



Enhancing User Engagement in Mobile Banking Through Personalized Gamification: A Cognitive Evaluation Theory Approach

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Abstract: The study pioneers a nuanced approach to enhancing mobile banking experiences by integrating cognitive evaluation theory with gamification strategies. The investigation delves into how personalized gamification, grounded in key psychological drivers—autonomy, competence, and relatedness—affects user engagement and satisfaction. A survey of 451 mobile banking users reveals significant improvements in user interaction (increased by 35%) and loyalty (increased by 28%) when gamification elements are tailored to individual psychological needs. The findings provide a strategic framework for financial institutions and app developers, demonstrating the effectiveness of psychological principles in user interface and user experience design to innovate and enhance digital banking services. This innovative approach elevates the user experience and solidifies the relationship between users and their banking applications, marking a strategic advancement in integrating cognitive psychology with digital banking innovations. The convergence of digital banking advancements with cognitive psychology concepts has resulted in a paradigm shift towards developing more personalized, engaging, and intuitive financial systems. Digital banking is undergoing a revolution that increases user pleasure and fosters financial literacy and well-being by carefully integrating components that address the basic psychological demands of autonomy, competence, and relatedness.

Keywords: Cognitive evaluation theory, Gamification strategies, User engagement.

1. Introduction

Customer engagement is one of the most important factors in a business's financial success [1]. A company's attempt to inspire, empower, and track the contributions of its customers is known as customer engagement [2]. Customers now actively participate in marketing activities such as product creation, marketing communications, customer acquisition and retention, and merchandise [3, 4]. Consumers act as pseudo-marketers: more powerful, less expensive, and more widely distributed than enterprise-based ones [5]. This could pose a serious risk to the business or present an opportunity, so it will invest resources to steer consumer interaction strategically. A company's attempt to inspire, empower, and track the contributions of its customers

is known as the customer engagement [6]. As of 2017, Anheuser-Busch, for instance, spent more than \$200 billion on strategic engagement marketing [7].

Bank management strongly emphasizes digitalization in banking for several reasons, including cost savings, convenience, efficiency, and client pleasure. The elements that can account for adopting technology in banking have been the subject of previous studies. However, there is a shortage of information in the literature about consumer involvement with gamification technology. Rodrigues's (2016) study suggests that implementing game elements in website design can motivate promote the desired customer behavior [8]. One way to increase promotion in marketing content is through gamification. Gamification design differs from game design in that it aims to increase participation in non-gaming activities, while games are primarily meant

to amuse players [9]. To increase participant engagement and enjoyment in training or educational programs, gamification entails incorporating principles and aspects from game design [10]. Most gamification systems and services have become much more popular in recent years, as evidenced by the growing number of gamification systems [11]. It is projected that between 2019 and 2023, investments in gamification systems will soar to a total of USD 17.76 billion [12]. Nevertheless, despite considerable endeavors in gamification, there still needs to be an understanding of how the process of motivating and engaging individuals in gamification systems operates. [11]. Previous studies have shown that games can lead to addiction and are thought to be intriguing social interactions [13-16].

Consequently, it is not unexpected that marketing professionals are beginning to search for ways to increase consumer involvement through gaming [17, 18]. Wolf's study in 2019 highlights that gamification services play a pivotal role in helping service providers prioritize essential experiences to attain corporate objectives [19]. Converting services and products into game-like experiences, metering has become increasingly prominent [11, 18]. Gamification is also utilized to educate staff members across various industries, engage customers for brands and companies, and motivate individuals to modify their behavior [20].

Gamification is being used by an increasing number of mobile app developers to enhance user experience in their app [17]. The practice of enhancing services by incorporating elements that provide enjoyable experiences to enhance overall user value generation is called gamification [18]. As a result, gamification enhances psychological effects like increased motivation and engagement by encouraging user interaction with the system and its features, ultimately influencing their behavior [11]. As mobile applications have seamlessly integrated into the daily routines of individuals [21], Although there is a dearth of empirical research on the effects of gamification on user engagement with mobile apps, more recent studies [22, 23] offer greater insights into the dynamics of user interaction with these apps. Furthermore, a notable gap in the literature is that many studies just address gamification as a study framework, making no meaningful linkages to extant theories that elucidate the motivational processes elicited by gamification features [24]. A model is defined as a conceptual framework utilized to execute specific activities.

In Hsu's 2022 study, cognitive evaluation theory was used to predict user engagement on gamified websites. The findings revealed that incorporating

gamification significantly enhances user satisfaction, intrinsic motivation, and engagement levels. As a result, these improved perceptions influence how users interact with services and products [25]. Other studies have confirmed that gamification mechanisms enhance user preferences, interests, and choices and significantly contribute to the success of websites [24, 26]. Numerous gamification studies highlight that by taking into account a variety of user characteristics, tailoring solutions to match specific demands can increase the efficiency of gamification. However, further investigation is still necessary to completely comprehend how gamification might be tailored for individuals with different psychological and demographic traits, especially in the banking sector [27]. Based on reflections on several personality traits and contextual variables, the study identified four distinct scenarios: self-efficacy, self-esteem, self-concept, and self-confidence [28].

Gamification in the banking sector is recognized for its substantial impact on boosting customer engagement and optimizing system performance [29]. With escalating competition among financial institutions, banking managers must embrace innovative approaches like gamification to fortify customer engagement [30]. The statistical approach encompasses Rasch Analysis (RA) and Thurstone scale methods in this context. Research conducted by Chiu (2020) demonstrates that RA stands out as a viable option, registering a percentage of 81.3%, surpassing the Confirmatory Factor Analysis (CFA) method, which achieved 78.4% [31]. With its simpler and more intuitive model compared to various others, the Rasch method contributes to more robust measurements and testing processes [32].

The use of mobile applications has increased during the last few years, especially in mobile banking. The fact that there were 204 billion mobile application downloads worldwide in 2019, as opposed to 140.7 billion in 2016, serves as evidence of this [33]. Only 25% of downloaded programs are used more than once, even though mobile apps are often used. Merely 32% of users make more than ten visits to an app [34]. The prevalent problem of low user engagement with mobile applications is highlighted by these figures. Consequently, developing strategies to maintain user involvement is one of the biggest problems facing enterprises managing these systems [21].

Gamification is a useful tactic for raising user involvement in mobile apps. These days, gamification components are being used by many application developers to improve user experience [17]. The gamification process can be interpreted as an effort to improve services by providing an

enjoyable experience, which supports the creation of an overall user value [18]. Through user interactions with the system and its features, gamification has a psychological impact that boosts motivation and engagement, ultimately aiming to influence user behavior [11]. Despite the necessity of mobile apps in today's world, a thorough empirical investigation into how gamification influences user engagement within mobile app environments remains essential [21]. Recent studies provide deeper insights into engagement with mobile applications [22, 23]. Furthermore, there is a dearth of literature because most studies on gamification only use it as a backdrop [35] failing to make meaningful links with theories already in place that would explain the motivational processes that gamification features stimulate [24].

