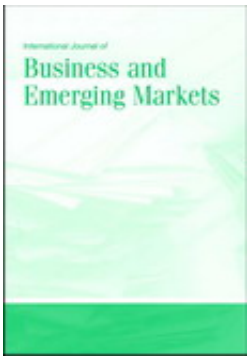

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Gamified features as a mediator of fitness app engagement: a cross-sectional study

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Gamified features as a mediator of fitness app engagement: a cross-sectional study

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Abstract: The research explores the influence of performance expectancy, social influence, hedonic motivation, habit, and user engagement in continued usage. Data was collected from 438 fitness app users in China through an online survey. Performance expectancy ($\beta = -0.008$, $p = 0.874$), social influence ($\beta = 0.026$, $p = 0.557$), hedonic motivation ($\beta = 0.104$, $p = 0.064$), and habit ($\beta = 0.084$, $p = 0.165$); none of these has a direct effect on continued user intention. However, each determinant significantly influenced gamified features ($p < 0.05$), which in turn had a strong and significant effect on continued app use ($\beta = 0.593$, $p < 0.001$). Mediation analysis confirmed that gamified features significantly mediated the relationships between the four antecedents and continued usage. The results show that gamification is crucial to improve user experience and promote long-term use of a fitness app.

Keywords: technology acceptance model; TAM; path coefficient; hedonic motivation; performance expectancy; UTAUT2; gamified features.

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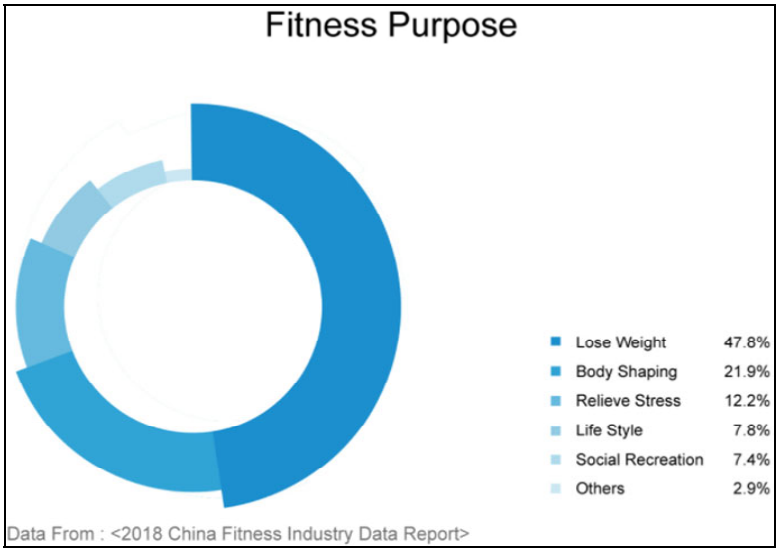
1 Introduction

China has seen rapid growth in the use of fitness applications (apps) in the last few years, because of increasing health consciousness, high digitalisation, and encouraging government initiatives to promote physical well-being. The latest data from the fitness app industry report shows that China has the biggest fitness app market in the world. It has over 400 million users using its fitness apps to follow physical activities, control health metrics, and attend digital fitness programs. The online fitness market in China has reached a market value of RMB100 billion (USD14 billion) in 2023 (Wang and Liang, 2024). The increasing popularity of wearable devices such as Xiaomi and Huawei smartwatches integrate mobile apps with real-time health data, accelerating the growth of fitness apps. There are several reasons why Chinese users use fitness apps, as proposed by Cai et al. (2022). The first is that digital fitness solutions are more convenient and available, and therefore, a user can engage in a workout and monitor health by using this device. Second, social influence, especially the part of community engagement, is important because most Chinese fitness apps provide various group challenges, live streaming, and social networking to promote participation. The social influence is strong factor due to the collectivist society China has. In collectivist societies, individuals are more likely to align their actions with group norms and derive motivation from shared goals, peer influence, and communal participation. The increasing growth of preventive healthcare led users to adopt fitness apps as a part of their lives and to maintain a healthy life. Key players in the market include Keep, JoyRun, and Huawei Health, which use a combination of guided workouts, AI-based coaching to provide a guide, and gamification to keep subscribers engaged.

Figure 1 shows the trends in the health and fitness industry in China. As per the view of Verot (2025), the main fitness purposes for Chinese users are to lose weight, body shaping, relieve stress, lifestyle, social recreation, and others. Despite the growth in fitness apps in China, the user retention problem is still a challenge. Studies show that many users download fitness apps but ultimately leave them soon. It is difficult to maintain motivation and engagement because users tend to change their workout routine frequently (Huang et al., 2024). To address this problem, gamification has become a strategic tool that incorporates some of the game-like elements, including badges, challenges, streaks, leader boards, and other virtual rewards to increase application usage. Gamification has a high scope of implementation, but its effectiveness in promoting continuing engagement is mostly underexplored. Based on behavioural models, such as the technology acceptance model (TAM), performance expectancy, social influence, hedonic motivation, and habit are critical determinants for technology adoption (Yang and Koenigstorfer, 2021). However, in the case of fitness apps, it remains unanswered how gamified elements mediate between determinants and continuous use of the app (Malik and Singh, 2022). Similarly, mobile friendliness is a key area towards adoption of any application (Chen, 2024). This relationship is key for learning how to retain users in the competitive digital health market of China and thus, is important in helping fitness

app developers and marketers to optimise user retention strategy. This study contributes by examining the mediating role of gamification in fitness app usage, filling a critical research gap. Previous research has investigated the determinants for adoption, however, the mediates effect of gamified features has not been studied sufficiently in the context of China. According to the unique digital ecosystem, which includes apps like WeChat and gamification-driven platforms such as Douyin (Chinese TikTok), understanding user behaviour is essential. Furthermore, cultural preferences in China, such as collectivism and social motivation, may influence the way that gamified elements are perceived and utilised.

Figure 1 Chinese health and fitness industry trends (see online version for colours)



Source: Verot (2025)

This study aims to investigate the role of gamified features as a mediator in the relationship between the determinants of fitness app usage (performance expectancy, social influence, hedonic motivation, and habit) and continuous use of fitness apps in China.

1.1 Objectives

- To investigate the impact of performance expectancy, social influence, hedonic motivation, and habit on the continuous use of fitness apps.
- To examine the relationship between performance expectancy, social influence, hedonic motivation, habit, and the use of gamified features in fitness apps.
- To analyse the effect of gamified features on the continuous use of fitness apps.
- To assess whether gamified features mediate the relationship between the identified determinants and the continuous use of fitness apps.

- To provide practical recommendations for fitness app developers and marketers to enhance user engagement and retention through gamification strategies.

2 Literature review

2.1 Performance expectancy and continued use of fitness apps

The performance expectancy refers to the degree to which a user believes that using the fitness application will help them achieve their fitness goal (Ferreira Barbosa et al., 2022). The users continue using the fitness apps when they think that the app helps them achieve their fitness goals. It is found in studies that performance expectancy is the key indicator of technology acceptance and continued use of the app (Mustafa et al., 2023; Mishra et al., 2025). Fitness apps that provide goal-oriented features such as progress tracking, AI-based suggestions, and interactive support have the potential to gain the belief of users in their effectiveness (Chiu et al., 2021). Those who use the app see the changes in their fitness habits and start using the app more and more because of the feeling of reliance. User engagement is further strengthened by the convenience of accessing structured workouts, health insights tailored for individuals, as well as performance analytics. The app becomes a part of a fitness journey, as the app becomes useful and develops trust over time. Also, gamification elements add some extra advantages such as achievement badges and performance summaries, which build motivation and keep the users constantly involved. However, as some researchers suggest, perceived usefulness by itself is not always enough to ensure continuous use, as the high dropout rates in digital fitness platforms indicate the existence of other psychological and behavioural factors for sustained engagement (Chiu and Cho, 2021). Although the dropout rate is high in the digital fitness category, continuous improvements, such as personalised recommendations, a good user interface, and fewer usability-related issues in the application, can solve this issue. Fitness app retention is strongly driven by the perceived performance expectancy, and therefore the perceived effectiveness encourages user commitment, which supports that perceived performance expectancy has a positive effect on continued use.

