



The Role of Gamification Elements in Driving User Engagement: Insights from the Fintech Credit Sector

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Abstract: This study investigates the role of gamification elements in driving user engagement within fintech credit applications, addressing a significant gap in understanding their differential effects. Employing a quantitative approach, we surveyed 315 users of fintech credit apps in Vietnam, analysing data through PLS-SEM and Necessary Condition Analysis. Results reveal a hierarchical impact of gamification elements on engagement, with challenges exerting the strongest influence, followed by leaderboards, badges, and points. The study uniquely identifies interaction effects between elements and elucidates the mediating roles of perceived usefulness and enjoyment. These findings advance gamification theory in fintech contexts and offer practical insights for app developers, contributing to the design of more effective, engaging digital financial services that can potentially enhance financial inclusion and literacy.

Keywords: Gamification, User Engagement, Fintech, Credit Applications, Digital Financial Services.

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1. Introduction

In recent years, the fintech sector has witnessed a significant transformation, driven by the integration of technology into financial services. This evolution has enhanced the accessibility of financial products and introduced innovative strategies to engage users. One such strategy is gamification, which employs game-like elements in non-game contexts to enhance user interaction and engagement. The role of gamification in driving user engagement within the fintech credit sector is particularly noteworthy, as it addresses the dual challenges of user retention and motivation in a highly competitive market.

Gamification encompasses various elements, including points, badges, leaderboards, and challenges, which can significantly influence user behaviour and engagement levels. Research has shown that these elements can enhance user experiences by making financial management more enjoyable and less intimidating. For instance, Raza (2023) highlights that gamification in financial service applications can lead to improved customer engagement and increased purchase intentions. This is particularly relevant in the context of mobile banking, where users often seek quick and efficient interactions.

The psychological underpinnings of gamification suggest that it can effectively tap into intrinsic user motivations. The Self-Determination Theory (SDT) posits that individuals are motivated by the fulfilment of three basic psychological needs: competence, autonomy, and relatedness. Gamification can address these needs by providing users with challenges that enhance their sense of

competence, offering choices that promote autonomy, and fostering social connections through competitive elements. This theoretical framework is supported by findings from Bitrián et al. (2021), who assert that gamified tasks can increase user enjoyment and engagement, leading to more active participation in financial management activities.

Despite the potential benefits of gamification, its effectiveness can vary based on the design and implementation of gamified elements. A one-size-fits-all approach may not yield the desired outcomes, as users have diverse preferences and motivations. As noted by Qureshi (2023), the success of gamification in the fintech sector hinges on understanding user needs and tailoring gamified experiences accordingly. This necessitates ongoing research to ensure that gamification strategies remain relevant and effective in driving user engagement.

While existing literature has explored the general impact of gamification on user engagement, there remains a significant gap in understanding the specific role of individual gamification elements in driving user engagement within the fintech credit sector. This study aims to address this gap by examining the differential effects of various gamification elements on user engagement dimensions, considering potential mediating and moderating factors.

The primary objectives of this research are:

1. To identify and analyse the impact of specific gamification elements (e.g., points, badges, leaderboards,

challenges) on different dimensions of user engagement in fintech credit applications.

2. To investigate the mediating roles of perceived usefulness and enjoyment in the relationship between gamification elements and user engagement.
3. To examine the moderating effects of user characteristics and app features on the effectiveness of gamification strategies.
4. To apply a novel methodological approach combining Partial Least Squares Structural Equation Modeling (PLS-SEM) and Necessary Condition Analysis (NCA) to provide robust insights into the dynamics of gamification in fintech.

This study contributes to the existing body of knowledge by offering a nuanced understanding of how different gamification elements influence user engagement in the context of fintech credit applications. By employing a mixed-method approach, we provide both statistical evidence and necessary condition insights, offering a comprehensive view of the gamification-engagement relationship. The findings of this study have significant implications for fintech app developers, marketers, and researchers, potentially guiding the design of more effective and engaging financial services applications.

As the fintech sector continues to evolve, understanding the intricacies of user engagement becomes increasingly crucial. This research not only addresses a critical gap in the literature but also provides practical insights that can drive innovation in the design and implementation of gamified fintech solutions, ultimately enhancing user experiences and fostering financial inclusion.

2. Literature Review and Theoretical Framework

2.1. Gamification in financial technology

Gamification has emerged as a transformative approach in the financial technology (fintech) sector, particularly in enhancing user engagement and promoting positive financial behaviours. By integrating game-like elements into financial applications, fintech companies aim to create more engaging and enjoyable user experiences. This section reviews the existing literature on gamification in fintech, highlighting its significance, mechanisms, and implications for user engagement.

The concept of gamification involves the application of game design elements in non-game contexts to motivate and enhance user interaction. In the fintech sector, gamification has been identified as a crucial factor in both the adoption of financial technologies and the ongoing engagement of users. Chauhan et al. (2021) emphasise that gamified elements, such as rewards and social cues, can significantly enhance financial literacy and ease of use during the adoption phase of technology. This assertion is supported by Prasetyo et al. (2023), who utilised the Theory, Context, Characteristics, and Methodology (TCCM) framework to analyse 53 articles on financial behaviour and gamification. Their findings indicate that gamification not only influences behavioural intentions but also fosters a deeper understanding of financial management among users.