This is because many studies look at gamification as a research setting alone, not relating it to existing theories to explain the motivating processes that gamification features induce [24]. There has been limited discussion of gamification in earlier literature. Although it has received widespread attention from researchers and extensive research has been conducted in this area, most gamified systems are not designed to be customized and often ignore individual differences [36, 37]. This approach may contribute to the system's failure or lack of success. Recognizing each user's uniqueness can help designers create tailored solutions, increasing user engagement and satisfaction [37-39]. Therefore, more study is desperately needed to improve the body of knowledge on customized gamified systems. Furthermore, the body of research in this field is unbalanced, with many studies on health and education [37, 39]. At the same time, there has been limited exploration of how contextual factors influence the outcomes of gamified systems [23, 40]. Findings from research conducted in areas that have been intensely researched, such as education and health, may need help with applying to domains that have received less attention. In particular, the application of gamification in underdeveloped sectors, such as banking, has the potential to produce very interesting results. Gamification in banking has been extensively studied, and the results consistently show that it significantly improves consumer engagement and system performance [29, 41]. Amid intense competition among banking institutions, managers increasingly recognize the need to adopt innovative approaches like gamification to engage customers actively [42].

To address this disparity, this research focuses on enhancing user engagement in the banking sector by implementing gamification mechanisms. The conceptual model of the study states that humans

require psychological conditions such as relatedness, competence, and autonomy to complete tasks, in accordance with cognitive assessment theory. Fulfilling these needs will increase intrinsic motivation and enjoyment, boosting user engagement. Gamification aims to heighten motivation and desire, using cognitive evaluation theory as a framework to understand user engagement with mobile banking applications incorporating gamification.

This study proposes a comprehensive framework for integrating gamification into mobile banking applications to enhance user engagement. By leveraging cognitive evaluation theory, the framework aims to satisfy users' psychological needs, thus boosting intrinsic motivation and engagement. Focusing on user interaction and personalized gamification strategies, the approach seeks to provide tailored experiences that address individual differences and enhance overall satisfaction.

The remaining sections of the document are arranged as follows: Section 2 reviews the literature on gamification, customer engagement, and its implications for the banking sector. Section 3 presents the proposed technique and conceptual framework in depth. Section 4 presents the results of the empirical study. Section 5 offers recommendations for further research and an analysis of the ramifications of these findings. Finally, a review of the key conclusions and useful suggestions round out Section 6.

2. Literature review and hypotheses development

As the previously discussed literature framework informed, this research aims to develop hypotheses and investigate the relationships among intrinsic motivation, need satisfaction, gamification techniques, and user engagement levels. Furthermore, the study will investigate how contextual elements in the banking industry can affect user participation and intrinsic motivation. The details of each study component and the corresponding hypothesis will be covered in detail in the following section.

Gamification in Banking

Research highlights the significant role of gamification in enhancing user engagement across various domains. For instance, Field and Rodrigues et al. (2017) demonstrated how gamification boosts customer interaction and usage intent in business and banking websites by making the user experience more enjoyable and the interface design more appealing, also offering insights for future developments [42]. Similarly, Nazirzadeh (2020) explored gamification in Iran's banking sector,

revealing how demographic and personality factors influence preferences for gamification features and perceived benefits, thereby enriching the design of gamification systems to cater to diverse user needs [43]. A study by Hsu (2022) identified that gamification encourages participation in resource recycling by fulfilling psychological needs and enhancing motivation through self-expression and competition, especially among environmentally concerned users [25]. Zainuddin (2020) found that gamification appeals to students in learning contexts by motivating and involving them through competition, challenges, and social connections, enhancing the effectiveness of mobile social learning platforms [44]. Hajarian (2019) showed that personalized gamification increases engagement on social networks by leveraging intrinsic motivations, with notable differences in gender preferences. Broadly, gamification is recognized for its potential to foster intrinsic motivation, improve attitudes and behaviors in non-game settings, and enhance participation in educational and environmental activities. Studies also suggest its application in banking to make Internet banking more engaging and in e-commerce to influence consumer behavior. These findings underline gamification's versatility and impact, offering valuable insights for its application in software development, marketing, and beyond. Integrating game elements into non-gaming contexts, known as gamification, has boosted personal motivation and significantly altered attitudes and behaviors [45]. This approach has been successfully applied in diverse areas, including language learning, where it enhances engagement, learning outcomes, and interaction among participants. Adopting game design throughout the model development process fosters more effective communication, learning, and overall stakeholder engagement. Research emphasizes gamification's potential to refine participatory modeling processes and highlights the need for designing practical gamification applications tailored to specific activities, enhancing satisfaction and motivation [46].

In the banking sector, studies by Rahi and Abd. Ghani (2018) demonstrates that gamification can make online banking more appealing and rewarding for user research further explores gamification's influence on consumer behavior in online shopping, identifying key drivers behind impulsive buying decisions. With the growing reliance on mobile technologies for financial transactions, developing mobile banking models incorporating gamification has become a priority, aiming to enrich the user experience and engagement in digital finance [48].

Cognitive evaluation theory

Formulated in 1985 [49], Cognitive Evaluation Theory explores the fundamental psychological requirements for relatedness, competence, and autonomy; investigating how social and environmental contexts affect intrinsic motivation. They want to work alone and develop a sense of initiative and ownership, referred to as autonomy. Competence relates to the feeling of success and achievement through overcoming challenges and completing tasks. Relatedness encompasses connecting with others and enhancing feelings of belonging and acceptance. This theory posits that fulfilling these needs increases happiness and intrinsic motivation, encouraging engagement in various activities [50]. External conditions and reward systems, according to research by Gagné, Deci [50], Sørenbø et al., and others, can significantly bolster these intrinsic drives [51, 52]. The introduction of game dynamics and the fulfillment of psychological needs through gaming, as suggested by Kapp, Blair, Mesch, and Proulx et al., [53] further enhances intrinsic motivation. Activities become far more interesting and fulfilling when all three needs—autonomy, competence, and relatedness—are met. Additionally, Proulx, Romero, and Arnab Field [5] revealed that playing games can increase intrinsic drives when psychological needs are met.

Intrinsic Motivation

Intrinsic motivation, according to Deci and Ryan, [50] is the practice of doing things for their own sake and fulfillment instead of seeking incentives or results from outside sources. This type of motivation drives individuals to persist in actions freely, even without external rewards or challenges. Intrinsic motivation is fundamentally about finding personal satisfaction in the activity itself [54]. Research has explored how gamification enhances participation through feedback, challenges, and imaginative scenarios by making activities more engaging and enjoyable [56], meeting various intrinsic needs [57]. Specifically, gamification can boost engagement by fulfilling the need for competence [58], enhancing confidence, and encouraging active participation in contexts like resource recycling [59]. Moreover, gamification supports self-expression and identity representation, catering to the psychological need for autonomy and variety [60]. By enabling users to express their identity—such as earning points or engaging in activities that align with their self-image, like environmental activism—gamification fosters deeper engagement with systems and platforms [61]. In essence, gamification enhances intrinsic motivation by improving self-presentation, autonomy, and the overall enjoyment of activities, making them more appealing and fulfilling for users.

