (2020)	Commensurate/incommensurate game elements	Fitness	-	-	Intrinsic motivation; Engagement; Loyalty Continuance Intention	Quantitative research
Aydinliyurt et al. (2021)	Behavioral Activation System (Reward Responsiveness, Drive, Fun Seeking) Rewards giving, Badges upgrading	Mobile Applications	Satisfaction	-	Continuance Intention	Quantitative research
Zhang et al. (2021)	Rewards giving, Badges upgrading	E-commerce	Perceived enjoyment; Social interaction	Gender; Age	Impulse buying	Quantitative research
Cho et al. (2021)	Intrinsic motivational affordances (goal setting, self-monitoring); Extrinsic motivational affordances (virtual rewards, monetary rewards); Social-based motivational affordances (Collaboration, cooperation, sharing, competition, recognition)	Fitness	-	-	Engagement in physical activity and sports	Qualitative research

Table 1 (continued)

Source	Dimensions	Context	Mediator	Moderator	Dependent variable	Methods
Rohan et al. (2021)	Gamification Categories (Achievement, Social, immersion)	Education	Satisfaction	-	MOOC Continuous Intention	Quantitative research
Yin et al. (2022)	Challenge, fitness bootcamp, task, badge, level, achievement, voice feedback, leaderboard, community, moment, avatar, calorie factory, scenario running Rewards, competition	Fitness	-	-	User satisfaction	Quantitative research
Tsai et al. (2022)		Fitness	Perceived value (Utilitarian value, Hedonic value)	-	Intention to continue use	Quantitative research
Xu et al. (2023)	Utilitarian affordance (monetary rewardability); Social affordance (connectiveness); Hedonic affordance (playfulness, novelty)	E-commerce	Immersive experience	-	Purchase intention	Quantitative research
Lai and Langley (2024)	Gamification as socio-technical intermediation; Game logics (competition, rewards, behavioral nudges)	FinTech / Digital Finance	-	-	User financial behavior and platform engagement	Qualitative research
Cai et al. (2024)	Gamification elements (points, badges, levels); Intrinsic satisfaction needs (autonomy, competence, relatedness)	Knowledge-sharing platforms	Intrinsic satisfaction needs	-	Knowledge-sharing behavior	Quantitative research
Liu et al. (2024)	Gamification-enabled customer experience (entertainment, interactivity, reward mechanisms, personalization)	E-government digital platforms	Customer experience	Trust in government	Continuance intention	Quantitative research
Zhang and Anwar (2025)	Gamification elements (rewards, progress tracking, social comparison)	Environmental app (Ant Forest)	Perceived responsibility	Environmental awareness	Environmentally responsible behavior	Quantitative research
Stylos and Vassiliadis (2025)	Gamification design elements (fun, challenge, feedback, social engagement); Image perception (cognitive, affective)	Hospitality / Service Apps	Image perception	Generation Z	Behavioral intentions	Quantitative research

As described in Table 1, most quantitative studies involve one or two gamification elements, lacking a comprehensive investigation into the concept. Qualitative research, on the other hand, tends to focus on subtle game elements in various domains, resulting in an overly detailed breakdown. Since wearable fitness devices typically rely on long-term, voluntary, and self-directed behaviors, understanding user motivation is particularly important. Based on our review of previous research on gamified wearable devices from the perspective of motivation theory (Cho et al., 2021; Kim et al., 2023), we found that motivation theory provides a valuable framework for understanding user engagement with wearable fitness devices. Accordingly, we reconceptualized the gamification of wearable fitness devices into four domains derived from intrinsic, external, and social motivation. Specifically, gamification based on self-monitoring (e.g., progress, challenges, feedback) and goal setting (steps, distance, time, duration, weight, calories) is considered to inspire intrinsic motivation for the use of wearable fitness devices. Next, rewards-based gamification (e.g., badges, points, medals, trophies, milestones, credits, prizes, draws) provides external motivational cues. Lastly, social promotion-based gamification (teamwork, nudges, likes, disclosure, leaderboards, self-presentation) is considered to activate social motivation for using wearable fitness devices.

This classification not only aligns with common gamification practices but also mirrors the theoretical development of motivational psychology, particularly as framed by self-determination theory (SDT) (Ryan and Deci, 2000). SDT posits that human motivation can be broadly categorized into intrinsic motivation, extrinsic motivation, and relatedness-driven motivation, corresponding closely to the gamification elements of self-monitoring, goal setting, rewards, and social facilitation used in this study. Meanwhile, this tripartite motivational structure reflects the evolution of motivation theory itself. Early research distinguished between intrinsic and extrinsic motivation, where the former refers to engaging in an activity for its inherent satisfaction, and the latter refers to doing so for external rewards or outcomes (Deci and Ryan, 2013; Ryan and Deci, 2000). More recently, scholars have recognized social motivation as a distinct category, particularly relevant in digital and gamified environments (Zuckerman and Gal-Oz, 2014). Integrating these three types of motivation provides a solid theoretical foundation for analyzing how different gamification elements influence users' sustained engagement with wearable fitness devices.

Self-Monitoring. According to Snyder (1979), self-monitoring refers to the process in which individuals observe and record their behaviors, thoughts, and emotions. This process of self-observation enables individuals to understand and manage their behavior better, aiming to achieve specific goals or to enhance personal efficacy (Carels et al., 2005). Since self-monitoring is a goal-oriented gamification element associated with intrinsic motivation, it serves as a motivator to encourage users' engagement in physical activities (Cho et al., 2021). For this reason, self-monitoring has been widely adopted in fitness contexts (e.g., Burke et al., 2011; Greaves et al., 2011). In the present study, self-monitoring is defined as the perceived ability of wearable fitness devices to track personal exercise outcomes and offer feedback, such as step count, heart rate, and distance.

Goal setting. Goal-setting theory is a motivational framework that posits that individuals are more likely to be motivated and perform better when they set specific challenging goals (Locke and Latham, 2002). Engaging in physical activities and exercise is typically a goal-driven behavior (Cho et al., 2021). According to Edwards et al. (2016), goal setting is a crucial element in fitness applications and wearable devices, empowering users to establish

daily physical activity goals for standing, exercising, and moving. This feature allows users to compare their performance against the initial goals on a daily, weekly, or monthly basis, making goal setting a pivotal element in the gamification of wearable fitness devices. In the present study, goal setting refers to perceived functions provided by wearable fitness devices that allow users to set daily exercise goals, such as walking distance, weight, and calorie expenditure.

Rewards. In general, reward-based gamification strategies, as an auxiliary element among gamification approaches, have been commonly combined with other gamification strategies in previous literature (Buchem et al., 2015; Patel et al., 2017). They have proven to be an indispensable marketing tool for developers in maintaining user relationships (Bolton et al., 2000; Lewis, 2004). In Cho et al. (2021) study, rewards serve as potent motivators, inspiring users to actively participate in physical activities and strive toward their health and fitness goals. By providing a system of recognition and reinforcement, rewards contribute to positive user experiences, fostering a sense of accomplishment and satisfaction (Tsay et al., 2018). In our research, "rewards" are operationally defined as the degree to which wearable fitness devices provide trophies or badges when users achieve their goals or competitive outcomes.

Social facilitation. During collaborative physical activities with others (e.g., team sports), participants' actions are influenced by external motivational factors in the social interaction process, such as social rewards leaderboards, badges, and recognition from other participants. In particular, social sharing and competition have been incorporated into lifestyle improvement applications as one of the most effective gamification strategies (Hamari and Koivisto, 2015b). Social sharing involves disclosing tracking data and exercise to others, revealing physiological data and individuals' feelings about physical activities (Tong et al., 2016). Social group participants can be stimulated by observing peers' physical activity and posts from others, enhancing goal achievement and engagement in physical activities (Liu and Lachman, 2021). Furthermore, competition is associated with an individual's desire to seek social recognition and status, and this social need is one of the key motivations for participation in physical activities (Vassileva, 2012). Therefore, we positioned social facilitation as a pivotal factor within the gamification concept and operationalized it as the perceived functionality of wearable fitness devices to compare a user's exercise performance, share exercise achievements, and connect and interact with other users.

Perceived values of wearable devices for physical activity. Value is viewed as a consumer's overall assessment of a product's utility based on the perceived benefits and costs of using a target product or service (Zeithaml, 1988). Generally, products and services that appeal to consumers offer an enhanced perception of value, which significantly impacts customer satisfaction, loyalty, and future behaviors, including purchase intentions and word-of-mouth (WOM) (Chen and Tsai, 2008). Researchers have suggested that the concept of "perceived value" is quite complex and multidimensional (Ashraf et al., 2019; Sánchez-Fernández and Iniesta-Bonillo, 2007; Tuncer et al., 2021). For example, in various consumer marketing fields, researchers commonly use utilitarian and hedonic values as the two primary dimensions of perceived value to assess subsequent consumer behavior and decision-making (Bridges and Florsheim, 2008; Chiu et al., 2014; Tsai et al., 2022). They have also suggested that these dimensions comprehensively capture users' functional and emotional needs and experiences, accurately reflecting their motivations and satisfaction. Specifically, utilitarian value refers to the degree to which a

product or service provides tangible, functional benefits or satisfies specific needs (Jones et al., 2006). In the case of wearable fitness devices, utilitarian value is assessed based on the device's practical utility and functionality in meeting users' health and fitness needs (Kim, 2016). Relevant features include health monitoring, activity tracking, sleep analysis, and real-time feedback, all of which provide users with practical benefits and support in their daily fitness lives. On the other hand, hedonic value pertains to the degree to which a product or service provides enjoyment, pleasure, or emotional satisfaction (Ozturk et al., 2016). The hedonic value of wearable fitness devices encompasses entertainment and emotional engagement resulting from personalized fitness challenges, engaging virtual experiences, stylish design, and community interaction.

From a service marketing perspective, gamification is an experiential marketing strategy designed to enhance service value through game-like experiences (Mullins and Sabherwal, 2020). In line with this notion, Hsu and Chen (2018) suggested that gamification strategies meet consumers' value pursuits for utilitarian and hedonic services. Therefore, the utilitarian and hedonic values of wearable fitness devices are likely to be determined by specific gamification elements.

First, wearable fitness device users, through gamified self-monitoring, acquire bodily data, feedback, and tracking information (Wang et al., 2020). This gamification element enhances wearable fitness devices' perceived usefulness and usability, consequently elevating their utilitarian values (Akdim et al., 2022). In addition, successfully achieving goals or surpassing personal records through self-monitoring can generate positive emotional experiences (Consolvo et al., 2006). Such experiences enhance the perceived hedonic values of wearable fitness devices and encourage users to continue participating in physical activities (Carels et al., 2005). Fritz et al. (2014) emphasize that goal-oriented tasks and self-monitoring features in activity-sensing devices significantly enhance user enjoyment and long-term commitment. Therefore, self-monitoring generates positive emotional experiences throughout physical activities and thus enhances wearable fitness devices' perceived hedonic value. All in all, self-monitoring should positively affect the perceived values of wearable fitness devices, and thus, the following hypotheses were developed:

H1. Self-monitoring will positively affect perceived utilitarian value.