H1 Performance expectancy shows a positive relationship with continued use of fitness apps.

2.2 Social influence and continued use of fitness apps

Social influence is the opinion, behaviour, or expectation of family, friends, or peers that lead the user to make some decisions (Ferreira Barbosa et al., 2022). For example, if most of the people in a group are using a fitness app, then the person who is not using the app will also feel motivated or even pressured to use that. The continued use of fitness apps is largely driven by social influence since users are more likely to continue with the app if they feel social support and encouragement. This has been suggested by Hassan et al. (2024) as well. Also, community engagement, social media integration, and recommendations are crucial for technology adoption and sustained usage (Whelan and Clohessy, 2021). Leader boards, group challenges, and sharing progress updates prompt the users to stay active on the platform with a sense of accountability (Gupta et al., 2021).

The better that users feel encouraged by their friends, family, or online communities, the more likely they are to stay with fitness goals. Social interaction gives a sense of validation and motivation, which serves to strengthen commitment and reduce dropout rates. Social comparison theory indicates that users seek consistency to match their peers' progress in their fitness activities (Hansen et al., 2024). This competition allows for motivating and engaging users in the app. Social reinforcement mechanisms, such as notifying users about peer activity, also help in user retention using external motivation. However, studies suggest excessive social comparison may demotivate users when their progress is perceived as less than others (Durau et al., 2022). Nevertheless, this can be tackled by positive reinforcement (non-competition) in fitness apps rather than competition. Negative effects are mitigated by personalised goal setting, encouragement-based notifications, and social support groups that keep social influence as a motivator and not a deterrent. The social influence in fitness apps encourages users to maintain their motivation, provide accountability, and support a user by reinforcing non-competition and maintaining long-term engagement.

H2 Social influence shows a positive relationship with continued use of fitness apps.

2.3 Hedonic motivation and continued use of fitness apps

Hedonic motivation refers to the enjoyable element in technology that attracts users to use that technology for a long time (Yang and Koenigstorfer, 2021). In the context of fitness applications, the implementation of interactive UI design, gamified features, and so on attract users to use the application. Fun elements in the fitness app heavily influence the willingness of users to continue using the app over time. The study by Ferreira Barbosa et al. (2022) says that fitness apps with an engaging and fun side, such as gamification, social interactions, and interactive challenges, motivate users. It is more likely for users to use application for a long time (Sharma et al., 2024a). The hedonic motivation that involves activities that are enjoyable instead of obligatory acquires intrinsic engagement. Features like virtual rewards, achievement badges, and competitive leader boards give the feeling of achieving something and therefore cause consistent usage. The visually appealing interfaces, immersive experiences, and personalised workout challenges lead to higher retention rates. Social features like community-based challenges and shared achievements with other peers encourage engagement. However, some research states that gamified features may be enjoyable, but only enjoyable elements are not enough to sustain engagement; the motivation reduces as the novelty of the feature fades (Huang et al., 2024). The continuous development of the feature and adapting to the challenges over time can help to maintain the novelty of the feature. The hedonic motivation is key to sustaining engagement in a fitness app, as the enjoyable elements promote long-term use, so hedonic motivation positively influences continued app usage.

H3 Hedonic motivation shows a positive relationship with continued use of fitness apps.

2.4 Habit formation and continued use of fitness apps

Habit formation is a crucial part of the continuous use of a fitness app, as frequent use of an application changes the behavioural pattern in the user, which is important for

continuous use. A study by Wang and Lin (2021) defines a habit as a tendency to perform certain tasks. Humans perform these tasks unconsciously due to repeated learning. Habit in technology use acts as a crucial factor in predicting technology acceptance (Kim et al., 2022). Continuous and frequent use of any application makes some behavioural changes. These continuous changes can be achieved by positive reinforcement mechanisms such as streaks, rewards, and personalised insights. Positive reinforcement mechanisms such as streaks, rewards, and personalised insight into the fitted behaviour improve consistency of behaviour through engaging with a fitness app. Psychological factors like the Zeigarnik effect, where users get a sense of urgency for an incomplete task, also apply in the context of fitness apps (Naviaux et al., 2021). When users get habitual using the fitness application they feel a sense of urgency to frequently check the app regardless of the benefits they get from the application. As people use the app more and more over time, these patterns become habits and reduce the cognitive effort to use the app, and are also good for keeping people around the app. However, some studies say that this is very tough to build a habit through digital platforms, as there are many distractions in real life where users can discontinue using the app if it feels repetitive and ineffective (Soulé et al., 2022). This problem can be solved by employing personalised notifications, AI-driven workout strategies, and social accountability to maintain interest. So, habit formation is essential to maintain user engagement and sustained use of the application.

H4 Habit shows a positive relationship with continuous use of the fitness app.

2.5 Performance expectancy and gamified features

Gamified features in fitness apps increase the performance expectancy of users by giving them a sense of achieving their fitness goals. A study by Li et al. (2022) shows that gamification is an efficient way to maintain healthy habits in users, as gamification provides personalised gamified sports and fitness services, which make this app loved by all users. Gamification has shown the potential to improve customer retention as this positively changes user behaviour (Gunhan et al., 2024). Gamification uses fitness routines as structured and goal-centred experiences, making users more likely to perceive the app as a key element for progress. Immediate feedback in the form of performance leader boards and milestone rewards makes the app more usable and perceived as having more value. The utilisation of gamification in areas where users can have a sense of accomplishment leads them to connect app usage with real progress, which reinforces performance expectancy. However, some studies claim that gamified features do not necessarily enhance performance expectancy because the overdependence on rewards and competitive components may lead to an external motivation (Martín et al., 2023). Strategic implementation of gamification helps to solve this issue. Following an effective design, gamification helps to maintain high motivation in users. Gamification plays an important role in enhancing performance expectancy through the reinforcement effectiveness of apps.

H5 Performance expectancy shows a positive relationship with gamified features.

2.6 Social influence and gamified features

Social influence plays a critical role in maintaining user engagement with gamified features in fitness applications, as the comparison with peers motivates users to continue

using the application. Fitness apps with social elements, like leader boards, virtual challenges, and peer support, have gained more user participation (Neupane et al., 2021). According to social comparison theory, gamified features are more appropriate when there are others to achieve milestones because this gives a sense of competition and accountability (Yin et al., 2022a). Leader boards help users improve their performance since there are rankings in place against others, and virtual challenges create this sense of community while achieving something together. Friends or online communities that provide social support to the users motivate them further because they get recognition for their progress. Social reinforcement further supports the perception of value on the elements that are gamified and offers higher chances to make gaming an important part of their regular activity. Long interaction with gamified features is maintained by the psychological motive to keep a competitive edge or to contribute to group achievement. The results are positive from the point of view of social influence, but some studies indicate that competitive gamification can have a negative effect by discouraging, for example, the users who are not keeping up with other high-performing users (Chan et al., 2024). By implementing social factors such as motivation, competition, and community engagement, gamified features improve user engagement and create a strong bond with the app.