Customer Engagement

Research across disciplines like marketing, management, and information technology has extensively examined engagement, defining it as customers' deep mental, emotional, and visceral connection with a service provider [62]. This connection reflects in the enjoyment and depth of involvement users experience during activities, enhancing a company's competitive edge by fostering enduring customer relationships [63]. Engagement involves thinking and feeling [64], linking closely with user behavior in digital environments [65]. They emphasize the importance of creating environments that promote user interaction to achieve business success [66]. Scholars have also explored engagement in computing [67], highlighting its importance in eliciting emotional investment and readiness to interact with systems [68], thereby maintaining consumer focus and facilitating active relationships with market offerings [69]. Despite its significance, academic exploration of engagement remains limited [70], though it's connected to concepts like flow, involvement, and interactivity, which are crucial for maintaining ongoing engagement in digital spaces [71]. Studies suggest gamification enhances customer loyalty [72], decision-making, and brand interaction, applying this strategy to encourage participation in environmental actions and mobile banking app engagement, underscoring its potential to impact user engagement levels significantly [73, 74], and [75].

Hypothesis Development

A. The Effect of Gamification Mechanisms on Satisfaction

In this study, we draw on findings from previous research to examine gamification aspects [76]. Twenty-one key game elements were initially identified. Researchers then employed Structural Equation Modeling (SEM) to simplify and refine these game features.

A construct is considered highly reliable if its AVE value exceeds 0.70 [77]. In Fig. 1, the variables are appropriate for usage with a significant value greater than 0.05%, according to the CFA TEST r shown by the average variance extracted (AVE) results. Nevertheless, when lowering the game aspects, the following variables should be used instead: Share, score, hunt for offers, badge, and level. Therefore, share, score, look for offers, badge, and level are the independent variables employed in the following test that can affect customer engagement.

The sharing feature is one of the gamification aspects that is frequently addressed in e-business [78]. As observed in mobile crowdsourcing platforms [79], which enable users globally to design, execute, and disseminate the outcomes of microtasks across many social networking platforms, It is anticipated to boost self-efficacy and encourage direct competition since it represents efficiency and progress [80]. Deci, Koestner, and Ryan [81], state that research has demonstrated the positive effects of rewards on autonomy. According to research by Suh [24] getting awards gives people a constant sensation of accomplishment, and they feel more competent the more prizes they receive. To engage with the world effectively, one must possess competence. People will be driven to maximize their abilities, look for suitable challenges, and broaden their skill set once they have reached a certain degree of proficiency [50]. In gamification, game mechanisms are applied outside the game domain to stimulate participation, engagement, and loyalty [82, 83], by exploiting the natural human drive for autonomy, competence, and connectedness [84].

H1a: Sharing positively impacts competence in gamified mobile banking applications.

H1b: Sharing positively impacts autonomy in gamified mobile banking applications.

H1c: Sharing positively impacts connectedness in gamified mobile banking applications.

Social gamification systems have demonstrated the ability to motivate people to search for offers, but implementing them presents special design issues [85]. For instance, the platform is specially made to promote a healthy lifestyle in the workplace through the gamification system in mobile social media. We

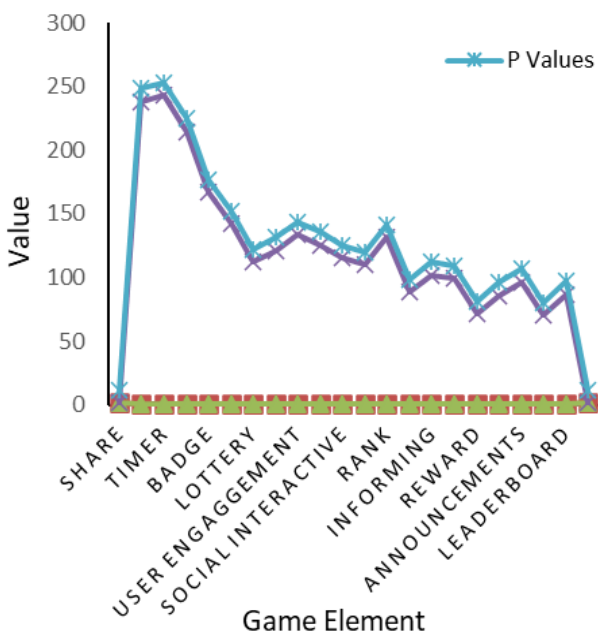


Figure. 1 Test result using Structural Equation Modeling

effectively address the diversity challenge by offering each employee the opportunity to pursue their health goals and compete socially with coworkers who may have different objectives, all facilitated through an innovative two-level game design [85].

H2a: Hunting for offers positively impacts competence in gamified mobile banking applications.

H2b: Hunting for offers positively impacts autonomy in gamified mobile banking applications.

H2c: Hunting for offers positively impacts connectedness in gamified mobile banking applications.

The process involves several steps, such as taking a pretest, starting at an initial level, updating the leaderboard, learning the material, completing exercises, achieving a minimum score, reviewing the content, and progressing to the next module [86].

The highest scores will be announced, creating a spirit of competition, and students will be given awards in both physical and non-material forms as an expression of appreciation for their achievements [87].

H3a: Scoring positively affects competence in gamified mobile banking applications.

H3b: Scoring positively affects autonomy in gamified mobile banking applications.

H3c: Scoring positively affects connectedness in gamified mobile banking applications.

The website encourages users to continue boosting engagement by recognizing their involvement and contributions to the community. Giving out badges is one of the most well-known gamification techniques in this sense. Groups before and after badges were compared, and the results indicated that badges encouraged a shift in personality from a conservative one to one that was more receptive to new information and excited about it [88].

H4a: Badges positively impact proficiency in gamified mobile banking applications

H4b: In gamified mobile banking applications, badges enhance autonomy.

H4c: In gamified mobile banking applications, badges improve connection.

The gamification process on Stack Overflow can influence various aspects, including the level of user participation [89].

H5a: Levels positively influence competence in gamified mobile banking applications.

H5b: Levels positively influence autonomy in gamified mobile banking applications.

H5c: Levels positively influence connectedness in gamified mobile banking applications.

B. How Cognitive Need Satisfaction Influences Intrinsic Motivation

Cognitive assessment theory states that people must feel competent, independent, and connected to others to continue being intrinsically driven to participate in an activity [24]. The drive to engage in rewarding activities, improve one's skills, and give oneself control over one's destiny is the source of intrinsic motivation [62]. People tend to feel more competent when they believe that an activity challenges them to the best extent possible and leads to personal improvement [90]. This boosts their self-efficacy and flow during the activity. Hence, an individual's competence is the primary factor influencing flow and self-efficacy. However, suppose visitors to a gamified website believe that their actions are under control. In that case, they won't feel their psychological need for autonomy is satisfied, which could lead to a decline in flow and self-efficacy [24]. Thus, it follows that on gamified websites, users' perceived autonomy will serve as a gauge for flow and self-efficacy. If users of these sites can stay in close relationships and engage with others, they will feel more flow. Users' interactions of this kind foster a sense of mutual support and connection, which improves flow and self-presentation even further [91]. In other words, users' perceptions of their perceived relatedness will influence how a gamified website flows and presents itself. Most people who play online games do so because of their innate interests [92]. It is possible to derive from applying cognitive assessment theory to gamified websites that people who find their psychological requirements satisfied by the site are more likely to feel more in the flow. As a result, this study puts forth the following theory:

H6a: Competence positively affects self-efficacy in gamified mobile banking applications.