H2. Self-monitoring will positively affect perceived hedonic value.

Second, goal setting helps users clarify their fitness goals and needs (Locke and Latham, 1985). For example, users may set goals such as increasing step count, improving heart rate, or reducing weight. By specifying these goals, users can better understand how wearable fitness devices meet their actual needs, enhancing users' awareness of the device's utility and consequently generating a positive perception of functionality (Nelson et al., 2016). Additionally, Nelson et al. (2016) found that the goal-setting function of wearable fitness devices provides users with clear direction and motivation. As users pursue their goals, they experience a sense of accomplishment and satisfaction, significantly enhancing their mental enjoyment and pleasure (Leung et al., 2014). This, in turn, enhances the perceived hedonic value of gamified fitness devices. All in all, goal setting should positively affect the perceived values of wearable fitness devices, and thus, the following hypotheses were developed:

H3. Goal setting will positively affect perceived utilitarian value.

H4. Goal setting will positively affect perceived hedonic value.

Third, external rewards such as points, rewards, levels, and badges are common gamification incentives in wearable fitness devices (Cho et al., 2021). To earn these rewards, users must frequently engage with the devices and explore their various practical functions (Tsai et al., 2022). This interaction helps users achieve specific goals and experience the higher utilitarian value provided by the devices (Consolvo et al., 2006). Meanwhile, when users of exercise-gamification services participate in goal-oriented activities that include rewards, they find the process more appealing and experience higher hedonic value (Hamari and Koivisto, 2015a). This implies that external rewards also enhance the hedonic values of wearable fitness devices. For example, Patel et al. (2017) reported that level-up and points systems as rewards for participants in a gamified digital health intervention led to a more motivating experience, and the rewarded participants felt more enjoyment and satisfaction. All in all, gamification elements should positively affect the perceived values of wearable fitness devices, and thus, the following hypotheses were developed:

H5. Rewards will positively affect perceived utilitarian value.

H6. Rewards will positively affect perceived hedonic value.

Lastly, engaging in social facilitation features (such as sharing, liking, and commenting with friends) can significantly motivate users to fully explore and utilize the diverse functions of wearable fitness devices. This deeper interaction with the device enhances users' perceived utilitarian value, as they are more likely to experience practical benefits and effectiveness through their usage (Hamari and Koivisto, 2015a). Furthermore, Tu et al. (2019) found that fitness app users motivated by social facilitation features, particularly sharing and liking functions, exhibited better performance in terms of steps taken and distance walked. This is primarily because the social facilitation aspects of gamified wearable fitness devices enable users to gain social support, establish relationships, and enhance their sense of belonging (Boratto et al., 2017; Seefeldt et al., 2002; Whiteman-Sandland et al., 2018). Consequently, users experience psychological enjoyment and emotional satisfaction, increasing their willingness to continue participating in physical activities, thereby reinforcing the hedonic value they derive from the devices. All in all, gamification elements should positively affect the perceived values of wearable fitness devices, and thus, the following hypotheses were developed:

H7. Social facilitation will positively affect perceived utilitarian value.

H8. Social facilitation will positively affect perceived hedonic value.

Outcomes of perceived values from gamified wearable fitness devices. Users' continuance behaviors regarding gamified wearable fitness devices encompass two primary aspects: device loyalty and continuance exercise intention with the device. Loyalty refers to consumers' intention to and behavior of consistently using a product or service, as well as their willingness to engage in positive WOM by recommending the product or service to others (Huang et al., 2024). Customer loyalty is essential in marketing, as it directly influences the long-term success of products or services and ensures the sustained viability of a seller or brand over time (Naranjo-Zolotov et al., 2019). In the current research, device loyalty specifically refers to consumers' intention to continue

using gamified wearable fitness devices in the future, coupled with a strong willingness to recommend such devices and share their usage experiences with others.

Continuance exercise intention refers to an individual's ongoing willingness to engage in physical exercise (Hamari and Koivisto, 2015b). In the context of gamified wearable devices, the continuous exercise intention cultivated by the sustained use of gamified wearable devices not only encourages ongoing participation in physical activities but also fosters a sense of commitment to the device (Cho et al., 2020). Chen et al. (2020) noted that continuous exercise intention not only improves users' fitness levels but also enhances customer retention rates. This higher retention rate is crucial for a device's profitability and long-term market presence. In this study, we operationalized continuance exercise intention as the extent to which users are willing and likely to continue exercising using gamified wearable fitness devices in the future.

While scholars have identified a variety of determinants of device loyalty (e.g., satisfaction, quality, and trust), individuals use or consume products or services fundamentally because of their benefits and value rather than their inherent attributes (Chiu et al., 2014). In this regard, perceived value is considered a better antecedent of consumers' continued usage intention and behavior than any other variables (Lee et al., 2007). Additionally, Kervenoael et al. (2020) noted that perceived value is a decisive factor in explaining the adoption of smart devices. Furthermore, according to the means-ends chain (MEC) theory, consumer behavior is value-driven, and thus, the perceived value ultimately influences the consumer's decision-making and choices (Gutman, 1997).

Akdim et al. (2022) suggested that the experience of using a product or service is multidimensional, and thus, it is essential to consider both utilitarian and hedonic values to predict consumer behaviors. Numerous studies indicated a preference among customers for hedonic attributes rather than utilitarian attributes in experiential service industries such as airlines (Kim, 2015), the fast-casual dining sector (Ryu et al., 2010), and the tourism industry (Kim et al., 2012). On the other hand, Akdim et al. (2022) observed that utilitarian value significantly impacts the continuance intention to use social mobile apps by providing users with functional benefits and practical utility. From a functional perspective, gamified wearable fitness devices encompass various intelligent features such as health monitoring, activity tracking, and goal setting, which provide significant utilitarian value (Wang et al., 2020). Simultaneously, these devices offer consumers hedonic experiences such as entertainment, social interaction, and esthetic appeal (Tu et al., 2019). Therefore, gamified wearable fitness devices successfully integrate both utilitarian and hedonic values, meeting users' practical health management needs while also enhancing emotional satisfaction and social engagement.

The existing literature has shown that when consumers perceive high levels of both utilitarian and hedonic values from their experiences, they are likely to develop positive behavioral intentions, including repeat purchases and continued use (Akdim et al., 2022). For example, Chiu et al. (2014) found that both perceived hedonic and perceived utilitarian values explain consumers' repeat purchase intentions when using online shopping, which is consistent with previous findings in other contexts (e.g., mobile hotel booking [Ozturk et al., 2016]; social media usage [Ashraf et al., 2019], and smartwatch usage [Hong et al., 2017]). This dual perception of utilitarian and hedonic values positively impacts consumers' motivations, potentially encouraging them to continue using the device and maintain their fitness activities (Akdim et al., 2022; Hamari and Koivisto, 2015a). Accordingly, we propose that:

H9. Perceived utilitarian value will have a positive impact on device loyalty.

H10. Perceived hedonic value will have a positive impact on device loyalty.

H11. Perceived utilitarian value will have a positive impact on continued exercise intentions while using a gamified wearable fitness device.

H12. Perceived hedonic value will have a positive impact on continued exercise intentions while using a gamified wearable fitness device.

Personal innovativeness as a moderator. Personal innovativeness is defined as the willingness of an individual to try out new technology (Agarwal and Prasad, 1998). Advanced technologies (e.g., smart devices) can offer consumers freedom and control, as well as the efficient use of time and effort, but they can also cause some consumers to experience concerns and stress, leading to ambivalent attitudes toward the products/services (Parasuraman and Colby, 2015). Moreover, personal innovativeness is considered slow to form and not easily changeable (Ashraf et al., 2019). Therefore, marketing practitioners have paid huge attention to the concept of personal innovativeness as a segmentation variable in their marketing activities for high-tech products or services (Aroean and Michaelidou, 2014; Camilleri, 2018). Since gamified wearable fitness devices are tech-based products, it is logical for this study to use personal innovativeness as a consumer's personal trait and segmentation variable (i.e., moderator) when explaining how user experiences differently affect future behaviors. While gamification theory provides insight into how specific design elements (e.g., rewards, self-monitoring) influence users' psychological engagement and behavior, innovation diffusion theory helps explain how individual differences—such as consumers' propensity to adopt new technologies—influence their response to these elements. Integrating both theories allows this study to examine not only what features motivate users but also which types of users are more likely to be influenced by these gamification elements (Lu et al., 2005), thereby offering a more comprehensive framework for understanding user behavior in gamified health technology contexts.

Indeed, personal innovativeness was identified as an important moderator in the acceptance of tech-based products/services in recent studies (Ahmed et al., 2013; Fatima et al., 2017; Kim et al., 2021; Leicht et al., 2018; Molinillo et al., 2023). For example, Kang and Chae (2011) found that the influence of the perceived value of smartphone applications on consumers' adoption intentions varied depending on consumers' innovativeness levels. This implies that the influence of experiences with technology-based products or services on consumers' intentions to continue usage depends on the level of personal innovativeness.