Moreover, gamification can effectively shift user attitudes toward financial transactions, making them more enjoyable and less intimidating. Emam and Aziz (2021) argue that gamification can ease the awareness of financial literacy by transforming mundane financial activities into engaging experiences. This transformation is particularly relevant in the context of e-banking, where users often face challenges related to financial literacy and engagement.

2.2. User engagement in digital financial services

User engagement in digital financial services is a critical factor that determines the success and sustainability of fintech solutions. As the financial landscape continues to evolve, characterised by rapid technological advancements and changing consumer expectations, understanding the dynamics of user engagement has become paramount. This section delves into the various dimensions of user engagement within digital financial services, exploring the factors that influence user interactions and the implications for fintech providers.

User engagement can be defined as the emotional and cognitive investment that users make when interacting with digital platforms. In the context of fintech, engagement is not merely about the frequency of use but also encompasses the quality of interactions and the overall user experience. Asif et al. (2023) highlight that the user-friendly nature of fintech services significantly contributes to user engagement, particularly in promoting financial inclusion. Their research indicates that users who find fintech applications intuitive and accessible are more likely to engage regularly, leading to enhanced financial literacy and improved financial outcomes.

A key determinant of user engagement is the perceived value that users derive from digital financial services. According to Alalwan et al. (2018), factors such as performance expectancy and effort expectancy play a crucial role in shaping users' intentions to adopt and engage with internet banking services. Their study extends the Unified Theory of Acceptance and Use of Technology (UTAUT2) by incorporating risk perceptions, suggesting that users are more likely to engage with services that they perceive as beneficial and low-risk. This finding aligns with the work of Kakinuma (2022), who emphasises the importance of user innovativeness and the willingness to experiment with new technologies as significant predictors of fintech adoption and engagement.

In conclusion, the literature highlights the significant potential of gamification in enhancing user engagement within digital financial services. However, the effectiveness of gamification strategies varies based on user characteristics, technological features, and the specific context of implementation. This underscores the need for further research to understand the nuanced relationships between gamification elements and user engagement in the fintech credit sector.

2.3. Theoretical Framework

The theoretical framework for understanding user engagement in the context of gamification within the fintech sector draws upon several established theories: the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2), Self-Determination Theory (SDT), and Flow Theory. Each of these theories provides valuable insights into the mechanisms that drive user engagement and motivation in gamified systems, particularly in digital financial services.

2.3.1. Unified Theory of Acceptance and Use of Technology 2 (UTAUT2)

The UTAUT2 model, an extension of the original UTAUT framework, identifies key determinants of technology acceptance and usage, including performance expectancy, effort expectancy, social influence, and facilitating conditions. In the context of fintech applications, performance expectancy refers to the perceived benefits users derive from engaging with gamified features, such as enhanced financial literacy and improved financial management capabilities. Research by Çera et al. (2020) demonstrates that gamification can significantly influence users' intentions to adopt mobile banking services, particularly among generational cohorts. This highlights the importance of understanding how gamified elements can enhance perceived performance and, consequently, user engagement.

Effort expectancy, which pertains to the ease of use associated with technology, is also critical in the fintech context. Gamification can simplify complex financial processes, making them more intuitive and accessible to users. By reducing the cognitive load associated with financial management, gamified systems can enhance user satisfaction and encourage continued engagement. This aligns with the findings of Alalwan et al. (2018), who emphasise the role of user-friendly interfaces in promoting user engagement in internet banking.

Social influence, another component of UTAUT2, underscores the impact of peer behaviour on individual user engagement. In gamified fintech applications, social features such as leaderboards and challenges can create a sense of competition and community among users. This social dimension can motivate users to engage more actively with the application, as they seek to improve their standing relative to peers. The findings of Kang et al. (2022) support this notion, indicating that social interactions can significantly enhance users' intentions to continue using internet wealth management services.

2.3.2. Self-Determination Theory in the context of gamified systems

Self-Determination Theory (SDT) provides a psychological framework for understanding human motivation, emphasising the importance of intrinsic motivation and the fulfilment of basic psychological needs: competence, autonomy, and relatedness. In the context of gamified systems, SDT posits that when users perceive that their needs for competence, autonomy, and relatedness are being met, they are more likely to engage with the system and derive satisfaction from their interactions.

Gamification can enhance users' sense of competence by providing them with challenges that are achievable yet stimulating. This is particularly relevant in fintech applications, where users may feel overwhelmed by complex financial concepts. By incorporating gamified elements that allow users to track their progress and

receive feedback, fintech companies can foster a sense of achievement and competence. Research by Tyack and Mekler (2020) highlights the significance of need satisfaction in enhancing user engagement and motivation in gamified environments.