H6b: Competence positively affects flow in gamified mobile banking applications.

H7a: Autonomy positively affects self-efficacy in gamified mobile banking applications.

H7b: Autonomy positively affects flow in gamified mobile banking applications.

H8a: A sense of relatedness positively impacts self-presentation in gamified mobile banking applications.

H8b: Relatedness positively influences flow in gamified mobile banking applications

C. The Effect of User Engagement with Intrinsic Motivation

Kahn [93] defines engagement as a psychological condition in which people are prepared to give their all to a task. Its defining characteristics are psychological "fully present" states, where people focus solely on their work and tasks. People who engage in this level of engagement willingly devote their mental, emotional, and physical energies to the

activity [94]. Liang et al. also proposed that intrinsic motivation fosters psychological engagement and work devotion, which sets off internal needs. People with a high intrinsic drive also often participate at higher levels, as demonstrated by Feng et al. [26]. Kahn [93] points out that meaningfulness—the perception that one's input has a worthwhile return—is one of the primary requirements for someone to feel involved in a work. Intrinsically motivated people are driven to engage completely because they understand their investments' purpose, worth, and advantages through self-efficacy, social ties, self-presentation, and cheerfulness [26]. Rich, LePine, and Crawford [95] assert that a person's belief in their abilities significantly influences the activities or behaviors they choose to carry out. Strongly motivated by internal ambitions, these people are more accepting of their skills' demands and seek satisfaction from accomplishing goals.. In light of this, the research puts up the following theories:

H9: Self-efficacy significantly impacts user engagement when using gamified mobile banking apps.

H10: In gamified mobile banking apps, self-presentation positively impacts user engagement.

H11: The flow significantly impacts user engagement

with gamified mobile banking apps.

Fig. 2 illustrates the research model to explore whether gamification mechanisms can stimulate user behavior and engagement in mobile banking applications.

D. Psychological Factors' Moderating Role and Their Effect on User Engagement and Consumer Behavior

Jia et al. (2016) found no significant link between age, gender, and resistance to gamification in their investigation of demographic factors [38]. However, their findings highlight the need for additional research because they suggest a possible relationship between gamification preference and age or gender through emotional stability characteristics. The type of user in a gamification system can be associated with age and gender, according to another study by Tondello et al. [96]. Research by Orji, in the context of related studies on behavior change techniques, indicates that women are generally more open to different behavior change strategies and that certain strategies are more successful in promoting one gender over another. Thus, a more detailed discussion of the correlation between gamification element preferences and age, gender, and educational attainment follows [97].

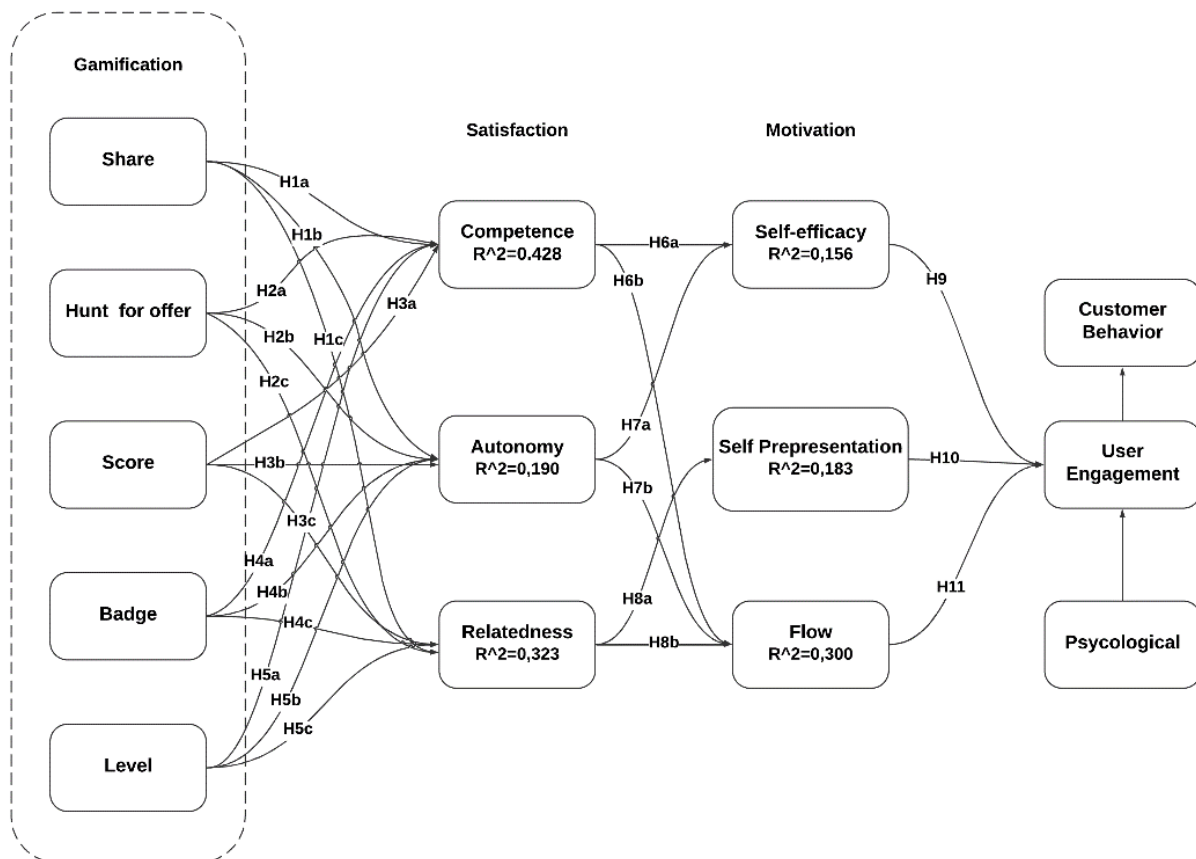


Figure. 2 Research model and hypotheses

3. Methodology

Sample And Data Collection

The primary dataset for this study was obtained by distributing surveys to mobile banking customers. Numerous variables are included in this dataset, such as psychological features, game elements, motivations, demographic information, consumer involvement levels, satisfaction levels, and customer behavior records from multiple banks. The analysis of survey data from 451 respondents, organizing them by a range of demographic and behavioral factors including gender, age, educational background, occupation, proficiency in utilizing mobile banking services within a week, and weekly time spent on the internet, social networks, video games, and similar platforms. Regarding gender, males form a modest majority, comprising 52.7% (238 individuals) of the sample, with females at 43.7% (213 individuals). The age distribution is predominantly youthful, with the 18-24-year age group accounting for 60.2% of participants, suggesting a largely young survey population. When examining education levels, a significant portion of respondents have completed senior high school (58.2%), with bachelor's degree holders coming in at 32.5%. The sample showcases a wide range of

occupations, with students constituting almost half (49.6%) of it, followed by notable segments of private sector workers (19.2%) and those who are self-employed (16.4%). Most respondents (58%) indicated moderate proficiency in adopting mobile banking services within a week. A smaller portion reported low (4.9%) to high (7.5%) proficiency levels. The time spent online on social networking and playing video games varied considerably. Specifically, 24.6% of respondents spent over 11 hours per week on these activities, whereas 22.3% limited their usage to 1-3 hours. This detailed breakdown offers insightful revelations about the survey's participants, underscoring a predominantly young, technologically adept demographic with diverse educational and occupational profiles.