Specifically, highly innovative users tend to have a strong intrinsic motivation to try new technologies; they enjoy interacting with new technologies and exploring cutting-edge ways to address challenges (Rogers et al., 2014). This intrinsic motivation enhances their engagement with the utilitarian aspects of technology, leading to sustained use and exercise intentions (Venkatesh et al., 2012). Furthermore, in a study of smart meter technology, Alkawsii et al. (2021) found that for consumers with high personal innovativeness, the expectation of device performance (utilitarian value) significantly influenced the intention to continue using the device more than it does for consumers with low personal innovativeness. These findings imply that compared to low innovators, high innovators derive greater utilitarian value from their interactions with technology,

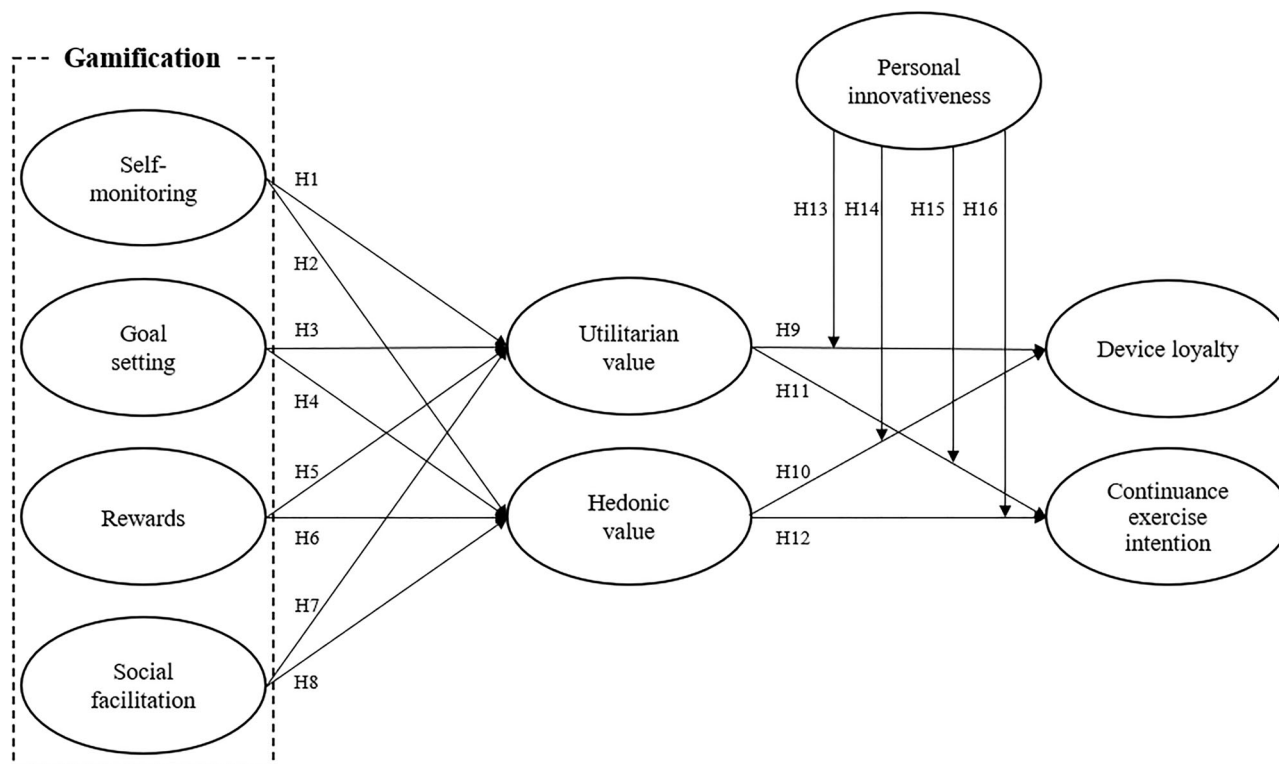


Fig. 1 Hypothesized research model. The model illustrates the proposed relationships between gamification elements (self-monitoring, goal setting, rewards, and social facilitation), perceived value dimensions (utilitarian value and hedonic value), and outcome variables (device loyalty and continuance exercise intention). Personal innovativeness is included as a moderating variable. H1-H16 represent the hypothesized paths among the constructs.

which is more conducive to maintaining and promoting continuous consumer behavior.

On the other hand, low-innovativeness consumers typically exhibit a conservative attitude toward new technologies, preferring familiar products and services to reduce the burden of learning and adapting to new technologies (Rogers et al., 2014). Accordingly, they tend to prioritize entertaining, enjoyable, and social experiences with smart devices (Rogers et al., 2014). Furthermore, for this group, hedonic value is also associated with user-friendly design and simple, easy-to-use functionalities (Akdim et al., 2022). Reducing usage barriers and enhancing convenience make it easier for low-innovativeness consumers to accept and positively experience products and services, fostering their continued use (Venkatesh et al., 2012). Therefore, it can be speculated that the lower a consumer's personal innovativeness, the greater the impact of perceived hedonic value on their device loyalty and continuance exercise intentions. Based on these factors, the following hypotheses were developed; all hypotheses are summarized in Fig. 1.

H13. Personal innovativeness will positively moderate the impact of perceived utilitarian value on device loyalty.

H14. Personal innovativeness will negatively moderate the impact of perceived hedonic value on device loyalty.

H15. Personal innovativeness will positively moderate the impact of perceived utilitarian value on continuance exercise intentions while using a gamified wearable fitness device.

H16. Personal innovativeness will negatively moderate the impact of perceived hedonic value on continuance exercise intentions while using a gamified wearable fitness device.

Methods

Participants and procedure. In this study, the target population was smart fitness device (i.e., smartwatch) users who use such devices for physical activities and exercise in South Korea. South Korea was selected as the study context due to its high level of digital technology adoption and the widespread use of wearable fitness devices among its population. As one of the most technologically advanced countries, South Korea offers a relevant and insightful setting for investigating user engagement with gamified features in wearable technologies. The study sample was obtained through a professional survey institute (<https://embrain.com/>) with 1,752,765 panels across all provinces in South Korea. Specifically, the research participants were recruited based on a multi-stage random sampling technique using demographic characteristics and geographic locations to ensure a representative sample. Specifically, we employed G*Power software (Faul et al., 2009) to calculate the required minimum sample size, considering a significance level of $\alpha = 0.05$, statistical power of 0.80, and effect size based on previous similar studies. The institute employed stringent selection procedures in which legal names, national identification numbers, and panel registration numbers were utilized to authenticate respondents. Additionally, the survey contained one piece of screening information: "Do you have experience using a smartwatch for your physical activities or exercise?" (participants had to say "yes" to move on to the following questions; otherwise, the survey ended) to ensure that the appropriate samples were collected. Once the participants completed the survey, the system identified and eliminated participants who completed it too quickly or in recurring patterns to qualify for incentives. Consequently, a total of 500 samples were obtained and used for data analysis. The participants consisted of 250 males (50%) whose average age was 40.17 years (SD = 10.78). Additionally, we collected detailed smartwatch usage characteristics. Most participants ($n = 398$) had used a

Table 2 Measurement coefficients, reliability, and convergent validity.

Factors and items	λ	Mean	SD	C.R.	AVE
Self-monitoring				0.833	0.632
I can check/track my steps with the smartwatch I use.	0.893	6.43	0.760		
I can check/track my walking/running distance with the smartwatch I use.	0.801	6.32	0.930		
I can check/track my heart rate with the smartwatch I use.	0.723	6.29	0.980		
Goal-setting				0.863	0.675
I set my goal walking distance with my smartwatch.	0.792	4.71	1.83		
I set my goal weight with my smartwatch.	0.824	4.13	1.80		
I set my goal calorie consumption with my smartwatch.	0.849	4.54	1.79		
Rewards				0.896	0.691
Reaching more achievement goals on the smartwatch is what motivates me to commit to exercising.	0.838	5.08	1.47		
When my smartwatch reminds me that I have surpassed my previous performance, this reminder is a form of reward for me.	0.879	5.15	1.48		
When a goal is achieved, the achievement badge given to me by the smartwatch is a type of reward for my activity performance.	0.871	4.97	1.49		
The smartwatch I use allows you to get a badge or some kind of reward when you achieve your exercise goal.	0.729	5.07	1.49		
Social facilitation				0.877	0.703
I can participate in competition with other users in smartwatch.	0.858	4.54	1.69		
I can Connect/interact with other users in smartwatch.	0.767	4.35	1.75		
I can use the apps installed on the smartwatch to compare my performance with that of others.	0.893	4.50	1.64		
Utilitarian value				0.786	0.550
The functions of the smartwatch are useful.	0.750	5.43	1.07		
Provides accurate information about the exercise I do.	0.718	5.10	1.10		
Using smartwatch enables me to track daily activities.	0.757	5.32	1.10		
Hedonic value				0.912	0.791
Using the smartwatch to assist with my workout makes me feel happier during my workout.	0.901	4.98	1.35		
Using the smartwatch to support my workouts makes exercise more fun.	0.945	5.05	1.37		
Using smartwatch keeps me happy.	.807	4.87	1.30		
Device loyalty				0.945	0.772
I want to continue using my smartwatch.	0.808	5.85	1.19		
I am willing to continue using smartwatch in the future.	0.782	5.89	1.18		
I will strongly recommend others to use smartwatch.	0.866	5.29	1.27		
I will speak positively about the usefulness of smartwatches to others.	0.954	5.50	1.22		
I will speak positively about my smartwatch experience to others.	0.959	5.50	1.22		
Continuance exercise intention				0.931	0.826
I intend to continue using a smartwatch while exercising in the future.	0.962	5.63	1.30		
There is a possibility that I will continue to use a smartwatch while exercising in the future.	0.955	5.62	1.27		
If I lose interest in exercising, I intend to continue exercising by using a smartwatch.	0.814	5.26	1.37		
Personal innovativeness				0.895	0.739
I am among the first in my circle of friends to buy a new product.	0.857	3.61	1.69		
I know more than others about new products.	0.892	4.02	1.63		
When I hear about a new product being released, I get interested enough to want to buy it.	0.833	4.11	1.70		

smartwatch for over 1 year, followed by 79 participants with 6–12 months of usage, and 23 participants with less than 6 months. Regarding exercise frequency, 313 participants reported wearing their smartwatch 2–4 days per week for exercise, 95 reported 5–7 days, and 92 reported 0–1 day. In terms of device brand, Samsung Galaxy Watch was the most used ($n = 286$), followed by Apple Watch ($n = 150$), with the remainder using Xiaomi, LG, Huawei, or Garmin smartwatches.

Instrument. We measured nine constructs using existing measurement items on 7-point Likert-type scales, ranging from 1 = “not at all” to 7 = “very much.” Specifically, we adopted and modified existing scales to measure four elements of smartwatch gamification, including self-monitoring (three items; Kim et al., 2023), goal setting (three items; Kim et al., 2023), rewards (four items; Kim et al., 2023; Tsai et al., 2022), and social facilitation (three items; Kim et al., 2023 and Tsai et al., 2022). Perceived values were measured using six items about utilitarian value and hedonic value adopted from Hong et al. (2017) and Tsai et al. (2022). Five items for device loyalty were adopted from the work of Cho (2019), Hong et al. (2017), and Tsai et al. (2022). We adopted three items from Roh et al. (2020) to measure

continuance exercise intentions. Lastly, three items for personal innovativeness were adapted from Hong et al. (2017). The measurement items were translated into Korean using a standard back-translation procedure (Brislin, 1986). Two bilingual researchers independently translated the items, and discrepancies were resolved through discussion. A separate pair of experts conducted back-translation, and the results were compared with the original to ensure semantic equivalence. A pilot test with 100 Korean users was conducted to assess item clarity and cultural appropriateness. Subsequently, a confirmatory factor analysis (CFA) was performed, and several items with unsatisfactory factor loadings were revised to improve measurement quality. The finalized measurement items are provided in Table 2.