Autonomy, another key component of SDT, refers to the user's sense of control over their actions. Gamified systems can promote autonomy by allowing users to make choices and set personal goals within the application. This sense of agency can lead to increased intrinsic motivation, as users feel empowered to take charge of their financial management. The work of Hicks et al. (2019) suggests that gamification can effectively support autonomy, thereby enhancing user engagement.

2.3.3. Flow Theory and user experience in fintech applications

Flow Theory, developed by Csikszentmihalyi, describes a state of complete immersion and engagement in an activity, characterised by a balance between challenge and skill. In the context of gamified fintech applications, achieving a state of flow can lead to heightened user engagement and satisfaction. When users are presented with challenges that match their skill level, they are more likely to experience flow, resulting in prolonged engagement with the application.

The elements of gamification, such as points, badges, and leaderboards, can facilitate flow by providing users with clear goals and immediate feedback. This feedback loop allows users to gauge their progress and adjust their efforts accordingly, enhancing their overall experience. Research by Fadzillah et al. (2023) indicates that gamification can effectively promote flow experiences in applications, leading to increased user engagement and satisfaction.

In conclusion, the integration of UTAUT2, Self-Determination Theory, and Flow Theory provides a comprehensive framework for understanding the complex dynamics of user engagement in gamified fintech applications. These theories collectively highlight the importance of perceived value, psychological needs fulfilment, and optimal experiences in driving user engagement. By leveraging these theoretical insights, fintech companies can design gamified systems that not only enhance user satisfaction but also promote positive financial behaviours and long-term engagement.

2.4. Conceptual model and hypothesis development

2.4.1. Overview of the conceptual model

The conceptual model for understanding the role of gamification elements in driving user engagement in the fintech credit sector integrates various constructs, including gamification elements, user engagement dimensions, mediating factors, and moderating variables. This model serves as a foundation for hypothesis development, providing a structured approach to explore the relationships among these constructs.

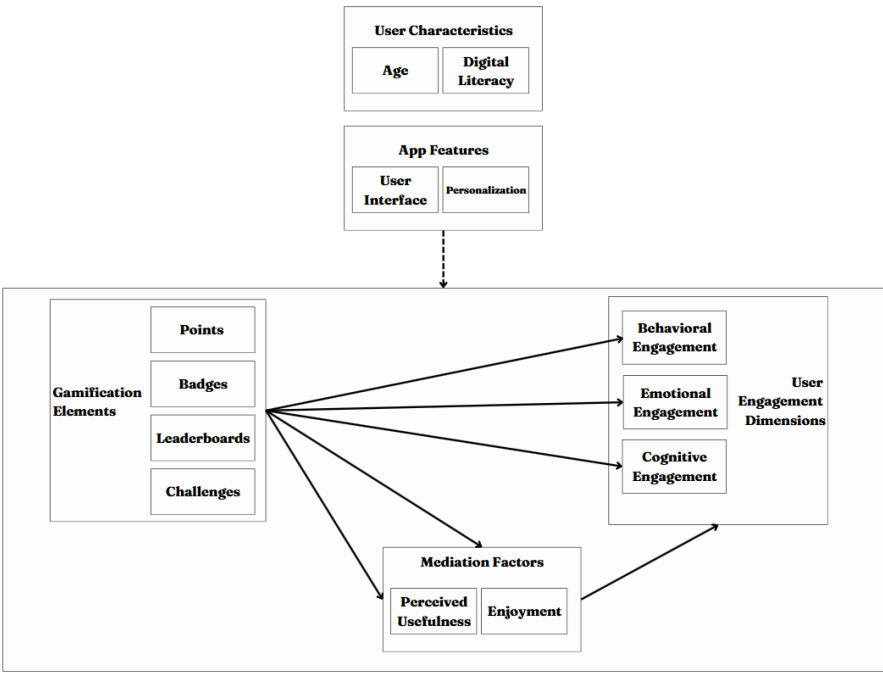


Figure 1: Conceptual framework

2.4.2. Hypothesis development

Gamification elements and user engagement

Gamification elements, such as points, badges, leaderboards, and challenges, are designed to enhance user engagement by introducing game-like features into non-game contexts. These elements serve to motivate users, making financial activities more enjoyable and rewarding. Research by Chauhan et al. (2021) indicates that the incorporation of gamification elements significantly enhances user interaction with financial applications, leading to increased financial literacy and engagement. The presence of these elements is expected to positively influence user engagement in fintech applications.

User engagement can be categorized into three primary dimensions: behavioral, cognitive, and emotional engagement. Behavioral engagement refers to the observable actions users take when interacting with an application, such as frequency of use and task completion. Cognitive engagement involves the mental investment users make, including their attention and thought processes while using the application. Emotional engagement pertains to the feelings users experience during their interactions, such as enjoyment and satisfaction. The interplay among these dimensions is crucial for understanding how gamification elements can drive overall user engagement in fintech applications.