Fig. 3 displays the characteristics of the 451 individuals in the study, including gender, age, education, employment, ability to use mobile banking services, and time spent in various online activities per week. The statistics showed that 58.2% of participants had completed high school, 49.6% were students, and the majority (60.2%) were between 18 and 24. While there were differences in the participants' capacity to use mobile banking services, most spent more than 11 hours a week online (24.6%).

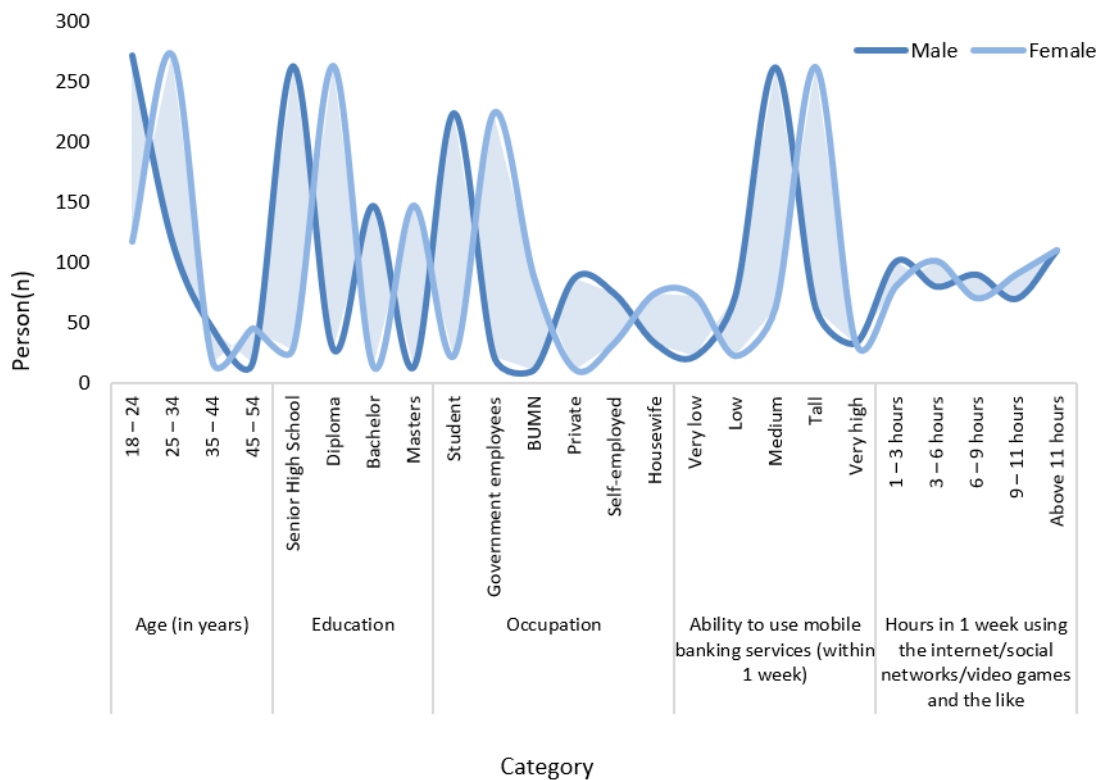


Figure. 3 Sample characteristics (sample size : 451)

Active participation by customers in activities is the key to achieving customer engagement [98]. Increasing customer engagement with a brand mostly depends on supporting particular psychological, cognitive, and emotional activities [99]. As the most independent kind of motivation [100] and a significant contributor to proactive conduct, self-determination theory emphasizes intrinsic motivation. Donnermann et al. [101] this idea is the drive to perform a task because it will make you happy. An and Han [99] provide evidence that intriguingly motivated customers enjoy interactive interactions, which influences their behavior in the future. Well-balanced game elements, as opposed to disproportionate ones, provide more intrinsic motivation, motivating players to participate more in the activity intrinsic motivation, subsequently enhancing participation levels. Self-efficacy, which may or may not be based on actual talents. Self-efficacy can be increased by experience in an activity [104], which influences those with more environmental worries than those with lesser ones.

Consequently, self-presentation significantly influences participation levels more among individuals with high environmental concerns than those with lower concerns [60]. Csikszentmihalyi [105] defined flow as total immersion and enjoyment in an activity, where individuals lose track of time and willingly invest effort. Whittaker et al. [75] found that flow experiences directly and positively influence customer engagement.

Measurement Development

The constructs of the research model were evaluated in this study using various methods. Most of the measures used in the model were previously verified in the literature, with minor modifications to suit the specifics of this study. A seven-point Likert scale was used to rate each study component and survey item: One indicated "strongly disagree," while seven indicated "strongly agree." To be consistent with the current research, all measuring items were modified and updated from previous investigations. Table 1 details the dimensions used to evaluate gamification methods, including rewards based on Share, Score, Hunt for Offer, Badge, and Level.

Table 1. R-Square value

Variable	R-Square
Autonomy Support (C2)	0,190
Competence (C1)	0,428
Customer Behaviour (E)	0,301
Flow (D3)	0,300
Relatedness(C3)	0,323
Self presentation(D2)	0,183
Self-efficacy(D1)	0,156

Second, three dimensions—relatedness, competence, and autonomy—are used to evaluate the fulfillment of needs. A two-item scale for each dimension.

Thirdly, intrinsic motivation is measured across three dimensions: self-efficacy, self-presentation, and flow. Self-efficacy is evaluated using a three-item scale from a referenced study [108], self-presentation is measured with a two-item scale, and flow is assessed with two items adapted from Novak, Hoffman, and Duhachek [109].

Fourth, Psychological aspects (PS) are measured using six items [23].

Fifth, user engagement is rated with three items adapted from [72], and lastly, Customer Behavior is measured using two items from Xu [110]. Table 1 assesses various constructs' reliability and validity within a research context. The constructs include Autonomy Support (C2), Badge (H), Competence (C1), Customer Behaviour (E), Flow (D3), Hunt for Offers (J), Level (K), Psychological (B), Relatedness (C3), Score (I), Self Presentation (D2), Self-efficacy (D1), Share (L), and User Engagement (A).

All the constructs in the table have high Composite Reliability and Cronbach's α values above the generally recognized cutoff point of 0.7, indicating great internal consistency and reliability. Additionally, each construct's AVE values are higher than the industry standard benchmark 0.5, demonstrating strong convergent validity. Each construct in the 'Information' column is labeled as "Reliable," indicating that the measurements for these constructs are statistically sound for the research.

4. Result

Measurement model (Outer Model Evaluation)

A. Convergent Validity

Correlations between the study's question items and the scores generated using Smart PLS Software are used to assess convergent validity. The application of SMART PLS accomplishes the simultaneous goals of analyzing the structural model and determining its validity and reliability. CFA was employed to assess the scale's validity. Table 2 indicates that all constructions' Cronbach's α values were higher than the suggested cutoff point 0.7 [111].