H6 Social influence shows a positive relationship with gamified features.

2.7 Hedonic motivation and gamified features

Hedonic motivation increases user engagement with fitness apps, and gamified features make the user experience enjoyable and intrinsic motivation. It has been found that people start engaging more if these platforms are enjoyable and entertaining (Zhang and Jung, 2022). Any product online and its purchase or use leads to either hedonic and utilitarian advantages (Divakar and Venkatesh, 2024). Badges, leader boards, challenges, and reward systems give a fun and rewarding feeling toward a task, and they make fitness activities more engaging (John et al., 2023). Gamification integration stimulates curiosity, competition, and social interaction in a user. Progress tracking and achievement unlocking are triggering dopamine responses that encourage engagement. Interactive challenges encourage users to establish higher fitness goals that give them a feeling of accomplishment. Studies by that gamification will work for everyone, as users trained to work extrinsically may lose interest as the gamification becomes repetitive and predictable, and over time, if users start to think that challenges are not novel, their engagement levels will drop out of simply being too tired of the game (Yin et al., 2022b). Fitness apps stay relevant and keep the users hooked to their health-tracking apps by giving them a lot of dynamic challenges to keep their engagement by playing more and more gamification strategies, from personalised goals to adaptive reward mechanisms. The gamified features serve an important role in the stimulation of hedonic motivation, which subsequently increases the likelihood of the gamer interacting with gamified elements.

H7 Hedonic motivation shows a positive relationship with gamified features.

2.8 Habit formation and gamified features

The gamified features are a crucial part of reinforcing habit formation by reinforcing repetitive behavioural patterns that encourage long-term fitness app use. It is known that consistent reinforcement, and gamification like rewards, progress tracking, or streaks contribute to this process (Neupane et al., 2021). All the features, such as daily challenges, achievement badges, and leader boards, promote a side of accomplishment, motivating users to play again and again (Esmaeilzadeh, 2021). Visual progress indicators and celebrations of milestones further engage people psychologically because they give them a sense of accomplishment. Eventually, gamification integrates with user behaviours over time and moves from being induced by rewards as an extrinsic motivation to becoming an intrinsic motivation that occurs without external prompting. However, some studies show that favouring gamified features for habit formation may engage users for the short term, but as users tire of novelty, and eventually lose interest if gamification elements cease to be novel or do not provide rewarding experiences (Oc and Plangger, 2022). Although disengagement may arise, continuous updates, changing goals, and personalised challenges keep novelty and sustained interest. Gamification results in the sustainable use of fitness apps by reinforcing repetitive behaviours through gamified features and contributes to habit formation.

H8 Habit shows a positive relationship with gamified features.

2.9 Gamified features and continued use of fitness apps

Gamified features add significant user engagement and lead to continued use of the fitness apps. Game-like features in fitness apps help to increase user satisfaction, commitment to work out, and adherence to long-term use (Yin et al., 2022b). Psychological features used in gamification, such as reward, competition, and social interaction, are used to sustain the interest of users (Windasari and Lin, 2021). Giving badges or levelling up users based on performance makes the users continue to work out regularly. Although some research says that gamification is not the solution, as people may stop using the tool once the novelty of rewards diminishes, and some users may even feel demotivated if they cannot compete with others (Li et al., 2022). Adaptive gamification strategies as personalised goal setting and a dynamic reward system, help to maintain the interest of users, and customised and AI-driven challenges help to keep the gamification fun and relevant to individual user preferences to maintain the fun element. Gamification has a positive effect on the continued use of fitness applications. The gamified features are crucial for the increase of user engagement.

H9 The gamified feature shows a positive relationship with continued use of the fitness app.

2.10 Gamified features as a mediator between performance expectancy and continued use

Gamified features make goal attainment of fitness apps more engaging and rewarding, and thus the relationship between performance expectancy and the continuous use of fitness apps is improved. The research shows that users who consider the fitness app effective are more likely to use it, and gamification helps enhance such perception by

providing motivation and engagement (Sun and Yuan, 2024). Points, leader boards, challenges, and rewards all together make an interactive environment that increases the perceived usefulness of the app; thus, the retention rate increases (Lyu et al., 2024). The psychological link between effort and the reward a person gets from games makes it easier to maintain fitness routines, making it less monotonous and more fun. When users get badges or milestone notifications for finishing workouts, it boosts the confidence of the user that the app works. Some critics say that these features are not useful for all users, as some users see them as unappealing and distracting (Tsai et al., 2022). Although gamification may not appeal to all users in the same way, the gamified elements can be adapted to meet the preferences of different users, and to mediate the relationship between performance expectancy and continued use. Dynamic goal setting, customisable challenges, and recommendations driven by the AI are employed to sustain motivation. Performance expectancy has a high impact on continued user retention through motivation, engagement, and perceived effectiveness, but the role of mediators is enhanced by the gamified features to amplify their role in sustaining user retention.

H10 Gamified feature mediates the relationship between performance expectancy and continued use of fitness app.

2.11 Gamified features as a mediator between social influence and continued use

The gamified features improve social engagement in fitness apps by encouraging engagement, competition, and community interaction. Peer encouragement, community challenges, and social comparisons are all important forms of social influence when it comes to retaining users in fitness apps (Zhang and Li, 2024). Gamification elements like leader boards, achievement badges, and social rewards amplify this influence by bringing accountability and motivation (Sharma et al., 2024b). Using gamified features strengthens social influence by getting users committed through external validation and reward. As a result, apps that reward users by giving them digital rewards or public recognition for their achievements motivate the users to keep on using the app. Social and gamified elements are integrated to form a reinforcing cycle, where the user continues to stay engaged to retain status and recognition amongst other users of the community. However, the effectiveness of gamification does not seem to be sufficient to achieve long-term engagement in all cases, as some studies claim that if users have no competitive drive, or if they prefer private fitness routines, the introduction of gamified social elements as a mediator will have no impact (Huang et al., 2024). Customisable gamification can be used to address these problems, and gamification remains effective as a mediator of different user preferences because it is based on personalised incentives and adaptive challenges. So, the gamification-mediated relationship between social influence and the continued use of fitness apps is based on gamified features that reinforce social influence and increase engagement and motivation.

H11 Gamified feature mediates the relationship between social influence and continued use of fitness app.

2.12 Gamified features as a mediator between hedonic motivation and continued use

The gamified features of a fitness app improve the hedonic motivation and continued use, and raise user enjoyment and engagement. A key determining factor in technology adoption and use is hedonic motivation and pleasure from an activity (Kim et al., 2022). Gamification of fitness apps by giving features like rewards, leader boards, and virtual challenges is especially engaging, increases user happiness, and is likely to sustain user retention (De Canio et al., 2021). Gamification transforms the regular workout routine into an interactive experience to encourage the user to maintain an intrinsic motivation in handling the situation. Unlocking new achievements or outperforming friends, are encouraging feature that motivates users to use the app over time. Although the long-term impact of gamification in retaining users is low, the engagement level decreases, and it may not work as much as a mediator for hedonic motivation (Sampat et al., 2023). Prevention of monotony can be sustained by continuous updates, personalised challenges, and an evolving reward system, and dynamic gamification strategies help to maintain engagement. Gamified features intermediate the relationship between hedonic motivation and continuous use through increasing engagement and enjoyment, and enhance user retention in fitness apps.