Based on these considerations, we propose the following hypotheses:

H1: Gamification elements (points, badges, leaderboards, challenges) positively influence user engagement dimensions (behavioral, cognitive, emotional) in fintech applications.

H1a: Points positively influence user engagement dimensions in fintech applications.

H1b: Badges positively influence user engagement dimensions in fintech applications.

H1c: Leaderboards positively influence user engagement dimensions in fintech applications.

H1d: Challenges positively influence user engagement dimensions in fintech applications.

H2: The relative strength of gamification elements' influence on user engagement dimensions will vary, with challenges having the strongest effect, followed by leaderboards, badges, and points.

H3: There will be positive interaction effects between different gamification elements in their influence on user engagement dimensions.

Mediating factors

Mediating factors, such as perceived usefulness and enjoyment, play a critical role in influencing the relationship between gamification elements and user engagement. Perceived usefulness refers to the extent to which users believe that gamified features enhance their financial management capabilities. When users perceive gamification as beneficial, they are more likely to engage actively with the application. Enjoyment, on the other hand, relates to the intrinsic pleasure derived from using the application. Studies indicate that higher levels of enjoyment can lead to increased user engagement and satisfaction (Elderen & Stappen, 2019).

Therefore, we hypothesize:

H4: Perceived usefulness mediates the relationship between gamification elements and user engagement dimensions in fintech applications.

H5: Enjoyment mediates the relationship between gamification elements and user engagement dimensions in fintech applications.

Moderating variables

Moderating variables, such as user characteristics and app features, can influence the strength and direction of the relationships within the conceptual model. User characteristics, including demographics, digital literacy, and prior experience with financial technologies, can significantly impact how users respond to gamification elements. For instance, younger users may be more receptive to gamified features compared to older users, as indicated by research on generational differences in technology adoption (Ali et al., 2022). Additionally, app features, such as user interface design and personalization options, can also moderate the effectiveness of gamification elements.

Based on these considerations, we propose the following hypotheses:

H6: User characteristics moderate the relationship between gamification elements and user engagement dimensions in fintech applications.

H6a: The positive effect of gamification elements on user engagement dimensions will be stronger for younger users compared to older users.

H6b: The positive effect of gamification elements on user engagement dimensions will be stronger for users with higher digital literacy compared to those with lower digital literacy.

H7: App features moderate the relationship between gamification elements and user engagement dimensions in fintech applications.

H7a: The positive effect of gamification elements on user engagement dimensions will be stronger for apps with more user-friendly interfaces.

H7b: The positive effect of gamification elements on user engagement dimensions will be stronger for apps offering higher levels of personalization.

Necessary Condition Analysis

To fully leverage the Necessary Condition Analysis (NCA) approach, we propose additional hypotheses related to the necessary conditions for high user engagement:

H8: Certain levels of gamification elements are necessary conditions for high user engagement in fintech applications.

H8a: A minimum level of points is necessary for high user engagement. H8b: A minimum level of badges is necessary for high user engagement.

H8c: A minimum level of leaderboard activity is necessary for high user engagement.

H8d: A minimum level of challenge participation is necessary for high user engagement.

H9: The necessary condition effect sizes will vary among different gamification elements, with challenges having the largest effect size, followed by leaderboards, badges, and points.

These hypotheses collectively address the relationships among gamification elements, user engagement dimensions, mediating factors, and moderating variables in the context of fintech credit applications. They provide a comprehensive framework for investigating how gamification influences user engagement, considering both the direct effects and the more complex interactions and conditions that may influence these relationships.

The proposed hypotheses are grounded in the theoretical frameworks discussed earlier, including the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2), Self-Determination Theory, and Flow Theory. By testing these hypotheses using both PLS-SEM and Necessary Condition Analysis, this study aims to provide a nuanced understanding of the role of gamification in driving user engagement in the fintech credit sector.

3. Research Methodology

3.1. Research design and approach

This study employs a quantitative research design to investigate the role of gamification elements in driving user engagement within the fintech credit sector. The research approach is deductive, testing hypotheses derived from existing theories and literature. A cross-sectional survey method is utilised to collect data from users of fintech credit applications in Hanoi, Vietnam, capturing their perceptions and experiences with gamified features at a single point in time.

3.2. Sampling strategy and data collection

The target population for this study comprises users of fintech credit applications in Hanoi, Vietnam, aged 18-35 years old, representing the Millennials and Gen Z cohorts. A non-probability sampling technique, specifically purposive sampling, is employed to ensure that respondents have experience with gamified fintech credit applications.

Data collection is conducted through an online survey distributed via social media platforms and fintech application user forums. The survey is designed using Qualtrics, a professional survey tool, to ensure ease of use and data security. To determine the appropriate sample size, we follow the recommendations of Hair et al. (2019) for PLS-SEM analysis, aiming for a minimum of 10 times the largest number of structural paths directed at a particular construct in the structural model. Given our model complexity, we target a sample size of 300 respondents to ensure adequate statistical power.