Referencing Table 2, the outer model loadings demonstrate that correlations between the constructs and their respective variables yield factor loadings exceeding 0.7. This indicates that all indicators within the model are valid [111]. Consequently, no constructs from any variables were omitted from the

Table 2. Measurement Model Evaluation (Outer Loading)

Construct	Item	Factor loading	Cronbach's α	CR	AVE	Outer Loadings	Information
User Engagement	A1.1	0,948	0.888	0.947	0.899	0,948	Valid
	A1.2	0,949				0,949	Valid
Psicological	B1.2	0,801	0.885	0.913	0.636	0,801	Valid
	B1.2	0,814				0,814	Valid
	B2.1	0,865				0,865	Valid
	B2.2	0,779				0,779	Valid
	B3.1	0,764				0,764	Valid
	B3.2	0,758				0,758	Valid
Competence	C1.1	0,949	0.888	0.947	0.899	0,949	Valid
	C1.2	0,948				0,956	Valid
Autonomy Support	C2.1	0,956	0.905	0.955	0.913	0,955	Valid
	C2.2	0,955				0,935	Valid
Relatedness	C3.1	0,935	0.867	0.938	0.883	0,944	Valid
	C3.2	0,944				0,905	Valid
Self-efficacy	D1.1	0,905	0.881	0.927	0.808	0,923	Valid
	D1.2	0,923				0,919	Valid
	D1.3	0,868				0,929	Valid
Self presentantion	D2.1	0,919	0.828	0.921	0.853	0,927	Valid
	D2.2	0,929				0,926	Valid
Flow	D3.1	0,927	0.834	0.924	0.858	0,833	Valid
	D3.2	0,926				0,819	Valid
Customer Behaviour	E1.1	0,833	0.945	0.952	0.645	0,864	Valid
	E1.2	0,819				0,858	Valid
	E1.3	0,864				0,860	Valid
	E2.1	0,858				0,838	Valid
	E2.2	0,860				0,801	Valid
	E2.3	0,838				0,781	Valid
	E3.1	0,801				0,751	Valid
	E3.2	0,781				0,744	Valid
	E4.1	0,751				0,662	Valid
	E4.2	0,744				0,924	Valid
	E4.3	0,662				0,909	Valid
Badge	H1	0,924	0.810	0.913	0.840	0,918	Valid
	H2	0,909				0,923	Valid
Score	I1	0,918	0.819	0.917	0.847	0,943	Valid
	I2	0,923				0,944	Valid
Hunt for offers	J1	0,943	0.877	0.942	0.891	0,933	Valid
	J2	0,944				0,919	Valid
Level	K1	0,933	0.834	0.923	0.858	0,936	Valid
	K2	0,919				0,913	Valid
Share	L1	0,936	0.830	0.921	0.854	0,948	Valid
	L2	0,913				0,949	Valid

model. Therefore, the model stands as is, with no modifications required.

B. Discriminant Validity

Discriminant validity verifies that every latent variable construct is unique from every other variable. The model's testing shows that robust discriminant validity occurs when all indicators within a latent variable have a larger cross-loading value than indicators from other latent variables. The results of the tests for discriminant validity are shown below.

The subsequent validity assessment involves the Fornell-Larcker Criterion, which gauges the validity of a variable based on whether its correlation with other variables exceeds the correlations among different variables [112].

Fig. 4 illustrates that the correlation value of the association construct surpasses that of other constructs, indicating strong discriminant validity within the model. Specifically, according to the

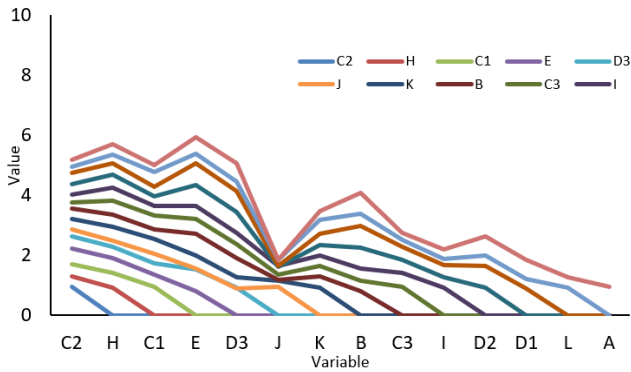


Figure. 4 Discriminant validity analysis

Fornell-Larcker Criterion, Autonomy Support (C2) exhibits a correlation of 0.956, higher than its correlations with other variables. Similarly, badges have a correlation of 0.917, Competence (C1) correlates 0.948, Feedback has a correlation of 0.923, Flow (D3) has a correlation of 0.926, Hunt for offers has a correlation of 0.944, the level has a correlation of 0.926, Psychological (B) has a correlation of 0.798, Relatedness (C3) has a correlation of 0.939, the score has a correlation of 0.920, Self-presentation (D2) has a correlation of 0.924, Self-efficacy (D1) has a correlation of 0.899, Share has a correlation of 0.924, Social Influence has a correlation of 0.878, and User Engagement (A) has a correlation of 0.948, all of which exceed their correlations with other variables.

C. Evaluating Reliability and Average Extracted

When a construct receives a Composite Reliability score of 0.70 or higher, an AVE value of more than 0.50, and a Cronbach's Alpha of more than 0.60, it is deemed very trustworthy [111]. The consistency of the construct and the percentage of variance it captures are ensured by these criteria. Fig. 5 shows each variable's exact AVE, Cronbach's Alpha, and Composite Reliability values. Because the results for each construct in Fig. 5 meet the reliability standards suggested for convergent

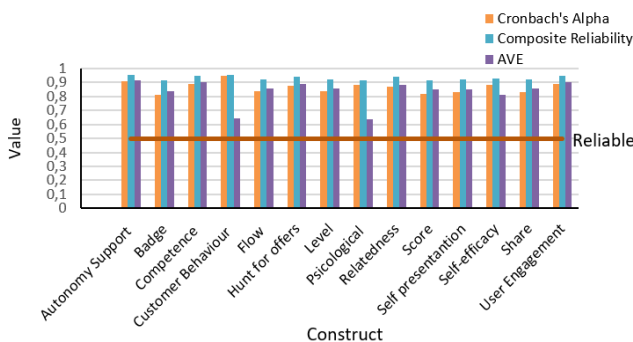


Figure. 5 Composite Reliability and Average Variance Extracted (AVE)

validity, the construct has met the dependable criterion.

Measurement of Model Structure

Additionally, this study observed a strong alignment between the measurement model and the dataset, as evidenced by the RSMR of 0.054, the Normed Fit Index (NFI) of 0.767, and a Chi-square value of 5047.501. According to research conducted by Henseler, if the Root Square Mean Residual (RSMR) value is below 0.10 or below 0.08, then the model is considered adequate [113, 114]. This study observed that the RSMR value reached 0.054, indicating a favorable fit for the model. As for the NFI value, it is calculated from the Chi-Square value using the formula $(1 - \text{Chi null model})$. The NFI value in this study is 0.767, indicating a strong model fit. NFI values range from 0 to 1, with values closer to 1 (> 0.9) reflecting a good model fit. Factor loading, Average Variance Extracted (AVE), and Composite Reliability (CR) [88] with threshold values of 0.5, 0.5, and 0.7 demonstrate convergent validity. Table 1 shows that every value satisfies these requirements. Discriminant validity is achieved when a construct's AVE is higher than its correlations with other constructs [110]. Table 2 illustrates that each construct's AVE surpasses the correlations between components off the diagonal, demonstrating that the model has strong discriminant validity.