Data analysis. Before testing the hypotheses, we performed a CFA to assess the validity and reliability of the measurement model using RStudio (Version: 2024.04.2 + 764). To assess potential common method bias, we conducted a CFA in which all measurement items were constrained to load onto a single latent factor (Podsakoff et al., 2003). The model exhibited poor fit to the data ($\chi^2 = [6577.96]$, $df = [405]$, $CFI = [0.516]$, $RMSEA = [0.175]$), indicating that a single-factor model could not account

Table 3 Summary results of measurement model validation.

Variables	1	2	3	4	5	6	7	8	9
1.SM	0.632	0.014	0.104	0.017	0.283	0.091	0.126	0.127	0.0009
2.GS	0.117	0.675	0.425	0.333	0.131	0.122	0.059	0.081	0.064
3.RE	0.322	0.652	0.691	0.342	0.338	0.483	0.255	0.392	0.060
4.SF	0.129	0.577	0.585	0.703	0.179	0.180	0.097	0.130	0.105
5.UV	0.532	0.362	0.581	0.423	0.550	0.530	0.487	0.449	0.081
6.HV	0.302	0.349	0.695	0.424	0.728	0.791	0.458	0.550	0.091
7.DL	0.355	0.243	0.505	0.311	0.698	0.677	0.772	0.659	0.073
8.CEI	0.356	0.284	0.626	0.360	0.670	0.742	0.812	0.826	0.058
9.PI	0.030	0.252	0.245	0.324	0.285	0.302	0.270	0.240	0.739

The diagonal shows AVE values of each construct, which are highlighted in bold. Correlations are under the diagonal, and squared correlations are above the diagonal. SM self-monitoring, GS goal setting, RE rewards, SF social facilitation, UV utilitarian value, HV hedonic value, DL device loyalty, CEI continuance exercise intention, PI personal innovativeness.

for the variance among all items. This result suggests that common method bias is unlikely to pose a significant threat in this study. To test the research hypotheses, we conducted latent moderated structural equations (LMS) modeling using a two-step evaluation method (Klein and Moosbrugger, 2000). Based on this approach, the current study estimated the model (hereafter referred to as Model 0) without latent interaction terms and evaluated it based on the existing fit indices (i.e., χ^2/df ratio, CFI, TLI, RMSEA, and SRMR) in the first step. Once Model 0 met the criteria of the existing fit indices, the second model (hereafter referred to as Model 1) with interaction terms was estimated. We evaluated Model 1 by performing the log-likelihood difference test using a formula ($D = 2[\log\text{-likelihood value of Model 0} - \log\text{-likelihood value of Model 1}]$) with the difference in the degree of freedom between the two models (Δdf). When the log-likelihood difference test was statistically significant, the path coefficients of Model 1 were used to test the hypotheses.

Results

Measurement model validation. We performed a CFA to assess the validity and reliability of the measurement model. The results indicated an acceptable model fit ($\chi^2/df = 1369.927/369 = 3.713$, CFI = 0.922, TLI = 0.908, RMSEA = 0.074, SRMR = 0.049; Hair et al., 2006). As shown in Table 2, the factor loadings of all measurement items were statistically significant and greater than 0.70. The composite reliability (CR) coefficients ranged from 0.786 to 0.939, and the average variance extracted (AVE) values ranged from 0.550 to 0.826. These results ensure the reliability and convergent validity of the measurement model (Fornell and Larcker, 1981; Kline, 2023). Regarding discriminant validity, we examined the intercorrelations between the latent factors and compared them with each latent factor’s AVE values. As shown in Table 3, all AVE values of the latent factors were greater than the squared values of the correlation coefficients between the latent factor and any other factors. Thus, we concluded that discriminant validity was also established (Fornell and Larcker, 1981; Kline, 2023).

Hypothesis testing. We performed an LMS modeling analysis to test the research hypotheses. Based on the two-step evaluation method suggested by Klein and Moosbrugger (2000), this study estimated the structural model (Model 0) without the two latent interaction terms (utilitarian value \times personal innovativeness, hedonic value \times personal innovativeness) in the first step. The results indicated an acceptable model fit between the specified model and data: $\chi^2/df = 1415.716.892/379 = 3.74$, CFI = 0.919, TLI = 0.907, RMSEA = 0.074, and SRMR = 0.058. Accordingly, we proceeded to the second step, where we estimated another

structural model (Model 1), including the latent interaction terms (utilitarian value \times personal innovativeness, hedonic value \times personal innovativeness), and performed the log-likelihood ratio test of Model 0 and Model 1 based on the chi-square distribution (Klein and Moosbrugger, 2000; Maslowsky et al., 2015). The result indicated that Model 1 with the latent interaction terms statistically outperformed Model 0 without them ($D = 2[|-19947.037| - |-19934.134|] = 25.806$, $\Delta df = 4$). Accordingly, we used the path coefficients from Model 1 to test the research hypotheses.

The results revealed that the path coefficients from self-monitoring ($\gamma = 0.395$, $p < 0.001$), rewards ($\gamma = 0.399$, $p < 0.001$), and social facilitation ($\gamma = 0.177$, $p < 0.01$) to perceived utilitarian value were statistically significant. Hence, H1, H5, and H7 were supported. However, goal setting did not significantly associate with perceived utilitarian value ($\gamma = -0.06$, $p = 0.36$), rejecting H3. The model explained 50% ($R^2 = 0.504$) of the variance in perceived utilitarian value. The path coefficients from rewards to perceived hedonic value were statistically significant ($\gamma = 0.771$, $p < 0.001$), supporting H6. On the other hand, the path coefficients from self-monitoring ($\gamma = 0.068$, $p = 0.095$) and social facilitation ($\gamma = 0.092$, $p = 0.071$) to perceived hedonic value were not statistically significant, and the direction of the path coefficient from goal setting to perceived hedonic value was negative ($\gamma = -0.216$, $p < 0.001$). Therefore, H2, H4, and H8 were untenable. The model explained 53% ($R^2 = 0.528$) of the variance in perceived hedonic value.

On the other hand, the path coefficients from perceived utilitarian value ($\beta = 0.47$, $p < 0.001$) and hedonic value ($\beta = 0.30$, $p < 0.001$) to device loyalty were statistically significant. Hence, H9 and H10 were supported. The model explained 56% ($R^2 = 0.559$) of the variance in device loyalty. Additionally, perceived utilitarian value ($\beta = 0.343$, $p < 0.001$) and hedonic value ($\beta = 0.485$, $p < 0.001$) were positively associated with continuance exercise intention. Therefore, H11 and H12 were supported. The model explained 62% ($R^2 = .623$) of the variance in continuance exercise intention.

Regarding the moderating effect of personal innovativeness, the interaction term between perceived utilitarian value and personal innovativeness was found to be significantly associated with smartwatch device loyalty ($\gamma = 0.12$, $p < 0.05$) and continuance exercise intention ($\gamma = 0.214$, $p < 0.001$). Therefore, H13 and H15 were supported. Furthermore, the interaction term between perceived hedonic value and personal innovativeness was found to be significantly associated with device loyalty ($\gamma = -0.177$, $p < 0.001$) and continuance exercise intention ($\gamma = -0.18$, $p < .001$). Accordingly, H14 and H16 were supported. The results are shown in Fig. 2.

To better understand the mediating role of perceived value in the proposed model, a bias-corrected bootstrapping mediation

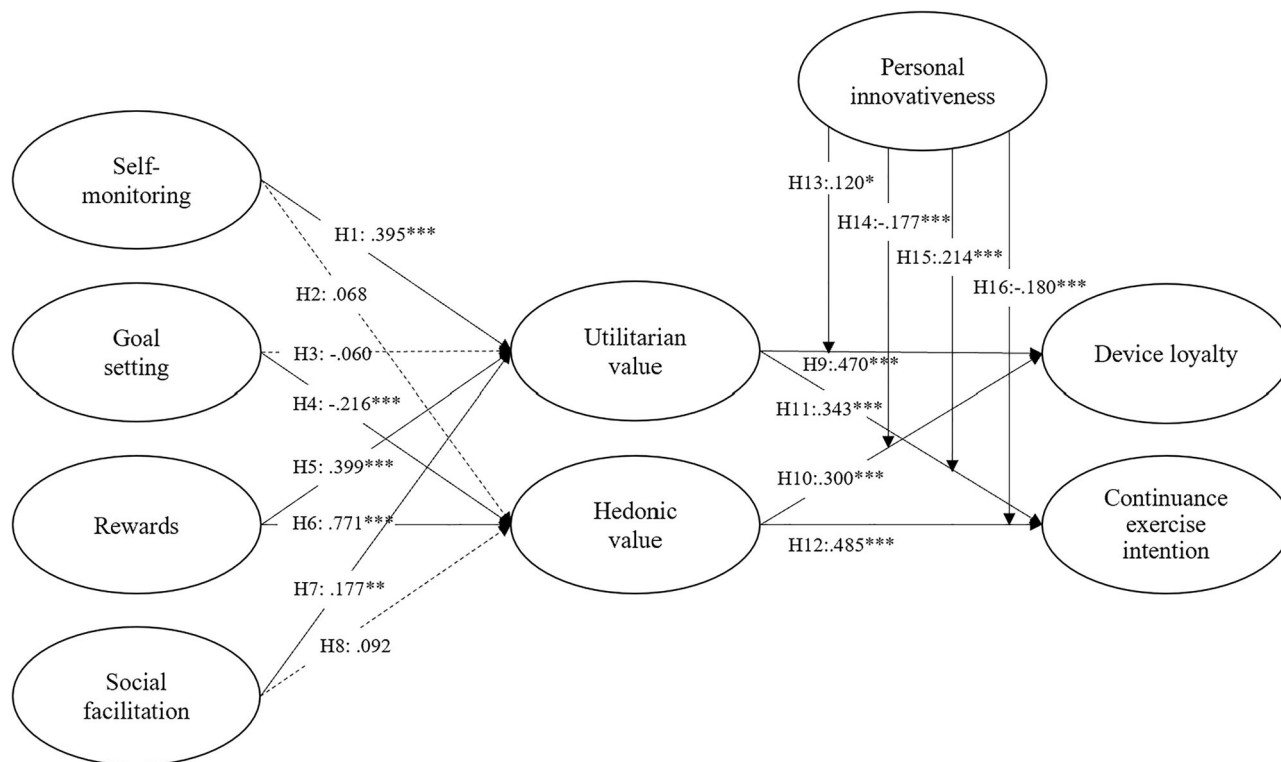


Fig. 2 Results of hypothesis testing. The figure presents the standardized path coefficients of the proposed research model. Solid lines indicate statistically significant paths, while dashed lines represent non-significant paths. The moderating effects of personal innovativeness are illustrated on the relationships between perceived value dimensions and outcome variables. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

analysis was conducted using 5000 resamples. The results revealed that perceived utilitarian value significantly mediated the association between self-monitoring and device loyalty ($\beta = 0.264$, 95% CI [0.144, 0.423], $p < 0.001$), as well as the association between self-monitoring and continuance exercise intention ($\beta = 0.228$, 95% CI [0.078, 0.404], $p < 0.01$). Additionally, perceived utilitarian value mediated the association between rewards and both device loyalty ($\beta = 0.137$, 95% CI [0.067, 0.241], $p < 0.01$) and continuance exercise intention ($\beta = 0.118$, 95% CI [0.037, 0.227], $p < 0.05$). In terms of hedonic value, the results indicated that perceived hedonic value significantly mediated the associations between rewards and both device loyalty ($\beta = 0.51$, 95% CI [0.027, 0.274], $p < 0.05$) and continuance exercise intention ($\beta = 0.251$, 95% CI [0.095, 0.408], $p < 0.01$), as well as the association between goal setting and continuance exercise intention, though negatively ($\beta = -0.058$, 95% CI [-0.125, -0.014], $p < 0.05$). However, no significant indirect effects were observed for goal setting or social facilitation via utilitarian value, nor for social facilitation via hedonic value. These findings highlight the central role of perceived value—particularly utilitarian value—as a key transmission mechanism through which gamification elements influence user behaviors. The results are shown in Table 4.