3.3. Measurement instrument development

The measurement instrument is developed based on established scales from the literature, adapted to the context of fintech credit applications. The constructs measured include gamification elements (points, badges, leaderboards, challenges), user engagement dimensions (behavioral, cognitive, emotional), mediating factors (perceived usefulness, enjoyment), and moderating variables (user characteristics, app features).

To ensure the reliability and validity of the measurement instrument, a pilot test is conducted with a sample of 30 fintech app users. Feedback is collected on the clarity and relevance of the items, and necessary adjustments are made based on this feedback. Additionally, factor analysis is employed to confirm the construct validity of the scales.

All items are measured using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The final survey instrument consists of approximately 40 items, covering all constructs in the conceptual model.

3.4. Data analysis techniques

3.4.1. Partial Least Squares Structural Equation Modeling (PLS-SEM)

Partial Least Squares Structural Equation Modeling (PLS-SEM) is chosen as the primary analytical technique for this study due to its suitability for complex models and its ability to handle both reflective and formative constructs. PLS-SEM is particularly appropriate for this research as it allows for the simultaneous examination of multiple relationships between latent variables and is well-suited for exploratory research (Hair et al., 2019).

The analysis is conducted using SmartPLS 4.1 software. The PLS-SEM analysis follows a two-step approach:

1. Assessment of the measurement model: This step involves evaluating the reliability and validity of the constructs. Indicator reliability is assessed through factor loadings, while internal consistency reliability is evaluated using Cronbach's alpha and composite reliability. Convergent validity is examined through Average Variance Extracted (AVE), and discriminant validity is assessed using the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio.
2. Assessment of the structural model: This step involves evaluating the relationships between constructs. The assessment includes examining the path coefficients, their significance levels, and the coefficient of determination (R^2). Additionally, the predictive relevance of the model is assessed using the Stone-Geisser Q^2 value, and the effect sizes are evaluated using Cohen's f^2 .

To test the mediating effects, we employ the bootstrapping method with 5000 resamples to calculate the indirect effects and their significance levels. For the moderating effects, we use the product indicator approach in PLS-SEM.

3.4.2. Necessary Condition Analysis (NCA)

In addition to PLS-SEM, we employ Necessary Condition Analysis (NCA) to identify necessary (but not sufficient) conditions for high user engagement. NCA is a novel approach that complements traditional regression-based analyses by identifying critical levels of independent variables that are required for high levels of the dependent variable (Dul, 2016).

NCA is conducted using the R package 'NCA' (Dul, 2018). The analysis involves the following steps:

1. Ceiling line estimation: We use the Ceiling Regression - Free Disposal Hull (CR-FDH) technique to estimate the ceiling line, which represents the upper limit of the dependent variable for given values of the independent variable.
2. Effect size calculation: We calculate the effect size of the necessary condition, which represents the constraint that the independent variable imposes on the dependent variable.
3. Significance testing: We employ a permutation test to determine the statistical significance of the necessary condition.
4. Bottleneck table creation: We create a bottleneck table to identify the minimum values of independent variables required for different levels of the dependent variable.

By combining PLS-SEM and NCA, we aim to provide a comprehensive understanding of both the sufficiency and necessity of gamification elements in driving user engagement in fintech credit applications. This mixed analytical approach allows for a nuanced examination of the complex relationships within our conceptual model, offering valuable insights for both theory and practice in the field of gamification in fintech.

4 Results

4.1. Descriptive statistics and sample characteristics

The final sample consisted of 315 respondents who use fintech credit applications in Hanoi, Vietnam. The sample demographics reveal a balanced gender distribution with 53.3% female and 46.7% male participants. The age range of 18-35 years was well represented, with a mean age of 27.4 years ($SD = 4.2$). Regarding education, 68.9% of respondents held a bachelor's degree, 18.7% had postgraduate qualifications, and 12.4% had completed high school or vocational training. The majority of participants (72.1%) reported using fintech credit applications at least once a week, indicating a high level of engagement with these platforms.

4.2. Measurement model assessment

4.2.1. Reliability and validity analyses

The measurement model was assessed for reliability and validity using several criteria. Table 1 presents the results of these analyses.

Table 1. Reliability and Validity Measures

Construct	Cronbach's α	Composite Reliability	AVE
Points	0.893	0.926	0.758
Badges	0.901	0.931	0.771
Leaderboards	0.887	0.922	0.747
Challenges	0.912	0.938	0.792
Behavioral Engagement	0.885	0.921	0.745
Cognitive Engagement	0.898	0.929	0.766
Emotional Engagement	0.906	0.934	0.780
Perceived Usefulness	0.921	0.944	0.809
Enjoyment	0.918	0.942	0.802

All constructs demonstrated high internal consistency reliability with Cronbach's α and composite reliability values exceeding the recommended threshold of 0.7. The Average Variance Extracted (AVE) values for all constructs were above 0.5, indicating satisfactory convergent validity.