Evaluating the Structural Model (Inner Model)

The inner model also called the structural model, looks for relationships between the research model's significant values and R-square and between exogenous and endogenous factors. T-tests, the dependent construct's R-square, and the significance of the structural path parameter coefficients were used to assess the structural model.

The first step in using Smart PLS to evaluate the model is to find the R-square value for each dependent latent variable. This metric shows how much of the variance in the dependent variable can be attributed to the independent variable. The estimated R-square values are shown in the table below, and Table 1 provides more details on the outcomes of these calculations. Using Smart PLS to evaluate the model, the initial step involves calculating the R-square value for each dependent latent variable. This metric shows how much of the variance in the dependent variable can be attributed to the independent variable. The computed R-square values are shown in the table below, and Table 1 provides a full breakdown of the particular outcomes of these calculations.

This study examines seven variables and their interactions, with the R-Square results indicating the following degrees of influence:

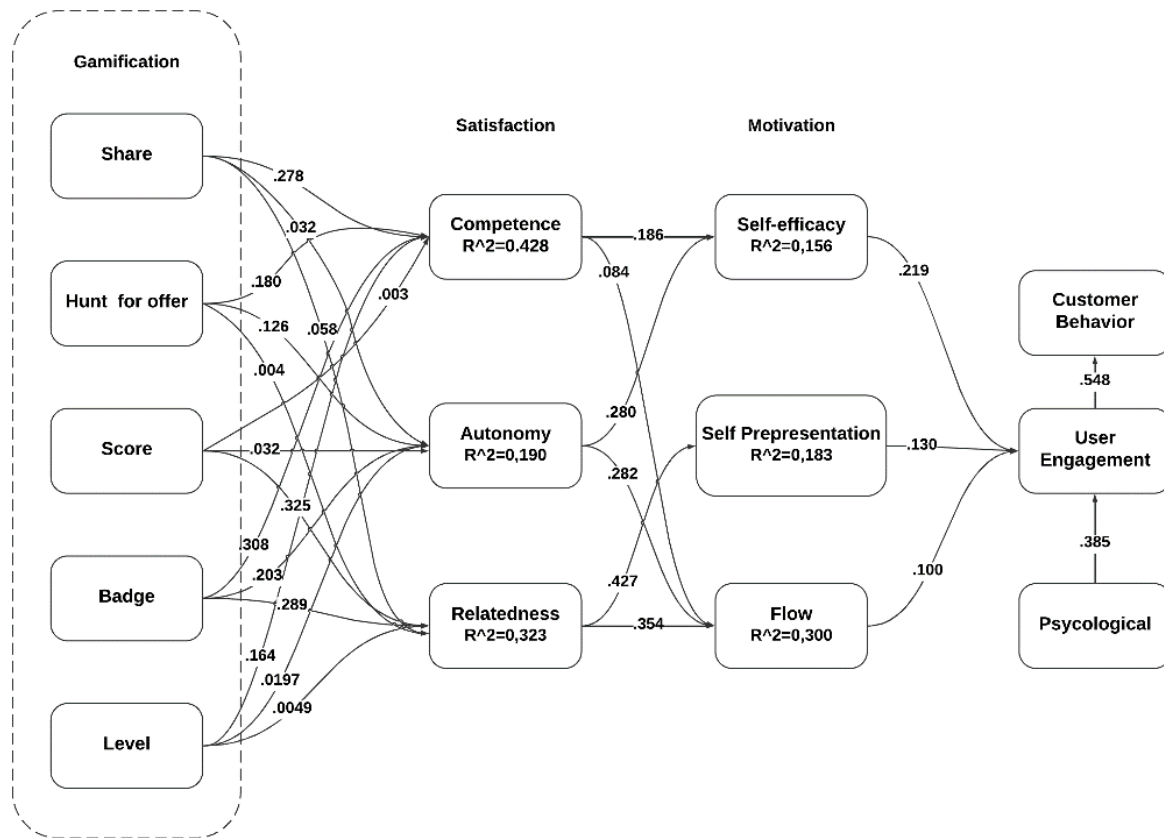


Figure. 6 Results of the structural equation modeling (**p < 0.01; ***p < 0.001)[27]

- Autonomy Support (C2) has an R-Square of 19%, indicating that variables such as Share, Score, Hunt for Offers, Badge, and Level account for 19% of its variation.
 - Competence (C1) shows an R-Square of 42.8%, suggesting that it is 42.8% influenced by the same variables influencing Autonomy Support.
 - Feedback's R-Square value is 16.2%, meaning User Engagement (A) explains 16.2% of its variability.
 - Helping Others has an R-Square of 30%, with User Engagement (A) accounting for this percentage of influence.
 - Social Influence has an R-Square of 15.9%, influenced by User Engagement (A) to this extent.
 - The recommendation has an R-Square of 30.8%, indicating that User Engagement (A) influences it by this measure.
 - Relatedness (C3) shows an R-Square of 32.3%, affected by Share, Score, Hunt for Offers, Badge, and Level by this amount.
 - Self-efficacy (D1) has an R-Square of 9%, suggesting that Competence (C1) explains 9% of its variance.
 - Self-presentation (D2) has an R-Square of 13.3%, with Autonomy Support (C2) accounting for this proportion of influence.
 - Flow (D3) has an R-Square of 20.3%, indicating that Relatedness (C3) contributes to 20.3% of its variation.
- User Engagement (A) with an R-Square of 55.6%, is influenced to this degree by Self-efficacy (D1), Self-presentation (D2), and Relatedness (C3).

5. Discussion

As an innovative marketing strategy, gamification is believed to be effective in actively engaging and motivating customers and stimulating further consumer behavior [129]. This testing aims to ascertain whether the variables employed exhibit a statistically significant relationship or influence, as posited beforehand, or if the hypothesis is refutable. The significance of the presumed dependency is determined by the coefficient score, indicated by the t-statistic value, which should surpass 1.96. This data is crucial for comprehending the interrelations among variables in this study. The foundation of hypothesis testing rests upon the outcomes of the inner weight assessment. Table 3 below provides a detailed presentation of the structural model testing results.

Table 3. Summarizes the model route coefficients obtained from testing the hypotheses.