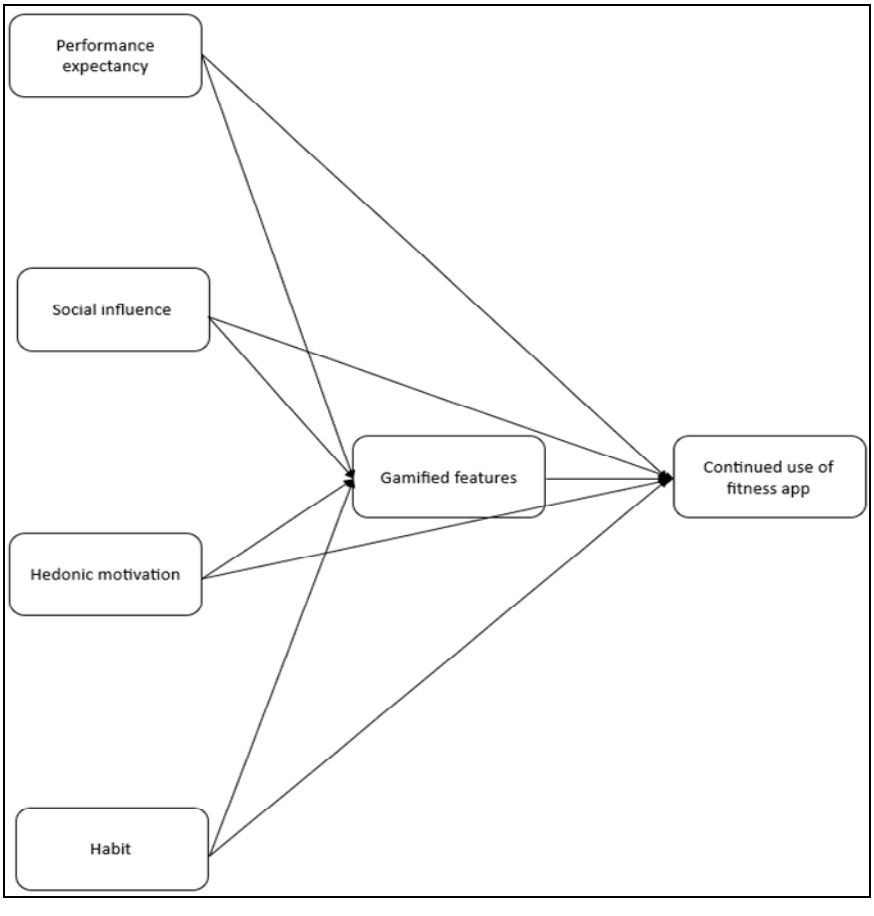
H12 Gamified feature mediates the relationship between hedonic motivation and continued use of fitness app.

2.13 Gamified features as a mediator between habit and continued use

The gamified features strengthen the relationship between habit formation and continued use by reinforcing automatic behaviour and engagement-driven incentives. As per the view of Habachi et al. (2024), the habitual usage of fitness applications is usually motivated by consistent cues, rewards, and reinforcement mechanisms. Achievement badges, leader board ranking, and other gamification elements help to increase user commitment by making it habitual, effortless actions (Jo and Baek, 2023). When users get instant rewards for consistent app usage, users get a feeling of accomplishment and start making the app habitual. Gamified elements thus act as extrinsic motivators over time that reinforce intrinsic habits and allow users to interact with the app frequently. Moreover, social gamification such as competition with peers or some virtual challenges is an add-on to motivate app usage, emphasising the routine use of the app. However, some studies say that gamification does not always guarantee long-term engagement, because the users stop being interested when the novelty of the rewards decreases (Ma et al., 2024). Adaptive gamification strategies can be employed to keep the reward interesting by implementing personalised challenges, introducing progressive difficulty levels, and also changing up the reward structure. So gamification enhances habitual retention just as a critical mediator between habitual behaviour and continued app use, as its gamified features act as reinforcing repetitive behaviour with engaging incentives.

H13 Gamified feature mediates the relationship between habit and continued use of fitness app.

Figure 2 Initial model



3 Theoretical underpinning

This study is based on the theoretical foundation of the unified theory of acceptance and use of technology 2 (UTAUT2), which extends the original UTAUT model with additional constructs such as hedonic motivation, habit, and price value. UTAUT2 offers a comprehensive framework for explaining user behaviour regarding technology adoption and continued usage (Tamilmani et al., 2021). In fitness applications, performance expectancy refers to perceived benefits from using the app, and social influence is the influence of peers and groups on the continued use of the app. Hedonic motivation is the fun enjoyment derived from app usage, and habit indicates the periodicity of those fun elements becoming a habit. The model is enhanced further by incorporating some gamified features as a mediator (Ferreira Barbosa et al., 2022). Understanding gamification elements, such as rewards, challenges, and progress tracking, not only increases engagement but also makes motivational factors into a habit. By combining UTAUT2 with gamification, the framework, as shown in Figure 2, links motivational drivers to app use and explains the reason for continued use. This mediational path not

only complements UTAUT2 but fills a theoretical gap by showing that gamification acts as a behavioural design layer, translating motivational factors into long-term usage. The proposed conceptual model in Figure 2 suggests that performance expectancy, social influence, hedonic motivation, and habit positively influence the use of gamified features. The path directions indicate causal influences flowing from the four factors toward continued app use, both directly and via gamified features. The two types of paths, such as direct and indirect, illustrate that both independent effects and mediated effects coexist, highlighting a layered influence structure important for designing strategies to boost app retention. The expected result will be gamified features significantly affecting the continued use of fitness apps. Not only does this framework add to the existence of UTAUT2 and integrates the mechanisms of behaviour design, but it also provides the structure of how gamification translates motivational factors into persistent engagement. In particular, in a collectivistic and technology-sophisticated culture, such as in China, where peer influence and social characteristics are essential, the use of gamification is likely to become a key feature in boosting user retention. The testing of this model will reveal whether gamification transforms initial motivation into sustained behaviour, offering clearer strategic insights for app developers targeting retention in culturally collectivist and gamification-friendly markets like China.

4 Literature gap

Despite extensive research on fitness app engagement (Esmaeilzadeh, 2021; Ferreira Barbosa et al., 2022; Habachi et al., 2024), there is a lack of research in understanding the interplay between gamification, habit formation, and continued use of the fitness app. Previous studies analyse performance expectancy, social influence, and motivation independently, without considering their collective effect through gamification. While a lot of research has been done on user engagement in fitness apps, the research exploring long-term effects on habit formation or continued engagement with gamification remains unexplored. Besides, most of the literature is located on either intrinsic or extrinsic motivation while ignoring the implementation of gamification to achieve both together to lift habitual engagement (Jo and Baek, 2023). Different gamification strategies for sustaining user retention over time also remain unexplored. There is a lack of empirical studies that explore the effect of gamification on maintaining motivational fluctuations that lead to disengagement (De Canio et al., 2021). Addressing these gaps will give further insight to explore the mechanisms that can improve the functionality of the app, as well as keep users engaged.