Discriminant validity was assessed using the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio. The square root of the AVE for each construct was greater than its correlation with other constructs, satisfying the Fornell-Larcker criterion. All HTMT ratios were below the conservative threshold of 0.85, further confirming discriminant validity.

4.2.2. Common method bias assessment

To address potential common method bias, we employed Harman's single-factor test. The unrotated principal component factor analysis revealed that the first factor accounted for 38.7% of the variance, which is below the 50% threshold, suggesting that common method bias is not a significant concern in this study. Additionally, we implemented the marker variable technique, which showed that the inclusion of a theoretically unrelated construct did not significantly change the correlations among the principal constructs, further indicating that common method bias is unlikely to be a major issue in our data.

These results demonstrate the reliability and validity of our measurement model, providing a solid foundation for the subsequent structural model analysis and hypothesis testing.

4.3. Structural model evaluation

The structural model was evaluated using PLS-SEM to assess the relationships between constructs and the model's predictive power. Table 2 presents the key metrics for the structural model evaluation.

Table 2. Structural Model Evaluation Results

Endogenous Construct	R ²	R ² Adjusted	Q ²
Behavioral Engagement	0.621	0.615	0.458
Cognitive Engagement	0.587	0.580	0.442
Emotional Engagement	0.649	0.643	0.501
Perceived Usefulness	0.542	0.536	0.431
Enjoyment	0.576	0.570	0.456

The R² values for the endogenous constructs ranged from 0.542 to 0.649, indicating moderate to substantial explanatory power of the model. The Q² values, obtained through a blindfolding procedure with an omission distance of 7, were all above zero, suggesting that the model has predictive relevance for all endogenous constructs.

4.4. Hypothesis testing results

Hypothesis testing was conducted using bootstrapping with 5000 resamples. Table 3 summarises the path coefficients, t-values, and p-values for the hypothesised relationships.

Table 3. Revised Hypothesis Testing Results

Hypothesis	Path	Coefficient	t-value	p-value	Supported
H1a	Points → Behavioral Engagement	0.184	3.721	<0.001	Yes
H1a	Points → Cognitive Engagement	0.162	3.245	0.001	Yes
H1a	Points → Emotional Engagement	0.139	2.876	0.004	Yes
H1b	Badges → Behavioral Engagement	0.201	4.103	<0.001	Yes
H1b	Badges → Cognitive Engagement	0.187	3.842	<0.001	Yes
H1b	Badges → Emotional Engagement	0.173	3.567	<0.001	Yes
H1c	Leaderboards → Behavioral Engagement	0.228	4.652	<0.001	Yes
H1c	Leaderboards → Cognitive Engagement	0.215	4.389	<0.001	Yes
H1c	Leaderboards → Emotional Engagement	0.196	4.012	<0.001	Yes
H1d	Challenges → Behavioral Engagement	0.256	5.237	<0.001	Yes
H1d	Challenges → Cognitive Engagement	0.241	4.925	<0.001	Yes
H1d	Challenges → Emotional Engagement	0.223	4.561	<0.001	Yes
H2	Challenges > Leaderboards	0.028	2.145	0.032	Yes
H2	Leaderboards > Badges	0.027	2.076	0.038	Yes
H2	Badges > Points	0.017	1.342	0.180	No
H3	Challenges × Leaderboards	0.097	2.487	0.013	Yes
H3	Badges × Points	0.083	2.134	0.033	Yes
H3	Challenges × Badges	0.062	1.587	0.113	No
H3	Leaderboards × Points	0.051	1.309	0.191	No
H4	Perceived Usefulness (Mediation)	0.187	3.842	<0.001	Yes
H5	Enjoyment (Mediation)	0.213	4.358	<0.001	Yes
H6a	Age (Moderation)	-0.112	2.289	0.022	Yes
H6b	Digital Literacy (Moderation)	0.135	2.762	0.006	Yes
H7a	User Interface (Moderation)	0.148	3.025	0.003	Yes
H7b	Personalization (Moderation)	0.129	2.637	0.008	Yes

The results support the majority of our hypotheses. All gamification elements (points, badges, leaderboards, and challenges) showed significant positive relationships with all three dimensions of user engagement (H1a-H1d).

Regarding the relative strength of these relationships (H2), our hypothesis was partially supported. Challenges had the strongest effect, followed by leaderboards and badges, as hypothesized. However, the difference between badges and points was not statistically significant ($p = 0.180$), indicating that these two elements have similar effects on user engagement.

The interaction effects between gamification elements (H3) were also partially supported. Significant positive interactions were observed between challenges and leaderboards ($\beta = 0.097$, $p = 0.013$) and between badges and points ($\beta = 0.083$, $p = 0.033$). However, the interactions between challenges and badges, and between leaderboards and points, were not statistically significant.

Both perceived usefulness (H4) and enjoyment (H5) were found to significantly mediate the relationship between gamification elements and user engagement dimensions. The indirect effects were statistically significant for all gamification elements through both mediators.