To further assess the robustness and appropriateness of the proposed structural model, we conducted an alternative model comparison by testing a competing model that excluded the mediating variables (i.e., perceived utilitarian and hedonic values) and the two latent interaction terms (utilitarian value \times personal innovativeness, hedonic value \times personal innovativeness). In the alternative model, direct paths were specified from the four gamification elements (self-monitoring, goal setting, rewards, and social facilitation) and personal innovativeness to the two dependent variables: device loyalty and continuance exercise

intention. The proposed model (with mediators and interaction terms) demonstrated better model fit and explanatory power (SRMR = 0.058, R^2 for device loyalty = 0.559; R^2 for continuance exercise intention = 0.623) than the alternative model (SRMR = 0.07, R^2 for device loyalty = 0.406; R^2 for continuance exercise intention = 0.539), indicating that the inclusion of perceived value and moderating effects substantially improved model performance.

Discussion

Drawing upon gamification theory, this study aimed to systematically investigate the psychological mechanism of user behaviors in using gamified wearable fitness devices. Specifically, based on the review of the gamification literature, this study identified and conceptualized four gamification elements and examined how these elements affect consumers’ device loyalty and continuance exercise intention via perceived values in the context of wearable fitness devices. Furthermore, the present study explored how personal innovativeness, as one of the typical user characteristics, modulates the effect of perceived values on such user behaviors. Overall, our empirical results support most of the proposed hypotheses and yield several new research findings.

First, the four gamification elements were found to significantly and dynamically affect perceived utilitarian and perceived hedonic values. Specifically, self-monitoring, rewards, and social facilitation all enhance the perceived utilitarian value of wearable fitness devices. The empirical results suggest that gamified self-monitoring enhances perceived usefulness, thereby increasing the utilitarian value of the device, which is consistent with the extant literature (Akdim et al., 2022; Fritz et al., 2014). Furthermore, our study also finds that reward-related gamification elements stimulate users’ perceptions of utilitarian value more than other

Table 4 Summary results of mediation analysis.

Independent variable	Mediating variable	Dependent variable	Standardized coefficient (β)	95% CI lower	95% CI upper	p-value
SM	UV	DL	0.264	0.144	0.423	<0.001
GS	UV	DL	-0.010	-0.075	0.044	0.733
RE	UV	DL	0.137	0.067	0.241	<0.010
SF	UV	DL	0.056	0.003	0.123	0.063
SM	UV	CEI	0.228	0.078	0.404	<0.010
GS	UV	CEI	-0.009	-0.063	0.040	0.732
RE	UV	CEI	0.118	0.037	0.227	<0.050
SF	UV	CEI	0.048	0.002	0.110	0.084
SM	HV	DL	0.025	-0.007	0.066	0.198
GS	HV	DL	-0.035	-0.081	-0.004	0.074
RE	HV	DL	0.151	0.027	0.274	<0.050
SF	HV	DL	0.015	-0.008	0.047	0.267
SM	HV	CEI	0.041	-0.011	0.107	0.169
GS	HV	CEI	-0.058	-0.125	-0.014	<0.050
RE	HV	CEI	0.251	0.095	0.408	<0.010
SF	HV	CEI	.026	-0.013	0.075	0.253

The diagonal shows AVE values of each construct. Correlations are under the diagonal, and squared correlations are above the diagonal.

SM self-monitoring, GS goal setting, RE rewards, SF social facilitation, UV utilitarian value, HV hedonic value, DL device loyalty, CEI continuance exercise intention

gamification elements. This result is consistent with previous literature, indicating that users of digital programs are more sensitive to reward mechanisms such as economic benefits and pricing (Hwang and Choi, 2020).

Regarding social facilitation, our results support other recent works that suggest social facilitation is an important element of technology use (Kim et al., 2023; Tsai et al., 2022). However, it is noteworthy that goal setting had no influence on the perceived utilitarian value of wearable fitness devices. According to Vroom's expectancy theory, an individual's motivation is driven by their expectation of achieving a goal and the value they place on the goal's outcome (Vroom et al., 2015). When there is a discrepancy between users' fitness goal expectations and the data provided by the device, users may experience frustration and disappointment (Kim et al., 2016). Such inconsistency (failure to achieve set goals) may lead users to question the reliability and accuracy of the device, thereby hindering their perception of the device's functional value (Alqahtani et al., 2020). This result aligns with Oyibo and Vassileva (2019), who found that users from collectivist cultures are less responsive to goal-setting features in fitness applications compared to socially oriented features. Given South Korea's strong collectivist orientation and high uncertainty avoidance (Hofstede, 2001), users may place less emphasis on individually defined goals and be more motivated by socially contextualized structures.

The results indicated that rewards enhance a device's perceived hedonic value; conversely, self-monitoring and social facilitation do not significantly influence perceived hedonic value, and goal setting was negatively associated with it. According to value-added theory, when users receive tangible or intangible rewards for their efforts, these rewards can enhance the product's attractiveness and improve the overall user experience (Zeithaml, 1988). Based on this theoretical perspective, one possible explanation for this finding is that the reward element can stimulate users' intrinsic motivation, leading them to experience a sense of satisfaction and enjoyment after exercising with gamified fitness devices, thereby enhancing their perceived hedonic value. Furthermore, Etkin (2016) argues that frequent quantification and monitoring of personal activities can shift focus from the enjoyment of the task to tracking progress and outcomes, making pleasurable activities feel more like work. Such an effect diminishes users' enjoyment and may reduce sustained engagement and subjective well-being. This aligns with the current findings,

suggesting that self-monitoring weakens the perceived hedonic value of fitness activities, explaining its non-significant impact.

Moreover, with regard to social facilitation, individuals tend to evaluate their performance by comparing themselves to others (cf. social comparison theory; Festinger, 1954). Frequent social comparisons among users of gamified wearable devices—such as through likes, comments, or leaderboards on social platforms—can lead to anxiety and stress, particularly in competitive environments (Vogel et al., 2014). This comparison and the associated pressure driven by social facilitation may diminish the enjoyment of activities, leading users to perceive that they do not provide hedonic value. In terms of goal setting, when individuals perceive their actions as voluntary and self-directed, their motivation and satisfaction tend to be higher (Deci and Ryan, 2000). However, when goal-setting mechanisms are overly rigid or limit users' autonomy, they may feel pressured or obligated to complete tasks, diminishing intrinsic motivation and reducing the perceived enjoyment of using the device (Vansteenkiste et al., 2004). Moreover, studies have shown that externally imposed goals or controlling structures can undermine users' sense of autonomy and enjoyment, particularly in digital or gamified environments (Gee, 2012). This may be particularly salient in the South Korean cultural context, where high performance expectations and strong collectivist norms can intensify feelings of obligation, thereby reducing hedonic engagement with goal-driven systems (Hofstede, 2001). This finding is also consistent with Oyibo and Vassileva (2019), who found that users from collectivist cultures respond less positively to rigid goal-setting features in fitness applications, which may be perceived as externally imposed rather than intrinsically motivating. This helps explain the negative association between goal setting and perceived hedonic value observed in this study.

Meanwhile, the current study's findings suggest that perceived utilitarian and hedonic values significantly influence users' device loyalty and continuance exercise intentions. Specifically, perceived utilitarian value has a greater impact on device loyalty than perceived hedonic value, which is consistent with the existing literature's findings (Llach et al., 2013; Ozturk et al., 2016). However, in terms of users' continuance exercise intention, perceived hedonic value has a greater influence on their intention to continue using the device than utilitarian value. That is, hedonic value is crucial in maintaining users' ongoing use of wearable fitness devices, effectively promoting their long-term exercise

behavior. The mediation analysis results underscore the critical role of perceived value, particularly utilitarian value, in explaining how gamification elements affect user behaviors. These findings highlight the important mediating role of perceived value in shaping user behaviors toward gamified wearable fitness devices. In particular, perceived utilitarian value significantly mediated the effects of self-monitoring and rewards on both device loyalty and continuance exercise intention, suggesting that users are more likely to continue using the device when they perceive functional benefits (Akdim et al., 2022; Wang et al., 2020). Moreover, hedonic value also played a mediating role in the relationship between rewards and behavioral outcomes, indicating the importance of emotional and experiential aspects (Tu et al., 2019). However, goal setting showed a negative indirect effect via hedonic value, implying that overly rigid goals may reduce enjoyment and motivation (Deci and Ryan, 2000). These results support prior research emphasizing that both cognitive and affective evaluations are crucial in sustaining engagement with gamified systems.

Lastly, personal innovativeness was found to positively moderate the effect of utilitarian value on device loyalty and continuance exercise intention while negatively moderating the effect of hedonic value on them. These results imply that utilitarian value has more impact on user behaviors in individuals with high innovativeness levels than those with low levels. Conversely, hedonic value is more important in user behaviors for individuals with low innovativeness levels than those with high levels. This could be attributed to the propensity of highly innovative users to embrace and adopt new technologies, specifically, their inclination to experiment with and explore novel fitness tools (Agarwal and Prasad, 1998; Rogers et al., 2014). Consequently, they perceive these devices not merely as entertainment products but as tools for achieving health objectives and enhancing physical fitness. Their interest in technology directs their attention toward the functionality and practicality offered by gamified fitness devices, enabling them to leverage features such as data tracking, goal setting, and achievement rewards to engage in physical activities more effectively. In contrast, low personal innovativeness users tend to prioritize the hedonic benefits of gamified fitness devices over practical benefits (Van der Heijden, 2004). Accordingly, they view gamified fitness devices as entertainment tools. Thus, their behaviors are more influenced by hedonic elements compared to individuals with high innovativeness levels.