5 Methodology

This quantitative research method is applied in this study to examine the relationship between determinants of fitness apps (performance expectancy, social influence, hedonic motivation, and habit) and continuous usage of fitness apps. A positivist research paradigm is used that involves measuring and analysing variables on an objective basis to find relationships between variables (Liu and Avello, 2021). This method is well-suited for study using quantitative methods, as this allows to do hypothesis testing, generalisation, and to begin to look for patterns in how people behave. As per the view of

Esmaeilzadeh (2021), the TAM is the theoretical foundation on which the measurement and analysis of fitness app adoption and continuance usage are conducted. Consequently, a survey-based approach is used to collect the structured responses from a large sample of fitness app users. A survey-based approach is followed to collect data from fitness app users in a structured format. This assures reliability and consistency in data and helps to understand the relationship between the measurement of constructs such as performance expectancy, social influence, hedonic motivation, habit, and the gamified features for continued use.

A structured questionnaire is designed using validated measurement scales so that the accuracy and validity of data can be ensured (Liu et al., 2022). A pilot study is done to ensure that the collected data is accurate and reliable, and this is done with 30 respondents before the actual data collection. This also helped to highlight any ambiguities in the questionnaire so that they could be refined to make the questions clearer and more understandable.

The survey is done online to facilitate the rate of response and accessibility. Within this setting, WeChat, fitness communities, and email lists are used for distribution channels, and a representative and diverse sample of fitness app users is obtained. Convenience Sampling is applied to be cost-effective and efficient, so the responses are the overall active fitness app users in China. Using this convenience sampling technique, the collected fitness app data is a good representation of the whole fitness app user population of China. Convenience sampling offers a cost-effective and efficient method and increases the accessibility of the study findings (Raifman et al., 2022). However, the use of convenience sampling may limit the generalisability of the findings to broader or less digitally engaged populations, such as older generations or less digitally convenient people. In this regard, diverse sample selection was done to increase the representativeness and generalisability. To achieve diversity in the response, participants come from fitness-related social media groups, the fitness community, and email lists. It is targeting Chinese residents aged 18 and above who have used a fitness application for the last three months before the survey date. The data is collected from a diverse respondent pool through online survey distribution. Popular platforms, such as WeChat, Xiaohongshu, and other platforms, are used to reach potential participants of the survey. also, email invitations are sent to individuals subscribed to fitness-related news and digital health platforms. Based on this, the final sample size of this study is 438.

The data collected is further analysed with the help of Smart Partial Least Squares (SmartPLS) software. While this does not impose any required normality assumption, this is a good tool for exploratory research, mediation analysis, and analysing survey data, such as Likert scale responses collected in this survey. Structural equation modelling (SEM) techniques are used to take the sample size as 10 times the indicators per construct (Hair and Alamer, 2022). Cronbach's alpha and CR are used to find the internal consistency and discriminant validity is calculated by the average variance extracted (AVE) and the Fornell-Larcker criterion (Afthanorhan et al., 2021). The path coefficients, R^2 values, and significance levels for the bootstrapping with 5,000 resamples of the structural model are tested to find out whether gamified features significantly affect the relationship between performance expectancy, social influence, hedonic motivation, habit, and continued use of fitness apps.

Ethical considerations are strictly followed in this study. Participants are informed that participation in the survey is voluntary, are promised that the data will remain

confidential, and a consent form is provided before completing the survey (Mustafa et al., 2022). No personal information is collected, and the response is stored securely to maintain privacy.

6 Measurement scales

The five-point Likert scale is comprised of 1 = strongly disagree, and 5 = strongly agree, therefore allowing users nuanced responses while maintaining ease of analysis. A three-item scale of performance expectancy, social influence, and hedonic motivation is taken from Akbar et al. (2023). A three-item scale of habit is taken from Limayem et al. (2007), gamified features from Malik and Singh (2022), and continued use of fitness apps by Bhattacherjee (2001). A Likert scale is a very convenient way of quantifying subjective opinions, which can be structured and used as data in SmartPLS software. This approach ensures the rigorous analysis of complex relationships between variables in the research through testing of to test the proposed hypotheses (Nham et al., 2024; Manigandan and Raghuram, 2025).

7 Result and discussion

Table 1 shows the demographic profile of 438 participants; the majority of participants are aged between 25–35 (45.4%). followed by those aged 35–44 (28.3%), indicating that the majority of users are within the prime working-age population, likely to be balancing health concerns with busy professional lives. Only 2.7% were aged 55+, suggesting underrepresentation of older adults, which may limit the generalisability of findings to more senior or less tech-savvy populations. The majority of the participants are male (58.7The educational background is predominantly Bachelor's degree holders (71.7%), followed by high school or below (16.4%) and Doctorate or higher (11.9%), suggesting that the sample comprises a relatively well-educated group. over half the respondents are office workers (54.8%), followed by students (32.2%), indicating a user base with routine-based lifestyles. The monthly income of most of the participants is between ¥3,000–6,000 which is reflective of mid-level income earners in urban China. Most of the participants have been using fitness apps for more than one year, 36.5%, and among all users71.7% of them use fitness apps daily.

Table 2 shows the reliability statistics of each construct employed in the study by Cronbach's alpha, composite reliability (CR), and AVE. The constructs have a Cronbach's alpha value greater than the acceptable threshold of 0.70, indicating that the constructs have good internal consistency, except for performance expectancy; all other constructs have good internal consistency. Gamified features and habit appear to be reliable with alpha values of 0.761 and 0.734, respectively. A CR value above 0.7 indicates strong internal consistency among observed variables measuring the same construct (Kassir, 2024; Pudjiarti et al., 2024). Although studies like Mai et al. (2025) suggest 0.6 is also acceptable. Acceptable construct reliability is supported by the CR (rho_c) values, which range between 0.783 (performance expectancy) and 0.863 (gamified features). AVE values are greater than the 0.50 benchmark for all constructs, and gamified features have the highest AVE of 0.677, indicating strong convergent validity. While performance expectancy has less reliability (alpha = 0.589), its AVE

(0.548) is well within the acceptable zone and may thus be included in the model. This construct is retained due to its acceptable CR (0.783) and AVE (0.548), meeting PLS-SEM standards (Hair et al., 2019; Fornell and Larcker, 1981).

Table 1 Demographic

Variable	*Category*	*Frequency (n)*	*Percentage (%)*
Age	18–24	103	23.5%
	25–34	199	45.4%
	35–44	124	28.3%
	55+	12	2.7%
Gender	Male	257	58.7%
	Female	179	40.9%
	Non-binary/other	1	0.2%
	Prefer not to say	1	0.2%
Education level	High school or below	72	16.4%
	Bachelor's degree	314	71.7%
	Doctorate or higher	52	11.9%
Occupation	Student	141	32.2%
	Office worker	240	54.8%
	Self-employed	57	13.0%
Monthly income (¥)	< 3,000	86	19.6%
	3,000–6,000	202	46.1%
	6,001–9,000	0	0
	9,001–12,000	80	18.3%
	More than 12,000	70	16.0%
Fitness app usage	Less than three months	127	29.0%
	3–6 months	15	3.4%
	6–12 months	136	31.1%
	Over one year	160	36.5%
Frequency of use	Daily	314	71.7%
	A few times a week	15	3.4%
	Weekly	108	24.7%
	Rarely	1	0.2%

The Fornell-Larcker criterion is used for the assessment of the discriminant validity of the constructs in Table 3. If the square root of the AVE of each construct exceeds the correlations between them, this indicates the discriminant validity of the dimensions. The square root of the AVE for Gamified feature is 0.949, higher than the correlations with habit (0.820), hedonic motivation (0.676), performance expectancy (0.721), and social influence (0.648), which indicates good discriminant validity. Similarly, Habit has a square root of AVE value 0.898 and is greater than its correlation with all other constructs. Social influence shows the lowest correlation (0.454) with hedonic motivation. These results suggest that the measures represent conceptually unique and not

overlapping constructs consistent with the validity of the measurement model. Hence, Table 3 suggests that all constructs meet the Fornell-Larcker criterion, confirming that each construct is distinct and conceptually unique.