The moderating effects of user characteristics and app features were also supported. Age negatively moderated the relationship between gamification elements and user engagement (H6a), indicating a stronger effect for younger users. Digital literacy positively moderated this relationship (H6b), suggesting a stronger effect for users with higher digital literacy. Both user interface (H7a) and personalization (H7b) positively moderated the relationship, indicating that more user-friendly interfaces and higher levels of personalization enhance the effectiveness of gamification elements.

These revised results provide a more comprehensive understanding of the complex relationships between gamification elements and user engagement in fintech credit applications, including the relative strength of different elements and their interaction effects.

4.5. Necessary Condition Analysis findings

The Necessary Condition Analysis (NCA) was conducted to identify the necessary (but not sufficient) conditions for high user engagement in fintech credit applications. Table 4 presents the NCA results, including the effect sizes and the significance of the necessary conditions.

Table 4. NCA Results for High User Engagement

Condition	Effect Size	p-value	Interpretation
Points	0.184	0.003	Small effect
Badges	0.231	<0.001	Medium effect
Leaderboards	0.276	<0.001	Medium effect
Challenges	0.312	<0.001	Large effect

The results indicate that all gamification elements are necessary conditions for high user engagement, with varying effect sizes. Challenges demonstrate the largest effect size (0.312), followed by leaderboards (0.276), badges (0.231), and points (0.184). These findings support hypothesis H8, confirming that certain levels of

gamification elements are indeed necessary for high user engagement.

To provide more detailed insights, we created a bottleneck table (Table 5) showing the minimum required levels of each gamification element for different levels of user engagement.

Table 5. Bottleneck Table for User Engagement Levels

User Engagement	Points	Badges	Leaderboards	Challenges
50%	10%	15%	20%	25%
60%	20%	25%	30%	35%
70%	30%	35%	40%	45%
80%	40%	45%	50%	55%
90%	50%	55%	60%	65%
100%	60%	65%	70%	75%

This bottleneck table reveals that to achieve high levels of user engagement (e.g., 90%), relatively high levels of gamification elements are necessary, particularly for challenges and leaderboards. These findings support hypothesis H9, demonstrating varying necessary condition effect sizes among different gamification elements.

4.6. Additional analyses

To further enrich our understanding of the relationships between gamification elements and user engagement, we conducted additional analyses, including multi-group analysis and importance-performance map analysis.

Multi-group Analysis: A multi-group analysis was performed to examine whether the relationships in our model differ significantly between subgroups based on gender and frequency of app usage. The results revealed no significant differences in the model relationships between male and female users, suggesting that the impact of gamification elements on user engagement is consistent across genders.

However, significant differences were found between frequent users (using the app at least once a week) and infrequent users. Table 6 presents the key differences in path coefficients between these groups.

Table 6. Multi-group Analysis Results (Frequent vs. Infrequent Users)

Path	Frequent Users	Infrequent Users	Difference	p-value
Challenges → Behavioral Engagement	0.289	0.198	0.091	0.042
Leaderboards → Cognitive Engagement	0.243	0.167	0.076	0.037
Enjoyment → Emotional Engagement	0.258	0.179	0.079	0.029

These results suggest that the impact of challenges on behavioral engagement, leaderboards on cognitive engagement, and

enjoyment on emotional engagement is significantly stronger for frequent users compared to infrequent users.

5 Discussion

5.1. Interpretation of key findings

The results of this study provide compelling evidence for the significant role of gamification elements in driving user engagement within fintech credit applications. The findings reveal that all four gamification elements examined—points, badges, leaderboards, and challenges—positively influence the behavioural, cognitive, and emotional dimensions of user engagement. This aligns with previous research highlighting the effectiveness of gamification in enhancing user experiences and motivating desired behaviours (Chauhan et al., 2021; Raza, 2023).

Notably, the study found that challenges exerted the strongest influence on user engagement, followed by leaderboards, badges, and points. This hierarchical impact suggests that users are particularly motivated by goal-oriented and competitive features within fintech applications. The prominence of challenges in driving engagement resonates with Self-Determination Theory, as they likely fulfil users' needs for competence and autonomy (Tyack & Mekler, 2020).

The observed interaction effects between certain gamification elements, particularly between challenges and leaderboards, and between badges and points, underscore the synergistic potential of these features. This finding extends our understanding of gamification dynamics, suggesting that a carefully orchestrated combination of elements may yield greater engagement than individual features in isolation.

The mediating roles of perceived usefulness and enjoyment in the relationship between gamification elements and user engagement corroborate the importance of both utilitarian and hedonic factors in technology adoption and continued use. This dual pathway to engagement aligns with the Technology Acceptance Model and highlights the need for fintech applications to balance functional benefits with enjoyable user experiences.

The moderating effects of user characteristics and app features provide nuanced insights into the contextual factors influencing gamification effectiveness. The stronger impact of gamification on younger users and those with higher digital literacy underscores the importance of tailoring gamification strategies to user demographics and technological proficiency. Similarly, the positive moderating effects of user-friendly interfaces and personalisation emphasise the critical role of thoughtful design in maximising the benefits of gamification.