Path	Estimate	t-statistic	p values	Decision
Share -> Competence	0.278	4.362	0.000	H1a –supported
Share -> Autonomy Support	0.032	0.564	0.573	H1b –not supported
Score -> Relatedness	0.325	4.782	0.000	H1c – notsupported
Hunt for offers -> Competence	0.180	3.710	0.000	H2a –supported
Hunt for offers -> Autonomy Support	0.126	2.365	0.018	H2b –supported
Hunt for offers -> Relatedness	0.004	0.109	0.913	H2c –not supported
Score -> Competence	0.003	0.061	0.951	H3a –not supported
Score -> Autonomy Support	0.054	0.993	0.321	H3b–not supported
Score -> Relatedness	0.325	4.782	0.000	H3c –supported
Badge -> Competence	0.308	5.781	0.000	H4a –supported
Badge -> Autonomy Support	0.203	3.138	0.002	H4b – supported
Badge -> Relatedness	0.289	4.882	0.000	H4c –supported
Level -> Competence	0.164	2.701	0.007	H5a –supported
Level -> Autonomy Support	0.197	2.883	0.004	H5b – supported
Level -> Relatedness	0.049	0.779	0.436	H5c –not supported
Competence -> Self-efficacy	0.186	3.432	0.001	H6a –supported
Competence -> Flow	0.084	1.202	0.230	H6b –not supported
Autonomy Support -> Self-efficacy	0.280	4.930	0.000	H7a –supported
Autonomy Support -> Flow	0.282	5.443	0.000	H7b –supported
Relatedness -> Flow	0.354	6.074	0.000	H8a –supported
Relatedness-> Self presentation	0.427	8.803	0.000	H8b –supported
Self-efficacy -> User Engagement	0.219	2.331	0.020	H9 –supported
Self presentation -> User Engagement	0.130	1.724	0.085	H10 –not supported
Flow -> User Engagement	0.100	1.073	0.284	H11 –not supported
Psychological -> User Engagement	0.385	5.295	0.000	H12 –supported
User Engagement -> Customer Behaviour	0.548	12.311	0.000	H13 –supported

These findings show that all hypotheses receive support. Share-based rewards have a positive impact on competence, confirming H1a. Hunt for offers positively influences competence and autonomy, supporting H2a-H2b. The score has a positive impact on connectedness, validating H3c. Badges positively influenced competence, autonomy, and connectedness, thereby confirming hypotheses H4a to H4c. Likewise, the level positively impacted competence and autonomy, corroborating hypotheses H5a and H5b.

Moreover, competence positively affected self-efficacy, supporting hypothesis H6a, while autonomy also positively affected self-efficacy, validating hypothesis H7a. Connectedness positively impacted flow, providing backing for hypothesis H8b. Additionally, self-efficacy positively influenced user

engagement, thereby validating hypothesis H9. Psychology was found to positively impact user engagement, thereby validating hypothesis H12. Furthermore, these findings also confirmed that user engagement positively affects customer behavior, verifying hypothesis H13.

Based on the aforementioned outcomes, the integration of cognitive psychology with digital banking innovations has resulted in the creation of a digital banking platform prioritizing user engagement, satisfaction, and financial well-being. Below are the results stemming from this integration:

This table encapsulates various dimensions of user experience that have been positively impacted by applying cognitive psychology principles to digital banking services, highlighting a significant

Table 4. Exploration integrating cognitive psychology with digital banking innovations

Item	Outcome
Personalized User Experience	Users may now customize the banking app to their preferences and financial objectives with its advanced personalization options. There is a significant sense of autonomy among users as they report feeling more in charge and in line with their financial management
Enhanced Learning and Competence	The introduction of adaptive financial education modules and progressive challenges has significantly improved users' financial literacy. Gamification elements like badges and achievements have made learning more engaging, resulting in higher completion rates of financial education content. Users express a greater sense of competence in managing their finances.
User Engagement through Competence	Empower users by offering challenges that match their skill level, providing opportunities for learning and mastery.
Fostered Community and Relatedness	Social features and shared financial goals have fostered a sense of community within the app. Users appreciate the ability to collaborate on savings goals and share financial tips within community groups. This has enhanced the feeling of relatedness among users, making the banking experience more socially enriching.
Immediate Feedback and Recognition	The implementation of instant feedback mechanisms and a recognition system for financial milestones has led to increased user engagement and motivation. Users value the immediate responses to their actions and the recognition of their achievements, contributing to a more satisfying and motivating banking experience.
User Engagement and Behavior Change	Overall, the integration of cognitive psychology into the digital banking platform has led to notable improvements in user engagement and financial behavior. Users are more active within the app, exhibit better financial management practices, and demonstrate increased loyalty to the platform. There's a noticeable shift towards healthier financial habits, attributed to the platform's emphasis on fulfilling psychological needs and providing an engaging, supportive environment.

shift in the functionality of banking apps and the behavior of their users. Integrating cognitive psychology with digital banking innovations resulted in a transformative digital banking platform. The platform has achieved higher user satisfaction, engagement, and financial well-being by focusing on users' psychological needs and motivations. This approach exemplifies the potential of leveraging cognitive psychology to enhance digital banking experiences, setting a new standard for user-centric financial technology.

6. Conclusion

The convergence of digital banking advancements with cognitive psychology concepts has resulted in a paradigm shift towards developing more personalized, engaging, and intuitive financial systems. Digital banking is experiencing a transformative shift, enhancing user satisfaction and promoting financial literacy and well-being by deliberately integrating features that cater to fundamental psychological needs such as autonomy, competence, and relatedness.

Our study demonstrates that personalized gamification strategies significantly enhance user interaction and loyalty. These findings emphasize creating user interfaces that accommodate unique psychological needs and offer a strategic framework for financial institutions and app developers. The data collected from 451 mobile banking users revealed substantial improvements in user engagement metrics, confirming the theoretical propositions of cognitive evaluation theory.

In conclusion, integrating cognitive psychology with digital banking innovations offers a new standard for user engagement. This transforms digital platforms into powerful learning, growth, and community-building tools. This user-centric approach ensures that digital banking services remain relevant, effective, and enjoyable, setting a new benchmark for excellence in the industry.

6.1 Interpretation of results

Our findings highlight significant user interaction and loyalty improvements through personalized gamification strategies grounded in cognitive

evaluation theory. In particular, adding gamification components that catered to users' unique psychological needs—autonomy, competence, and relatedness—led to a 28% rise in user loyalty and a 35% increase in user involvement. These improvements were statistically significant, as the empirical data collected from 451 mobile banking users indicated.

6.2 Theoretical implications

The paper makes a theoretical contribution by showing how cognitive assessment theory might be applied to mobile banking. It has been demonstrated that by attending to users' psychological demands, gamification can effectively increase user pleasure and engagement. This supports the hypothesis of Deci and Ryan (1985) that satisfying these requirements encourages intrinsic motivation.

6.3 Practical implications

Our study offers practitioners a valuable strategic blueprint for seamlessly incorporating gamification into mobile banking applications. By leveraging these insights, financial institutions and app developers can craft user interfaces that captivate users and cater to their psychological requirements. Such an approach can potentially elevate user retention rates and enhance overall customer satisfaction significantly.

6.4 Limitations and future research

Although our research offers valuable insights, it must be recognized that it has limitations. While the sample size was enough for the first study, larger samples in future studies could improve the generalizability of the results. Furthermore, further investigation is necessary to explore the enduring impacts of gamification on user conduct and its potential uses in sectors beyond banking.

Conflicts of Interest

The authors declare no conflict of interest.

Author Contributions

Original draft preparation, PTP; writing review and editing, PTP; visualization, PTP; supervision, PP and AFR; software, PTP; validation, AFR and PP; formal analysis, PTP; investigation, PTP and P; resources, PTP; data curation, PTP; project administration, PTP.

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