Table 2 Reliability

	Cronbach's alpha	*Composite reliability (rho_a)*	*Composite reliability (rho_c)*	*Average variance extracted (AVE)*
Continued use of fitness app	0.722	0.732	0.843	0.643
Gamified features	0.761	0.763	0.863	0.677
Habit	0.734	0.731	0.850	0.654
Hedonic motivation	0.721	0.743	0.843	0.642
Performance expectancy	0.589	0.609	0.783	0.548
Social influence	0.708	0.712	0.840	0.639

Table 3 Discriminant validity

	Continued use of fitness app	*Gamified features*	*Habit*	*Hedonic motivation*	*Performance expectancy*	*Social influence*
Continued use of fitness app						
Gamified features	0.949					
Habit	0.724	0.820				
Hedonic motivation	0.636	0.676	0.898			
Performance expectancy	0.576	0.721	0.778	0.692		
Social influence	0.539	0.648	0.766	0.454	0.708	

Table 4 represents the variance inflation factor (VIF) values of the items used for the study. It is used to detect multi-collinearity in predictor variables. A VIF over 5 indicates potential multi-collinearity, and the results of regression analysis might be distorted. All VIF values in this study are below 5, indicating that the constructs do not have multi-collinearity and, therefore, the predictor variables do not have significant overlap; hence, the regression results are reliable and valid. Thus, Table 5 suggests all item VIF values are below the threshold of 5, indicating no multi-collinearity among predictor variables.

The outer loadings of the constructs, as shown in Table 5, used in the study are presented in Table 5. The strength of the relationship between each indicator and its associated latent variable is expressed as outer loadings. The higher loadings show that the indicators are very good for representing the construct. Values of the outer loadings between 0.654 and 0.868 for the indicators of each construct are generally strong. This is found that the three items of GF1 (0.802), GF2 (0.831), and GF3 (0.835) have strong links to 'Gamified features', while 'continued use of fitness apps' items such as CU1 (0.792), CU2 (0.853), and CU3 (0.759) relates with 'continued use of fitness app'. Similarly, the loadings for 'habit' are significant with HAB1 (0.845) and HAB2 (0.829). For example, loadings for 'performance expectancy' indicators, like PE1 (0.654) and PE3

(0.806), are lower, indicating a slightly weaker relationship with the construct. The three social influence indicators have an extremely high correlation with their respective latent variables: SI1 (0.662), SI2 (0.862), and SI3 (0.858). These results agree with the validity of the model as all the constructs are adequately measured by their indicators. Therefore, Table 5 suggests that all indicator loadings exceed acceptable thresholds (≥0.65), confirming that each item reliably measures its associated construct.

Table 4 VIF

Items	*VIF*
CU1	1.401
CU2	1.566
CU3	1.365
GF1	1.487
GF2	1.533
GF3	1.622
HAB1	1.928
HAB2	1.814
HAB3	1.228
HM1	1.250
HM2	1.595
HM3	1.663
PE1	1.133
PE2	1.272
PE3	1.220
SI1	1.119
SI2	2.196
SI3	2.180

The results of the path coefficient analysis of all constructs are presented in Table 6. The 'hypotheses no.', 'paths', 'original sample values (O)', 'T statistics', 'P values', and 'result' of the hypotheses are listed in the table. Hypotheses H1 to H4 regarding the direct effect of performance expectancy, social influence, hedonic motivation, and habit on continued use of fitness apps are not supported, as their p-values are higher than 0.05, for example, p = 0.874 between performance expectancy and continued use. These findings suggest that the use of these factors did not directly impact continued use in this study. As opposed to that, H5 to H13 of hypotheses regarding relationships concerning the gamified features are accepted. Performance expectancy, social influence, hedonic motivation, and habit all have a significant positive effect on gamified features (all $p < 0.05$). The p-value of the gamified features on continued use is very significant (p-value = 0.000), which indicates that gamified features mediate the effect of other factors on continued use. Moreover, the mediation effects (H10 to H13) are also significant and indicate that gamified features mediate the relationships between antecedents and continued use of the fitness app. These findings imply that while the factors of performance expectancy, social influence, hedonic motivation, and habit did not directly influence continued use, the gamified features contributed significantly to the

continued usage. Thus, Table 6 suggested that only gamified features significantly influence continued use, mediating the effects of other variables, while direct paths from core UTAUT2 constructs are non-significant.

Table 5 Outer loadings

	Continued use of fitness app	*Gamified features*	*Habit*	*Hedonic motivation*	*Performance expectancy*	*Social influence*
CU1	0.792					
CU2	0.853					
CU3	0.759					
GF1		0.802				
GF2		0.831				
GF3		0.835				
HAB1			0.845			
HAB2			0.829			
HAB3			0.749			
HM1				0.740		
HM2				0.790		
HM3				0.868		
PE1					0.654	
PE2					0.752	
PE3					0.806	
SI1						0.662
SI2						0.862
SI3						0.858

Figure 3 Final structural model (see online version for colours)

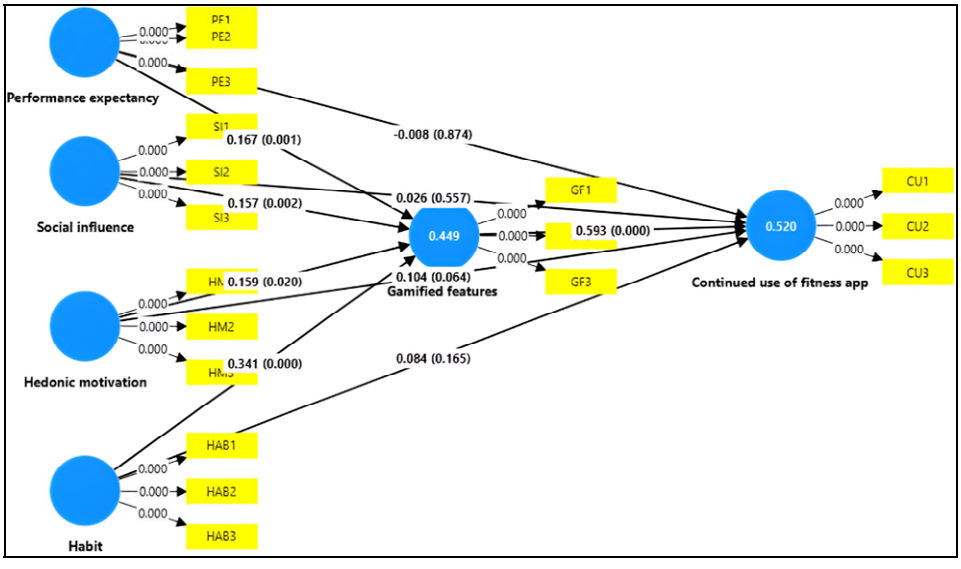


Table 6 Path coefficient

Hypothesis no.	*Path*	*Original sample (O)*	*T statistics*	*P value*	*Result*
H1	Performance expectancy → continued use of fitness app	–0.008	0.159	0.874	Not accepted
H2	Social influence → continued use of fitness app	0.026	0.587	0.557	Not accepted
H3	Hedonic motivation → continued use of fitness app	0.104	1.850	0.064	Not accepted
H4	Habit → continued use of fitness app	0.084	1.390	0.165	Not accepted
H5	Performance expectancy → gamified features	0.167	3.190	0.001	Accepted
H6	Social influence → gamified features	0.157	3.114	0.002	Accepted
H7	Hedonic motivation → gamified features	0.159	2.331	0.020	Accepted
H8	Habit → gamified features	0.341	5.364	0.000	Accepted
H9	Gamified features → continued use of fitness app	0.593	11.275	0.000	Accepted
H10	Performance expectancy → gamified features → continued use	0.099	3.215	0.001	Accepted
H11	Social influence → gamified features → continued use	0.093	3.149	0.002	Accepted
H12	Hedonic motivation → gamified features → continued use	0.094	2.380	0.017	Accepted
H13	Habit → gamified features → continued use	0.203	4.479	0.000	Accepted