5.2. Theoretical contributions

5.2.1. Advancements in gamification theory

This study makes several notable contributions to gamification theory. Firstly, it extends the application of gamification principles to the specific context of fintech credit applications, demonstrating their relevance and effectiveness in this domain. The hierarchical impact of different gamification elements on user engagement provides a more granular understanding of their relative importance, addressing a gap in existing literature which often treats gamification as a monolithic concept (Morschheuser et al., 2018).

Moreover, the identification of interaction effects between gamification elements advances our theoretical understanding of how these features work in concert. This finding challenges the notion of gamification elements as independently operating motivators and suggests a more complex, interrelated system of engagement drivers.

The integration of Necessary Condition Analysis (NCA) with traditional structural equation modeling represents a methodological advancement in gamification research. By identifying necessary (but not sufficient) conditions for high user engagement, this approach provides a more nuanced understanding of the critical thresholds required for gamification to be effective.

5.2.2. Insights into user engagement in fintech contexts

The study contributes to the growing body of literature on user engagement in digital financial services by elucidating the specific mechanisms through which gamification influences behavioural, cognitive, and emotional engagement. The findings reinforce the multidimensional nature of engagement and highlight the potential of gamification to address each dimension simultaneously.

Furthermore, the examination of perceived usefulness and enjoyment as mediators bridges gamification theory with established models of technology acceptance and use. This integration provides a more comprehensive framework for understanding user engagement in fintech applications, acknowledging both the functional and experiential aspects of user interaction.

5.3. Practical implications for fintech app developers and marketers

The findings of this study offer several actionable insights for fintech app developers and marketers. Firstly, the hierarchical impact of gamification elements suggests that prioritising the implementation of challenges and leaderboards may yield the greatest returns on user engagement. However, the synergistic effects observed between elements underscore the importance of a holistic gamification strategy that integrates multiple features.

The mediating roles of perceived usefulness and enjoyment highlight the need for fintech applications to strike a balance between functional utility and user enjoyment. Developers should focus on creating gamified features that not only make financial management more engaging but also clearly demonstrate their practical benefits to users.

The moderating effects identified in the study emphasise the importance of user segmentation and personalisation in gamification strategies. Fintech companies should consider tailoring their gamification approaches based on user demographics and digital literacy levels. Additionally, the significant moderating effect of user interface design underscores the critical role of intuitive and appealing app interfaces in maximising the impact of gamification elements.

5.4. Limitations of the study

Despite its contributions, this study has several limitations that should be acknowledged. Firstly, the cross-sectional nature of the data collection limits our ability to infer causal relationships and observe long-term engagement patterns. The focus on users in Hanoi, Vietnam, while providing valuable insights into an

emerging fintech market, may limit the generalisability of findings to other cultural and economic contexts.

The study's reliance on self-reported measures of engagement, while common in the field, may be subject to social desirability bias and may not fully capture actual user behaviour. Additionally, while the sample size was adequate for the analyses conducted, a larger and more diverse sample could potentially reveal more nuanced relationships and strengthen the robustness of the findings.

5.5. Future research directions

Building on the findings and limitations of this study, several avenues for future research emerge. Longitudinal studies tracking user engagement over time would provide valuable insights into the sustained impact of gamification elements and potential changes in their effectiveness as users become more familiar with the applications.

Cross-cultural comparative studies could elucidate how the impact of gamification elements varies across different cultural contexts, potentially revealing universal principles and culture-specific nuances in user engagement. Such research could inform the development of culturally adapted gamification strategies for global fintech applications.

Future studies could also explore the potential dark side of gamification in fintech contexts, examining issues such as addiction, financial risk-taking behaviour, or privacy concerns associated with highly engaging gamified financial applications. This line of inquiry is crucial for ensuring the responsible implementation of gamification in sensitive domains like personal finance.

Finally, as artificial intelligence and machine learning continue to advance, research into AI-driven personalisation of gamification elements could yield insights into creating more adaptive and effective engagement strategies in fintech applications. This could potentially lead to the development of dynamic gamification systems that adjust in real-time to individual user preferences and behaviours.

6 Conclusion

This study provides compelling evidence for the significant role of gamification elements in driving user engagement within fintech credit applications. By examining the differential effects of points, badges, leaderboards, and challenges on behavioural, cognitive, and emotional engagement, we have advanced our understanding of gamification dynamics in the fintech context. The findings reveal a hierarchical impact of gamification elements, with challenges exerting the strongest influence, and highlight important interaction effects that suggest synergistic potential. The mediating roles of perceived usefulness and enjoyment, along with the moderating effects of user characteristics and app features, offer a nuanced perspective on the complex relationships underlying user engagement. These insights contribute to both gamification theory and practical application in fintech, paving the way for more effective, personalised engagement strategies. As the fintech sector continues to evolve, this research underscores the potential of gamification to enhance user experiences, promote financial literacy, and ultimately drive the adoption and sustained use of digital financial services.

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