Theoretical implications. The present study's findings provide several meaningful theoretical implications for the literature on wearable devices and user behaviors. First, although scholars have explored the impact of gamification in various research contexts (Cho et al., 2021; Zhang et al., 2023), the existing conceptualization of gamification is inconsistent and unclear in the context of wearable fitness devices. In this regard, the present study identified key attributes of gamified wearable fitness devices (i.e., self-monitoring, goal setting, rewards, and social facilitation) through a comprehensive review of relevant literature and empirically tested such conceptualization and its impact on users' perceptions. Therefore, the current study contributes to the existing literature on wearable devices and user behaviors by offering a validated theoretical framework to conceptualize gamification elements in the context of wearable fitness devices.

Second, this study contributes to the literature by revealing the psychological mechanisms by which gamification elements affect user behaviors (i.e., device loyalty and continued usage intention) through perceived values (i.e., perceived utilitarian and hedonic values). Previous research on wearable smart devices mainly focused on the direct effects of gamification elements on user

behaviors, and thus, little is known about how such gamification elements lead to positive user behaviors and what psychological factors function in the relationship between the gamification of wearable fitness devices and user behaviors. In this regard, the present study's findings offer insight into each gamification element's specific role in users' value perceptions and how such value perceptions dynamically influence user behaviors.

Third, the current study extends the literature by revealing the relative effects of perceived utilitarian and hedonic values on user behaviors depending on personal traits (personal innovativeness). Previous literature has posited that users' information processing and judgment vary depending on various socio-economic variables (e.g., age, occupation, and income; Kappen et al., 2017; Zhang et al., 2021) and psychological traits (e.g., loneliness, self-efficacy, and affective state; Ko et al., 2022; Ellis et al., 2010; Zhao et al., 2014), yet little research considers such boundary conditions' likelihood of moderating the effect of perceived utilitarian and hedonic values on user behaviors. By revealing the role of personal innovativeness as a significant moderator, the present study offers insights into how value perceptions differently influence user behaviors depending on their personal traits in the context of wearable fitness devices.

Managerial implications. The current study's results also provide practical implications for developers and marketers of wearable fitness devices. First, they need to recognize the different roles of gamification elements, including self-monitoring, goal setting, rewards, and social facilitation, in users' value perceptions. Specifically, as the most effective gamification element in the current research context, rewards can be utilized to incentivize user engagement in positive behaviors. Developers should implement multi-tiered, dynamic reward systems, such as allowing users to earn badges (e.g., bronze, silver, gold) or reward points by progressively achieving daily or weekly activity milestones or completing specific workout tasks. Users will strongly perceive the value of using the device by receiving tangible rewards such as discounts, free membership, or exclusive content access and will be more motivated to continue using it. Meanwhile, the unexpected negative effect of goal setting on perceived hedonic value highlights the importance of considering user autonomy in feature design. When goal-setting mechanisms are overly rigid or externally imposed, they may reduce users' enjoyment and intrinsic motivation. Therefore, developers are encouraged to implement more flexible and autonomy-supportive goal-setting features that allow users to personalize their objectives based on their preferences and fitness levels. Alternatively, a smart adjustment mode could be implemented to automatically calibrate goals based on users' past performance, reducing perceived pressure and enhancing personalization.

Second, the present study indicates that while both perceived utilitarian and hedonic values are vital factors influencing user behaviors, utilitarian value is more effective in enhancing device loyalty, whereas hedonic value is more impactful in maintaining consistent exercise habits. Thus, to cater to users primarily seeking functionality for everyday use, gamified fitness device developers should focus on enhancing utilitarian value to foster greater loyalty by balancing improvements in rewards, self-monitoring features, and social facilitation, including accurate data tracking, reward mechanisms, and varied social services. On the other hand, to encourage sustained use, the focus should be on diverse and engaging reward mechanisms along with various gamified features to enhance users' perceived enjoyment and satisfaction, ultimately promoting sustained engagement in physical activity. In this way, developers can tailor their strategies to meet the differing needs of everyday users and fitness-oriented individuals, maximizing both loyalty and long-term exercise habits.

Finally, given that low-innovativeness users tend to prioritize hedonic value while highly innovative users tend to prioritize utilitarian value, differentiated positioning strategies can be developed based on the preferences of these different groups. Specifically, highlighting wearable fitness devices' reward mechanisms, entertainment value, comfort, and enjoyment would appeal to low-innovativeness users. On the other hand, highlighting the product's practicality, functionality, and performance advantages could meet high personal innovativeness users' needs. To distinguish between the groups, developers could implement a brief questionnaire during the initial device setup to assess users' personal innovativeness levels and then offer customized service modes. For instance, a "Play & Explore" mode for low-innovativeness users could highlight entertainment, visual feedback, and social games, while a "Performance" mode for high-innovativeness users could focus on data analytics, functional dashboards, and efficiency-oriented metrics. This adaptive approach could help enhance both user satisfaction and system effectiveness by tailoring device experiences to different user profiles.

Limitations and future research directions

While the current study provides theoretical insights and practical implications, it is important to discuss several limitations to suggest meaningful agendas for future research. First, the study primarily focused on smartwatches as the subject of investigation within the realm of wearable fitness devices. However, wearable fitness devices encompass a broader range, including ear-worn devices, wristbands, smart clothing, and more, which may limit the generalization of the empirical research findings. Future research can categorize wearable device types as a categorical variable to examine how gamification elements affect user behaviors differently depending on device types and further extend the body of knowledge on user perceptions and behaviors. Second, the survey data were collected from users in South Korea. Future research could be conducted in different countries to examine the proposed theoretical model's generalizability further. Additionally, future studies could incorporate customers' nationality and cultural background as moderating factors in the theoretical model to explore whether there are behavioral differences among user samples categorized by these characteristics. Third, the current study found that goal setting negatively associated with user-perceived hedonic value, which contrasts with common assumptions regarding other gamified wearable fitness devices. Future research could specifically focus on identifying why goal-setting elements might hinder or fail to enhance users' perceptions of hedonic value. Fourth, this study employed a cross-sectional research design, which limits the ability to establish causal relationships among variables. Although structural equation modeling (SEM) was used to test the hypothesized paths, future research may consider adopting longitudinal or experimental designs to further validate the directionality and causality of these relationships. Moreover, given the counter-intuitive finding that goal setting negatively associated with hedonic value, future studies could explore the psychological mechanisms underlying such adverse effects, particularly within performance-oriented cultures. For example, researchers may investigate whether perceived pressure, goal fatigue, or social comparison anxiety mediate this relationship. Another promising direction is to examine how adaptive vs. static goal-setting systems influence perceived enjoyment and motivation, potentially using experimental designs to isolate the causal mechanisms involved.

Data availability

All data generated or analyzed during this study are included in this article and its supplementary information files.

Received: 4 January 2025; Accepted: 28 January 2026;

Published online: 11 February 2026

References

- Agarwal R, Prasad J (1998) A conceptual and operational definition of personal innovativeness in the domain of information technology. *Inf Syst Res* 9(2):204–215
- Ahmed A, Rehman U, Rizwan M, Rafiq MQ, Nawaz M, Mumtaz A (2013) Moderating role of perceived risk and innovativeness between online shopping attitude and intention. *J Basic Appl Sci Res* 3(11):310–323
- Akdim K, Casaló LV, Flavián C (2022) The role of utilitarian and hedonic aspects in the continuance intention to use social mobile apps. *J Retail Consum Serv* 66: 102888
- Alkawsy G, Ali N, Baashar Y (2021) The moderating role of personal innovativeness and users experience in accepting the smart meter technology. *Appl Sci* 11(8):3297
- Alqahtani D, Jay C, Vigo M (2020) The effect of goal moderation on the achievement and satisfaction of physical activity goals. *Proc ACM Interact Mob Wearable Ubiquitous Technol* 4(4):1–18
- Aparicio M, Costa CJ, Moises R (2021) Gamification and reputation: key determinants of e-commerce usage and repurchase intention. *Heliyon* 7(3)
- Aroean L, Michaelidou N (2014) Are innovative consumers emotional and pres-tigiously sensitive to price? *J Mark Manag* 30(3–4):245–267
- Ashraf RU, Hou F, Ahmad W (2019) Understanding continuance intention to use social media in China: the roles of personality drivers, hedonic value, and utilitarian value. *Int J Hum Comput Interact* 35(13):1216–1228
- Aydinliyurt ET, Taşkın N, Scahill S, Toker A (2021) Continuance intention in gamified mobile applications: a study of behavioral inhibition and activation systems. *Int J Inf Manag* 61: 102414
- Baptista G, Oliveira T (2017) Why so serious? Gamification impact in the acceptance of mobile banking services. *Internet Res* 27(1):118–139
- Bolton RN, Kannan PK, Bramlett MD (2000) Implications of loyalty program membership and service experiences for customer retention and value. *J Acad Mark Sci* 28(1):95–108
- Boratto L, Carta S, Fenu G, Manca M, Mulas F, Pilloni P (2017) The role of social interaction on users motivation to exercise: a persuasive web framework to enhance the self-management of a healthy lifestyle. *Pervasive Mob Comput* 36:98–114
- Bridges E, Florsheim R (2008) Hedonic and utilitarian shopping goals: the online experience. *J Bus Res* 61(4):309–314
- Brislin RW (1986) The wording and translation of research instruments. In: Lonner WJ, Berry JW (eds) *Field methods in cross-cultural research*, pp 137–164
- Buchem I, Merceron A, Kreutel J, Haesner M, Steinert A (2015) Gamification designs in wearable enhanced learning for healthy ageing. In: 2015 international conference on interactive mobile communication technologies and learning (IMCL) pp 9–15
- Burke LE, Wang J, Sevick MA (2011) Self-monitoring in weight loss: a systematic review of the literature. *J Am Diet Assoc* 111(1):92–102
- Cai Y, Li X, Shi W (2024) Does gamification affect knowledge-sharing behavior? The mediating role of intrinsic satisfaction needs. *Online Inf Rev* 48(2):354–373
- Camilleri MA, Camilleri MA (2018) Market segmentation, targeting and positioning. Springer
- Carels RA, Darby LA, Rydin S, Douglass OM, Cacciopaglia HM, O'Brien WH (2005) The relationship between self-monitoring, outcome expectancies, difficulties with eating and exercise, and physical activity and weight loss treatment outcomes. *Ann Behav Med* 30(3):182–190
- Chen C-C, Hsiao K-L, Li W-C (2020) Exploring the determinants of usage continuance willingness for location-based apps: a case study of bicycle-based exercise apps. *J Retail Consum Serv* 55: 102097
- Chen C-F, Tsai M-H (2008) Perceived value, satisfaction, and loyalty of TV travel product shopping: Involvement as a moderator. *Tour Manag* 29(6):1166–1171
- Chiu CM, Wang ET, Fang YH, Huang HY (2014) Understanding customers' repeat purchase intentions in B2C e-commerce: the roles of utilitarian value, hedonic value and perceived risk. *Inf Syst Res* 24(1):85–114
- Cho H, Chi C, Chiu W (2020) Understanding sustained usage of health and fitness apps: Incorporating the technology acceptance model with the investment model. *Technol Soc* 63: 101429