A final structural model is presented in Figure 3, to show the key importance of constructs, how they are related to the continued use of fitness applications, and how the gamification features mediate this relationship. Findings show that gamified features significantly affect the continued use of fitness apps, working as a mediator between determinants and usage behaviours. There is no direct effect from performance expectancy to continued use, as the path coefficient (–0.008), t-value (0.874), and p-value (0.874) indicate that there is an insignificant path. Social Influence has a negligible effect on continued use (path coefficient = 0.026, p = 0.557), indicating social influence is not significantly associated with continued app use. In the case of hedonic motivation, continued use has a marginally significant relationship (path coefficient = 0.104, p = 0.064) and a significant positive relationship with gamified features (path coefficient = 0.159, p = 0.020). Continued use (0.084, 0.165) does not vary much across habit, but gamified features (0.341, 0.000) varies significantly with habit. The path coefficient between gamified features and continued use is as strong as the path coefficient = 0.593, p = 0.000, indicating an important role of gamification in the continued use of fitness

apps. These results indicate the contribution of gamified features to promote the long-term usage of apps.

Table 7 Hypotheses testing

Hypothesis	*Description*	*Result*
H1	Performance expectancy shows a positive relationship with continued use of the fitness app.	Rejected
H2	Social influence shows a positive relationship with the continued use of the fitness app.	Rejected
H3	Hedonic motivation shows a positive relationship with continued use of the fitness app.	Rejected
H4	Habit shows a positive relationship with continued use of the fitness app.	Rejected
H5	Performance expectancy shows a positive relationship with gamified features.	Accepted
H6	Social influence shows a positive relationship with gamified features.	Accepted
H7	Hedonic motivation shows a positive relationship with gamified features.	Accepted
H8	Habit shows a positive relationship with gamified features.	Accepted
H9	Gamified features show a positive relationship with continued use of fitness apps.	Accepted
H10	Gamified features mediate the relationship between performance expectancy and continued use of fitness apps.	Accepted
H11	Gamified features mediate the relationship between social influence and continued use of fitness apps.	Accepted
H12	Gamified features mediate the relationship between hedonic motivation and continued use of fitness apps.	Accepted
H13	Gamified features mediate the relationship between habit and continued use of fitness apps.	Accepted

The hypotheses result table shows the impact of main factors on the use of fitness apps. The results of Hypotheses H1 to H4 show how performance expectancy, social influence, hedonic motivation, and habit does not affect the continued use of fitness apps. This is clear from the result that only hedonic motivation had a marginally significant effect ($p = 0.064$) and habit had a statistically insignificant direct effect ($p = 0.165$). There are no significant direct relationships between performance expectancy ($p = 0.874$) and social influence with continued use ($p = 0.557$). This result contrasts with several past studies that conceptualised performance expectancy as a primary predictor of technology acceptance and continued usage (Akbar et al., 2023). Another possible reason is that although some may be attracted to fitness apps due to their expected performance benefits, users continue to use them more due to enjoyment and engagement, a transition from utility-based to experience-based usage (Chiu and Cho, 2021). This difference is mainly due to the cultural deviation, conceptual differences in respondents, and the individualistic selection of respondents in the study may cause this difference. The non-significant effect of social influence shows that people are more driven to achieve their personal goals rather than external pressures and opinions of peers. This contradicts Akbar et al. (2023); the possible reason may be the context of fitness, the variation in different fitness applications in different causes of this variation. Hedonic motivation is

only marginally significant; such a finding suggests that the degree of enjoyment and fun in using the app is related to its repeated use. This confirms the literature on intrinsic motivators in technology engagement, especially in health and wellness-related situations (Akbar et al., 2023). This confirms that the motivation alone is not enough to drive continuous usage; integrating it into the application is beneficial. The result also came for habit, which is directly not significant and contradicts the research by Limayem et al. (2007). This indicates that habitual use is forming in new users, and the new features, like gamification, help to build a habit. While an indirect path made one of the strongest total effects, its direct effect is weak. However, reason can also be due to China's market characteristics. In a mature market like China, users already expect high functionality as a baseline. The utility of fitness apps is no longer a differentiator; rather, it is expected. The majority of the apps have high performance, which makes this factor not a specific selling point. Thus, factors like performance do not directly drive continued use anymore because users take it for granted. Similarly, in a digitally saturated culture, Chinese users are already accustomed to using apps independently. Social sharing or peer endorsement is less influential for sustained use, especially in personal domains like fitness, where individual goals outweigh collective pressure. Also, factors like habit can be better understood via mediators like using gamification features that increase engagement of the user and reinforce behavioural patterns. Overall, results indicate that traditional performance expectancy and social influence constructs may be critical first steps for fitness app usage, but they are more strongly construed by motivational and design-related factors.

Hypotheses H5 to H8 tested the performance expectancy, social influence, hedonic motivation, and habit of gamified features in fitness apps. The results show that all four variables are positively related to gamified features with p values well below 0.05: performance expectancy ($p = 0.001$), social influence ($p = 0.002$), hedonic motivation ($p = 0.020$), and habit ($p = 0.000$). Performance expectancy has a significant effect, which tells users that gamified features show improved functionality and better performance outcomes to meet the expectations of users. It aligns with previous works that connected higher functional value to higher perceived usefulness of interactive technologies (Yin et al., 2022b). The social influence positively impacts gamified features, showing the importance of peers' opinions and societal norms in shaping the perception of the user. This is visible that competitive gamification elements, such as leader boards, challenges, and social sharing, are appealing to users in a social environment. Hedonic motivation suggests that users who desire to enjoy should tend to enjoy or expect the gamified components of fitness apps. This is consistent with past studies on gamification that suggest that gamification increases enjoyment and emotional engagement, which are two important factors for continued usage. The habit has the strongest path coefficient and indicates that users who are accustomed to a certain behaviour respond positively to gamified elements. It shows the reinforcing role of gamification in building routines as well as sustaining long-term engagement. These results show how gamified feature adoption can be taken in multiple dimensions, which include both cognitive (performance-related) and affective (enjoyment-related), along with habitual behaviour and social context.

Hypothesis H9 shows that gamified features directly influence the continued use of fitness apps. This hypothesis is supported by the results, which show a high path coefficient ($\beta = 0.593$) with a very significant p-value ($p = 0.000$), which shows a strong

direct relationship. These results indicate that gamification is a crucial factor for continued use and to maintain user engagement. Gamified features such as badges, rewards, leader boards, and progress tracking improve user motivation and satisfaction by making the experience rewarding and interactive. These findings align with the past literature that says gamification improves intrinsic motivation and creates a sense of enjoyment and achievement (Zhang and Jung, 2022). Gamified elements give users both extrinsic and intrinsic motivators to return to the app. The findings also fit very well with the principles of the unified theory of acceptance and use of technology (UTAUT2), especially with hedonic motivation and habit.

Hypotheses H10 to H13 show the mediating effects of gamified features in the relationship between motivational factors such as performance expectancy, social influence, hedonic motivation, and habit on the continued use of fitness apps. The results show that all four relationships are significantly mediated by gamified features, for example, with the following statistically significant indirect effects: performance expectancy ($\beta = 0.099$; $p = 0.001$), social influence ($\beta = 0.093$; $p = 0.002$), hedonic motivation ($\beta = 0.094$; $p = 0.017$), and habit ($\beta = 0.203$; $p = 0.000$). It shows that gamification is the key to building the perception of the user and maintaining motivation with continued use. Mediation between performance expectancy and continued use shows that gamified fitness apps are perceived as useful, which helps users maintain their intent to continue using the app. Gamification also converts the effect of social environments from static to interactive, goal-based behaviour to encourage continued use, which supports H11. The H12 mediation function confirms the fact that fitness apps with gamified features increase the pleasure and enjoyment users get from fitness apps, which conforms to the theories related to hedonic motivation. In the case of H13, continued use is also boosted by habit, suggesting that when it comes to habitual use, users who build a habit show a positive relationship with game-like elements. These findings show that a direct effect of gamified features in continued app use also works as a bridge for connecting motivational constructs to their sustained behavioural outcomes. This highlights their importance in the fitness app design as well as their key role in creating engagement and keeping the users on the app for a long time.

8 Conclusions

This study shows gamified features as a mediating variable to understand the factors that influence the continued use of fitness applications. The SmartPLS analysis of 438 samples shows that habit and hedonic motivation have a significant direct effect on continued use, but performance expectancy and social influence do not have any significant direct effect. All four variables significantly influence how users perceive the gamified features. Gamified features are found to have the strongest effects and are a positive driver of continued use. The relationship between each independent variable to continued use is successfully mediated by gamified features. This gamification played a major role in improving behavioural intention through intrinsic and extrinsic motivational forces. The findings give a broad idea of how gamification affects psychological and social constructs and leads long-term engagement with fitness apps. These results also show that gamification strengthens user commitment and adherence in digital health technologies and supports to adopt the fitness applications in the rapidly growing health tech industry.

The theoretical contribution of this study highlights the important role of gamification in shaping behavioural intention and the continued engagement of users with fitness applications. Unlike previous studies that were focused on the utilitarian aspects, this study employed the synergistic role of intrinsic motivation and gamified features and gives a more holistic approach to understanding user behaviour in digital health platforms. The findings will help developers and service providers of the fitness app market gain valuable insights from this study. The study suggests the importance of gamified features as a determinant of continued usage. This study also identifies important aspects such as rewards, challenges, and progress, which are strongly correlated with user retention.

Based on these findings, several strategic recommendations can be made for the developers, marketers, and decision-makers of the fitness app industry. The app designer should include gamified features such as badges, points, progress tracking, and leader boards in the app first. These elements are proven to enhance user engagement and have a strong impact on continued usage. The hedonic motivation should also be emphasised by providing visually appealing, interactive, and enjoyable experiences to the users. As per the view of Murnane et al. (2020), making the UI around emotional engagement, storytelling elements, customisable avatars, and real-time feedback helps to drive habitual use. The use of social influence in marketing strategies should promote community-building features, including peer challenges, social sharing, and in-app support groups. A complete and effective user journey can be created with an emphasis on both functional and motivational value, which helps in user retention in the competitive field of fitness technology.

There are a variety of ways that future research can take to explore further the issue of user engagement with fitness applications. The current study had a focus on concrete constructs, such as performance expectancy, social influence, hedonic motivation, habit, and gamified features; however, other psychological and behavioural factors, for instance, self-efficacy, perceived enjoyment, or digital fatigue, could be considered in future research to gain a clear picture of user behaviour. Digital fatigue is increasingly common in highly connected societies like China, where mobile and app usage is deeply integrated into daily routines. Therefore, future studies should consider incorporating digital fatigue as a factor influencing user intention and engagement with fitness apps. Future studies may also track user behaviour over time to explore how habits and perceived usefulness change with continued usage. The intention to use can also be measured using log data, sessions, or the amount of time spent on specific functions of the application. By combining survey responses and live metrics about the usage, researchers make evidence more credible and robust. Contextually, app data or log data can be used for longitudinal study purposes as well. This will clarify user retention and the effectiveness of the gamification strategies in the long run. Cross-cultural research is recommended to determine the cultural contexts in the adoption and continuous use of fitness apps. This can help app developers and the marketing team to make the app according to specific regions, and tell how much emphasis it has on social influence and gamified elements. Over time, the progress of technology and future models may include features such as AI-driven personalisation, AR, or wearable integration. Examining demographic-based responses, such as among older adults and non-tech savvy, could uncover new insights to make fitness apps more inclusive and accessible.

Declarations

The authors declare no conflict of interest.

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Appendix

Table A1 Measurement items

Construct	*Measurement items*	*Source*
Performance expectancy (PE)	• Fitness apps are effective in improving user fitness performance. • Fitness apps assist users in achieving their health goals efficiently. • Fitness apps are useful in managing daily fitness activities.	Akbar et al. (2023)
Social influence (SI)	• People important to the user think fitness app usage is beneficial. • The user's social circle encourages the use of fitness apps. • The decision to use fitness apps is influenced by people around the user.	Akbar et al. (2023)
Hedonic motivation (HM)	• Users find fitness apps enjoyable to use. • Fitness apps provide a fun and engaging experience. • The use of fitness apps offers entertainment value.	Akbar et al. (2023)
Habit (HB)	• The use of fitness apps has become a regular habit for users. • Users automatically turn to fitness apps when planning to exercise. • Users feel a sense of discomfort when they do not use a fitness app.	Limayem et al. (2007)
Gamified features (GF)	• The app includes gamified elements such as challenges and rewards that enhance motivation. • Features like leaderboards and achievements increase user engagement.	Malik and Singh (2022)

Table A1 Measurement items (continued)

Construct	*Measurement items*	*Source*
Gamified features (GF)	• The presence of game-like features makes the fitness app experience more enjoyable.	Malik and Singh (2022)
Continued use (CU)	• Users intend to continue using fitness apps on a regular basis. • Users are likely to keep using fitness apps in the future. • Fitness apps are considered an integral part of users' fitness routines.	Bhattacherjee (2001)

Table A2 Descriptive questions

Demographic variable	*Question*	*Response options*
Age	What is your age?	• 18–24 • 25–34 • 35–44 • 45–54 • 55+
Gender	What is your gender?	• Male • Female • Non-binary/other • Prefer not to say
Education level	What is your highest level of education completed?	• High school or below • Associate degree • Bachelor's degree • Master's degree • Doctorate or higher
Occupation	What is your current occupation?	• Student • Office worker • Self-employed
Monthly income	What is your approximate monthly income?	• Less than ¥3,000 • ¥3,000–¥6,000 • ¥6,001–¥9,000 • ¥9,001–¥12,000 • More than ¥12,000 • Prefer not to say
Fitness app usage	How long have you been using fitness apps?	• Less than 3 months • 3–6 months • 6–12 months • Over one year
Frequency of use	How often do you use fitness apps?	• Daily • A few times a week • Weekly • Rarely