- Cho I, Kaplanidou K, Sato S (2021) Gamified wearable fitness tracker for physical activity: A comprehensive literature review. *Sustainability* 13(13):7017
- Cho T-S (2019) A structural relationship between innovative aspects of sports wearable devices and their impact on customer satisfaction and word-of-mouth spreading. *Korean J Sports Sci* 28(5):551–567
- Consolvo S, Everitt K, Smith I, Landay JA (2006) Design requirements for technologies that encourage physical activity. In: Proceedings of the SIGCHI conference on Human Factors in computing systems
- Daedal Research (2022) Global wearable market size and trends with impact of COVID-19 and forecast up to 2027. <https://www.daedal-research.com/global-wearable-market-size-and-trends-with-impact-of-covid-19-and-forecast-up-to-2027#table-1>. Accessed Sep 2022
- de Kervenoael R, Hasan R, Schwob A, Goh E (2020) Leveraging human-robot interaction in hospitality services: Incorporating the role of perceived value, empathy, and information sharing into visitors' intentions to use social robots. *Tour Manag* 78: 104042
- Deci EL, Ryan RM (2000) The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychol Inquiry* 11(4):227–268
- Deci EL, Ryan RM (2013) Intrinsic motivation and self-determination in human behavior. Springer Science & Business Media
- Deterding S, Dixon D, Khaled R, Nacke L (2011) From game design elements to gamefulness: defining "gamification". In: Proceedings of the 15th international academic MindTrek conference: envisioning future media environments
- Edwards EA, Lumsden J, Rivas C, Steed L, Edwards L, Thiyagarajan A, Sohanpal R, Caton H, Griffiths C, Munafò M (2016) Gamification for health promotion: systematic review of behaviour change techniques in smartphone apps. *BMJ Open* 6(10):e012447
- Ellis S, Ganzach Y, Castle E, Sekely G (2010) The effect of filmed versus personal after-event reviews on task performance: the mediating and moderating role of self-efficacy. *J Appl Psychol* 95(1):122
- Etkin J (2016) The hidden cost of personal quantification. *J Consum Res* 42(6):967–984
- Fatima JK, Ghandforoush P, Khan M, Masico RD (2017) Role of innovativeness and self-efficacy in tourism m-learning. *Tour Rev* 72(3):344–355
- Faul F, Erdfelder E, Buchner A, Lang AG (2009) Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. *Behav Res Methods* 41(4):1149–1160
- Feng Y, Liu Z, Qian W, Guo M, Chen J (2019) Research on the Influence Mechanism of Gamification Elements on Users' Willingness to Continue Using in Interest-based Virtual Communities--Based on ECM-ISC Model. In 2019 16th International Conference on Service Systems and Service Management (ICSSSM). IEEE pp 1–6
- Feng W, Tu R, Hsieh P (2020) Can gamification increases consumers' engagement in fitness apps? The moderating role of commensurability of the game elements. *J Retail Consum Serv* 57: 102229
- Festinger L (1954) A theory of social comparison processes. *Hum Relat* 7(2):117–140
- Fornell C, Larcker DF (1981) Evaluating structural equation models with unobservable variables and measurement error. *J Mark Res* 18(1):39–50
- Fritz T, Huang EM, Murphy GC, Zimmermann T (2014) Persuasive technology in the real world: a study of long-term use of activity sensing devices for fitness. In: Proceedings of the SIGCHI conference on human factors in computing systems pp 487–496
- Gee JP (2012) Glued to games: how video games draw us in and hold us spellbound. *Am J Play* 4(4):510
- Greaves CJ, Sheppard KE, Abraham C, Hardeman W, Roden M, Evans PH, Schwarz P, de ISGPSU-D (2011) Systematic review of reviews of intervention components associated with increased effectiveness in dietary and physical activity interventions. *BMC Public Health* 11:1–12
- Guo J, Fussell SR (2022) It's great to exercise together on Zoom!": understanding the practices and challenges of live stream group fitness classes. *Proc ACM Human Comput Interact* 6(CSCW1):1–28
- Gutman J (1997) Means-end chains as goal hierarchies. *Psychol Mark* 14(6):545–560
- Hair JF, Black WC, Babin BJ, Anderson RE, Tatham RL (2006) *Multivariate data analysis* (Vol. 6). Upper Saddle River, NJ: Person Education. Inc
- Hamari J, Koivisto J (2015b) "Working out for likes": an empirical study on social influence in exercise gamification. *Comput Hum Behav* 50:333–347
- Hassan L, Dias A, Hamari J (2019) How motivational feedback increases user's benefits and continued use: a study on gamification, quantified-self and social networking. *Int J Inf Manag* 46:151–162
- Hong J-C, Lin P-H, Hsieh P-C (2017) The effect of consumer innovativeness on perceived value and continuance intention to use smartwatch. *Comput Hum Behav* 67:264–272
- Hsu C-L, Chen M-C (2018) How gamification marketing activities motivate desirable consumer behaviors: focusing on the role of brand love. *Comput Hum Behav* 88:121–133
- Huang Y, Kim D, Ko YJ (2024) The effect of livestreaming esports media on viewer satisfaction, flow experience, and media loyalty. *Commun Sport* 12(6):990–1033
- Hwang J, Choi L (2020) Having fun while receiving rewards?: Exploration of gamification in loyalty programs for consumer loyalty. *J Bus Res* 106:365–376
- Johnson D, Deterding S, Kuhn K-A, Staneva A, Stoyanov S, Hides L (2016) Gamification for health and wellbeing: a systematic review of the literature. *Internet Interv* 6:89–106
- Hofstede G (2001) Culture's recent consequences: Using dimension scores in theory and research. *Int J Cross Cult Manag* 1(1):11–17
- Hamari J, Koivisto J (2015a) Why do people use gamification services? *Int J Inf Manag* 35(4):419–431
- Jones MA, Reynolds KE, Arnold MJ (2006) Hedonic and utilitarian shopping value: Investigating differential effects on retail outcomes. *J Bus Res* 59(9):974–981
- Kang S-B, Chae M-H (2011) A study on the perceived value and adoption behavior of the smartphone application. *J Internet Electron Commer Res* 11(4):187–208
- Kappen DL, Mirza-Babaei P, Nacke LE (2017) Gamification through the application of motivational affordances for physical activity technology. In: Proceedings of the annual symposium on computer-human interaction in Play pp 5–18
- Kappen DL, Nacke LE (2013) The kaleidoscope of effective gamification: deconstructing gamification in business applications. In: Proceedings of the first international conference on gameful design, research, and applications pp 119–122
- Kim D-J, Lee Y, Rho S, Lim Y-K (2016) Design opportunities in three stages of relationship development between users and self-tracking devices. In: Proceedings of the 2016 CHI conference on human factors in computing systems pp 699–703
- Kim E-J, Kim JJ, Han S-H (2021) Understanding student acceptance of online learning systems in higher education: application of social psychology theories with consideration of user innovativeness. *Sustainability* 13(2):896
- Kim H-M, Cho I, Kim M (2023) Gamification aspects of fitness apps: implications of mHealth for physical activities. *Int J Hum Comput Interact* 39(10):2076–2089
- Kim J-H, Ritchie JB, McCormick B (2012) Development of a scale to measure memorable tourism experiences. *J Travel Res* 51(1):12–25
- Kim KJ (2016) Round or square? How screen shape affects utilitarian and hedonic motivations for smartwatch adoption. *Cyberpsychol Behav Soc Netw* 19(12):733–739
- Kim Y (2015) Assessing the effects of perceived value (utilitarian and hedonic) in LCCs and FSCs: evidence from South Korea. *J Air Transp Manag* 49:17–22
- Klein A, Moosbrugger H (2000) Maximum likelihood estimation of latent interaction effects with the LMS method. *Psychometrika* 65(4):457–474
- Kline RB (2023) Principles and practice of structural equation modeling. Guilford publications
- Ko YJ, Asada A, Jang W, Kim D, Chang Y (2022) Do humanized team mascots attract new fans? Application and extension of the anthropomorphism theory. *Sport Manag Rev* 25(5):820–846
- Lai KP, Langley P (2024) Playful finance: gamification and intermediation in FinTech economies. *Geoforum* 151: 103848
- Landers RN, Bauer KN, Callan RC (2017) Gamification of task performance with leaderboards: a goal setting experiment. *Comput Hum Behav* 71:508–515
- Ledger D, McCaffrey D (2014) Inside wearables: how the science of human behavior change offers the secret to long-term engagement. *Endeavour Partners* 200(93):1
- Lee SY, Petrick JF, Crompton J (2007) The roles of quality and intermediary constructs in determining festival attendees' behavioral intention. *J Travel Res* 45(4):402–412
- Leicht T, Chtourou A, Youssef KB (2018) Consumer innovativeness and intentioned autonomous car adoption. *J High Technol Manag Res* 29(1):1–11
- Leung K, Chen T, Chen G (2014) Learning goal orientation and creative performance: the differential mediating roles of challenge and enjoyment intrinsic motivations. *Asia Pac J Manag* 31:811–834
- Lewis M (2004) The influence of loyalty programs and short-term promotions on customer retention. *J Mark Res* 41(3):281–292
- Liu R, Benitez J, Zhang L, Shao Z, Mi J (2024) Exploring the influence of gamification-enabled customer experience on continuance intention towards digital platforms for e-government: an empirical investigation. *Inf Manag* 61(5):103986
- Liu Y, Lachman ME (2021) A group-based walking study to enhance physical activity among older adults: the role of social engagement. *Res Aging* 43(9-10):368–377
- Llach J, Marimon F, del Mar Alonso-Almeida M, Bernardo M (2013) Determinants of online booking loyalties for the purchasing of airline tickets. *Tour Manag* 35:23–31
- Locke EA, Latham GP (1985) The application of goal setting to sports. *J Sport Exerc Psychol* 7(3):205–222

- Locke EA, Latham GP (2002) Building a practically useful theory of goal setting and task motivation: a 35-year odyssey. *Am Psychol* 57(9):705
- Lu J, Yao JE, Yu CS (2005) Personal innovativeness, social influences and adoption of wireless Internet services via mobile technology. *J Strateg Inf Syst* 14(3):245–268
- Maden Ç, Bayramlar K, Arıca OT, Yaglı NV (2022) Effects of virtual Reality-Based Training and aerobic training on gaming disorder, physical activity, physical fitness, and anxiety: a randomized, controlled trial. *Ment Health Phys Act* 23: 100465
- Maslowsky J, Jäger J, Hemken D (2015) Estimating and interpreting latent variable interactions: a tutorial for applying the latent moderated structural equations method. *Int J Behav Dev* 39(1):87–96
- Mitchell R, Schuster L, Drennan J (2017) Understanding how gamification influences behaviour in social marketing. *Australas Mark J* 25(1):12–19
- Molinillo S, Rejón-Guardia F, Anaya-Sánchez R, Liébana-Cabanillas F (2023) Impact of perceived value on intention to use voice assistants: the moderating effects of personal innovativeness and experience. *Psychol Mark* 40(11):2272–2290
- Mullins JK, Sabherwal R (2020) Gamification: a cognitive-emotional view. *J Bus Res* 106:304–314
- Naranjo-Zolotov M, Oliveira T, Casteleyn S, Irani Z (2019) Continuous usage of e-participation: the role of the sense of virtual community. *Gov Inf Q* 36(3):536–545
- Nelson EC, Verhagen T, Noordzij ML (2016) Health empowerment through activity trackers: an empirical smart wristband study. *Comput Hum Behav* 62:364–374
- Oh J, Kim D (2023) Workout with a Smartwatch: a cross-sectional study of the effects of smartwatch attributes on flow experience and exercise intentions depending on exercise involvement. *Healthcare* 11(23):3074
- Oyibo K, Vassileva J (2019) The relationship between personality traits and susceptibility to social influence. *Comput Hum Behav* 98:174–188
- Ozturk AB, Nusair K, Okumus F, Hua N (2016) The role of utilitarian and hedonic values on users' continued usage intention in a mobile hotel booking environment. *Int J Hosp Manag* 57:106–115
- Palmer D, Lunceford S, Patton AJ (2012) The engagement economy: how gamification is reshaping businesses. *Deloitte Rev* 11:52–69
- Parasuraman A, Colby CL (2015) An updated and streamlined technology readiness index: TRI 2.0. *J Serv Res* 18(1):59–74
- Patel MS, Benjamin EJ, Volpp KG, Fox CS, Small DS, Massaro JM, Lee JJ, Hilbert V, Valentino M, Taylor DH (2017) Effect of a game-based intervention designed to enhance social incentives to increase physical activity among families: the BE FIT randomized clinical trial. *JAMA Intern Med* 177(11):1586–1593
- Podsakoff PM, MacKenzie SB, Lee JY, Podsakoff NP (2003) Common method biases in behavioral research: a critical review of the literature and recommended remedies. *J Appl Psychol* 88(5):879
- Putz L-M, Hofbauer F, Treiblmaier H (2020) Can gamification help to improve education? Findings from a longitudinal study. *Comput Hum Behav* 110: 106392
- Rogers EM, Singhal A, Quinlan MM (2014) Diffusion of innovations. In: (ed) An integrated approach to communication theory and research. Routledge pp 432–448
- Rohan R, Pal D, Funilkul S, Chutimaskul W, Eamsinwattana W (2021) How gamification leads to continued usage of MOOCs? A theoretical perspective. *IEEE Access* 9:108144–108161
- Roh D-Y, Oh Y-S, Park S-H (2020) The relationship among caring climate, autonomy and exercise adherence of fitness centers. *Korean J Sports Sci* 29(2):639–650
- Ryan RM, Deci EL (2000) Intrinsic and extrinsic motivations: classic definitions and new directions. *Contemp Educ Psychol* 25(1):54–67
- Ryu K, Han H, Jang S (2010) Relationships among hedonic and utilitarian values, satisfaction and behavioral intentions in the fast-casual restaurant industry. *Int J Contemp Hosp Manag* 22(3):416–432
- Sánchez-Fernández R, Iniesta-Bonillo MÁ (2007) The concept of perceived value: a systematic review of the research. *Mark Theory* 7(4):427–451
- Seefeldt V, Malina RM, Clark MA (2002) Factors affecting levels of physical activity in adults. *Sports Med* 32:143–168
- Senali MG, Iranmanesh M, Ismail FN, Rahim NFA, Khoshkam M, Mirzaei M (2023) Determinants of intention to use e-Wallet: personal innovativeness and propensity to trust as moderators. *Int J Hum Comput Interact* 39(12):2361–2373
- Snyder M (1979) Self-monitoring processes. *Advances in Experimental Social Psychology/Academic Press*
- Stragier J, Abeele MV, Mechant P, De Marez L (2016) Understanding persistence in the use of online fitness communities: comparing novice and experienced users. *Comput Hum Behav* 64:34–42
- Stylos N, Vassiliadis CA (2025) Gamification design: toward developing image perception scales for generation Z consumers. *Int J Contemp Hosp Manag* 37(5):1516–1533
- Tong X, Gromala D, Shaw CD, Neustaedter C (2016) Examining the efficiency of gamification incentives for encouraging physical activity–social collaborations or interactive mobile games. *PervasiveHealth* 2016:1–10
- Tsai JM, Hung SW, Lin GT (2022) Continued usage of smart wearable devices (SWDs): cross-level analysis of gamification and network externality. *Electron Mark* 32(3):1661–1676
- Tsay CHH, Kofinas A, Luo J (2018) Enhancing student learning experience with technology-mediated gamification: an empirical study. *Comput Educ* 121:1–17
- Tu R, Hsieh P, 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(5):682–693
- Tuncer I, Unusan C, Cobanoğlu C (2021) Service quality, perceived value and customer satisfaction on behavioral intention in restaurants: an integrated structural model. *J Qual Assur Hosp Tour* 22(4):447–475
- Van der Heijden H (2004) User acceptance of hedonic information systems. *MIS Q*:695–704
- Vansteenkiste M, Simons J, Lens W, Sheldon KM, Deci EL (2004) Motivating learning, performance, and persistence: the synergistic effects of intrinsic goal contents and autonomy-supportive contexts. *J Personal Soc Psychol* 87(2):246
- Vassileva J (2012) Motivating participation in social computing applications: a user modeling perspective. *User Model User Adap Interact* 22:177–201
- Venkatesh V, Thong JY, Xu X (2012) Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS Q*:157–178
- Vogel EA, Rose JP, Roberts LR, Eckles K (2014) Social comparison, social media, and self-esteem. *Psychol Pop Media Cult* 3(4):206
- Vroom V, Porter L, Lawler E (2015) Expectancy theories. In: (ed) *Organizational Behavior* 1. Routledge p 94–113
- Wang Y, Wang Y, Greene B, Sun L (2020) An analysis and evaluation of quality and behavioral change techniques among physical activity apps in China. *Int J Med Inform* 133: 104029
- Whiteman-Sandland J, Hawkins J, Clayton D (2018) The role of social capital and community belongingness for exercise adherence: an exploratory study of the CrossFit gym model. *J Health Psychol* 23(12):1545–1556
- Xi N, Hamari J (2019) Does gamification satisfy needs? A study on the relationship between gamification features and intrinsic need satisfaction. *Int J Inf Manag* 46:210–221
- Xu XY, Tayyab SMU, Jia QD, Wu K (2023) Exploring the gamification affordances in online shopping with the heterogeneity examination through REBUS-PLS. *J Theor Appl Electron Commer Res* 18(1):289–310
- Yin Q, Li L, Yan Z, Guo C (2022) Understanding the effects of self-peer-platform incentives on users' physical activity in mobile fitness apps: the role of gender. *Inf Technol People* 35(3):1054–1072
- Yin S, Cai X, Wang Z, Zhang Y, Luo S, Ma J (2022) Impact of gamification elements on user satisfaction in health and fitness applications: a comprehensive approach based on the Kano model. *Comput Hum Behav* 128: 107106
- Zeithaml VA (1988) Consumer perceptions of price, quality, and value: a means-end model and synthesis of evidence. *J Mark* 52(3):2–22
- Zhang L, Shao Z, Benitez J, Zhang R (2023) How to improve user engagement and retention in mobile payment: a gamification affordance perspective. *Decis Support Syst* 168:113941
- Zhang L, Shao Z, Li X, Feng Y (2021) Gamification and online impulse buying: the moderating effect of gender and age. *Int J Inf Manag* 61: 102267
- Zhang Q, Anwar MA (2025) Leveraging gamification technology to motivate environmentally responsible behavior: an empirical examination of Ant Forest. *Decision Sciences* 56(1):25–49
- Zhao G, Muehling DD, Kareklas I (2014) Remembering the good old days: the moderating role of consumer affective state on the effectiveness of nostalgic advertising. *J Advert* 43(3):244–255
- Zuckerman O, 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

Acknowledgements

This work was supported by the Global Joint Research Program funded by Pukyong National University (202412390001).

Author contributions

WGC conceptualized and designed the study. Material preparation, data collection, and analysis were collaboratively performed by WGC, YHH, and DHK. The first draft of the manuscript was written by WGC, with significant revisions and comments provided by YHH and DHK. DHK is the corresponding author and is responsible for all communication during the submission, peer review, and publication process. All authors have reviewed and approved the final version of the manuscript.

Competing interests

The authors declare no competing interests.

Ethical approval

This study was reviewed and approved by the Institutional Review Board (IRB) of Pukyong National University, Busan, Republic of Korea (Approval No. 1041386-202308-HR-87-01; Approval Date: 11 August 2023). The approval was valid for one year and covered all aspects of the study, including data collection, data analysis, participant recruitment, informed consent procedures, and confidentiality measures. All procedures involving human participants were conducted in strict accordance with the relevant institutional research ethics guidelines and the 1964 Declaration of Helsinki and its later amendments. The study did not involve any vulnerable populations, and no personally identifiable information was collected. All survey data were anonymised at the time of collection and handled accordingly.

Informed consent

Informed consent was obtained in written electronic form from all participants prior to the online survey, which was conducted between 29 August 2023 and 22 September 2023. Participants recruited through a professional online survey company were first presented with a digital consent form describing the study purpose, procedures, anonymity of responses, voluntary participation, exclusive academic use of the data, and the absence of foreseeable risk. Only those who selected the “Agree” option proceeded to the questionnaire, thereby providing consent to participate, consent for the use of their anonymised data for research purposes, and consent for the anonymous publication of aggregated findings. No personally identifiable information was collected, and no vulnerable populations were involved.

Additional information

Supplementary information The online version contains supplementary material available at <https://doi.org/10.1057/s41599-026-06640-2>.

Correspondence and requests for materials should be addressed to Daehwan Kim.

Reprints and permission information is available at <http://www.nature.com/reprints>

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Open Access This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

© The Author(s) 2026