Can Gamified Literacy Strengthen Cryptocurrency Investment?

Garima Agrawal, Dr. Gunjan Sharma
[1,2]Institute of Business management, GLA University, Mathura, Uttar Pradesh, India

Corresponding Author:**Garima Agrawal**

Abstract

Purpose –This study aimed to determine which factors are more important when investing in cryptocurrencies and how gamification in financial literacy encourages investment behaviour.**Methodology**– The research employed SmartPLS 4 software and Partial Least Squares Structural Equation Modeling (PLS-SEM) to validate the model, which integrates aspects like gamification, financial literacy, and investment. To gain a better knowledge of the problem, the study conducted a systematic literature review using the ADO (Antecedents, Decision, Outcome) paradigm. To evaluate suggested solutions, data were collected from 557 financial application users.**Findings** The study revealed that both objective and subjective knowledge of finance were positively linked to cryptocurrency investment. Nonetheless, subjective financial knowledge(SFK) had a stronger positive connection with cryptocurrency investment, especially when gamification was a factor. While objective financial knowledge(OFK) significantly affected the decision to hold cryptocurrencies, the role of gamification in this relationship was less impactful. In conclusion, SFK emerged as a more crucial predictor of cryptocurrency investment decisions than OFK.**Practical implications** – The study's findings provide academics with new information by deepening their understanding of The aspects that affect cryptocurrency investment in India. This research also offers specific implications for financial institutions, financial experts, and politicians in order to advise sensible digital currency investing behaviour.**Originality/value** – The current research is one of the first that assesses the influence of gamification on investor behaviour in cryptocurrency investment, which has gotten low consideration in the existing literature.

Keywords- Cryptocurrency investment, Gamification, objective financial knowledge, Subjective financial knowledge, Financial literacy, ADO framework (Antecedents, Decision, Outcome)

1.Introduction

Global connectivity and low-cost communication via the Internet have enabled everyone from a 2-year-old child to a 90-year-old grandmother to exchange information simultaneously at a low cost. Digital currency is the next mechanism that will spark a revolt, just as the internet transformed how people interact(Gupta et al., 2021). Satoshi Nakamoto popularized the notion of digital currency after publishing a white paper on the most popular cryptocurrency(Nakamoto, 2008).The Fortune India report indicates that Bitcoin, Dogecoin, Cryptocurrency Cash, Litecoin, Filecoin, Ethereum Classic, Cardano, Ethereum, Helium,and Monero are among the top ten cryptocurrencies worldwide with market capitalizations exceeding $1.45 trillion.(Keshavdev, 2022).Althoughprevious studies demonstrated cryptocurrency as an investment rather than value it as a currency (Ciaian et al., 2016),and it will hold a strong position in every trader's portfolio in the coming few years(Delfabbro et al., 2021).

Cryptocurrency has emerged as a significant financial instrument, alongside traditional asset classes such as stock market products (Subramaniam and Chakraborty, 2020). Investing in cryptocurrency is a highly volatile financial instrument where investment decisions fluctuate over time, leading to erratic behavior among investors. As a result of these characteristics, cryptocurrency investment entails higher risks, less stability and robustness of hedging features, and behavioral biases.(Mokni et al., 2022, Hairudin et al., 2022;).

Behavioral biases are more common in retail crypto investors due to their inexperience(Fonseca et al., 2020). These biases are generated by faulty reasoning, but they may be rectified with proper financial education. Despite its growing popularity, Cryptocurrency is thought to be too sophisticated for the typical consumer. Transacting on the blockchain presents numerous technological challenges, and trading cryptocurrencies needs a high level of financial awareness. However, with the proliferation of blockchains within this new architecture, gamification in financial education may be taken to an altogether new level, driving direct interaction in these ecosystems. The incredible advantages of financial literacy, combined with the fascinating power of gamification, make the two perfect partners for supporting investors in overcoming present hurdles and optimizing procedures.
Previous research has shown that financial knowledge and gamification have a major impact on investment choices made by individuals(Munnukka et al., 2017, Krische, 2019).Although financial knowledge &gamification have been advocated as important components of people's investment decisions, no empirically validated research has been

conducted on their effects on investing behavior in virtual currencies. Using Cryptocurrency investment behavior as a case study, this study aimed to fill a significant literature gap.

This work contributes to what we know in different ways.This study differs from previous research examining what influences investing decisions in traditional stock markets (Lim et al., 2013; Liao et al., 2017;Malmendier et al., 2020). Instead, itemphasises cryptocurrency investment, which has attracted less attention in earlier studies. Unlike previous research (Munnukka et al., 2017), this study assessed gamification in financial literacy by asking specific questions regarding investments, rather than general financial issues. This investigation evaluated not justthe impact of gamification on cryptocurrency investing, but also how it influences the connection between financial knowledge and cryptocurrency investment behaviour.As a result, this inquiry attempts to solve the research deficiency by setting the following goals:

- To examine how gamification affects investors' choices in cryptocurrency investments.
- To Evaluate how gamification influences the connection between financial knowledge and cryptocurrency investment decisions.
- To evaluate the expected benefits of investors' decisions in cryptocurrency investments.

2.Systematic Literature Review

To ensure the integrity of our research and data collection, we used Scopus as a reference database. The first boom period in crypto occurred in June 2011, and we searched the Scopus database from January 1, 2012 to April 11, 2022 to use this landmark as a reference date. Table 1 presents the systematic review protocol we adopted fromBriner and Denyer (2012).

Due to our approach, we do not focus on limiting keywords related to investor behavior and behavioral finance. Therefore, the suggested terms in our review are: “Cryptocurrency”, “Cryptocurrencies”, “gamification”, “Financial literacy” and “financial knowledge”.However, when we used mathematicalcorrectionsand unknowncharacters with the selected keywords, the following study framework appeared: Financial behavior and gamification, Financial literacy and gamification, Financial literacy and Cryptocurrency, Gamification and investment, Gamification and Cryptocurrency, and

gamification and financial knowledge And SFK and objective financial knowledge, as evidenced in Table 1. To carry out the search framework, we focused on the "topic" choice, which searches the title, abstract, author search terms, and other keywords sections of the paper's content.Our quality criteria were also applied in addition to the above. Our study included all academic journals written in English that addressed the subject.

Table 1 Systematic review protocol

Context and Rationale

- The increasing significance of gamification in cryptocurrency investments.
- Rising investor enthusiasm for the cryptocurrency market.
- Grasping the crucial role of financial literacy in cryptocurrency investing.

Objectives:

- To explore how gamification influences investor behavior based on existing literature in the cryptocurrency sector.
- To explore the limitations and benefits of financial literacy.
- To Identify what is known and unknown about crypto investors' behavior.

Criteria for Assessing Studies in this Review of Studies

- **Inclusion Criteria:**
  - Research that increases knowledge concerning investor behaviour in the cryptocurrency sector
  - Both qualitative and quantitative studies.
  - Conduct investigations among all fields.
  - Case studies.
- **Exclusion Criteria:**
  - Literature reviews.

Retrieval Method for Selection of Publications

- **Database:** Scopus
- **Time Period:** 2011–2022
- **Search Terms and Keywords:**
  - Financial behavior and gamification
  - Financial literacy and gamification

    - Financial literacy and cryptocurrency
    - Gamification and investment
    - Gamification and cryptocurrency
    - Gamification and financial knowledge
    - SFK and OFK
- **Language Restriction:** Only studies in English
- **Unpublished Data:** Excluded

Eligibility

Selection Criteria:

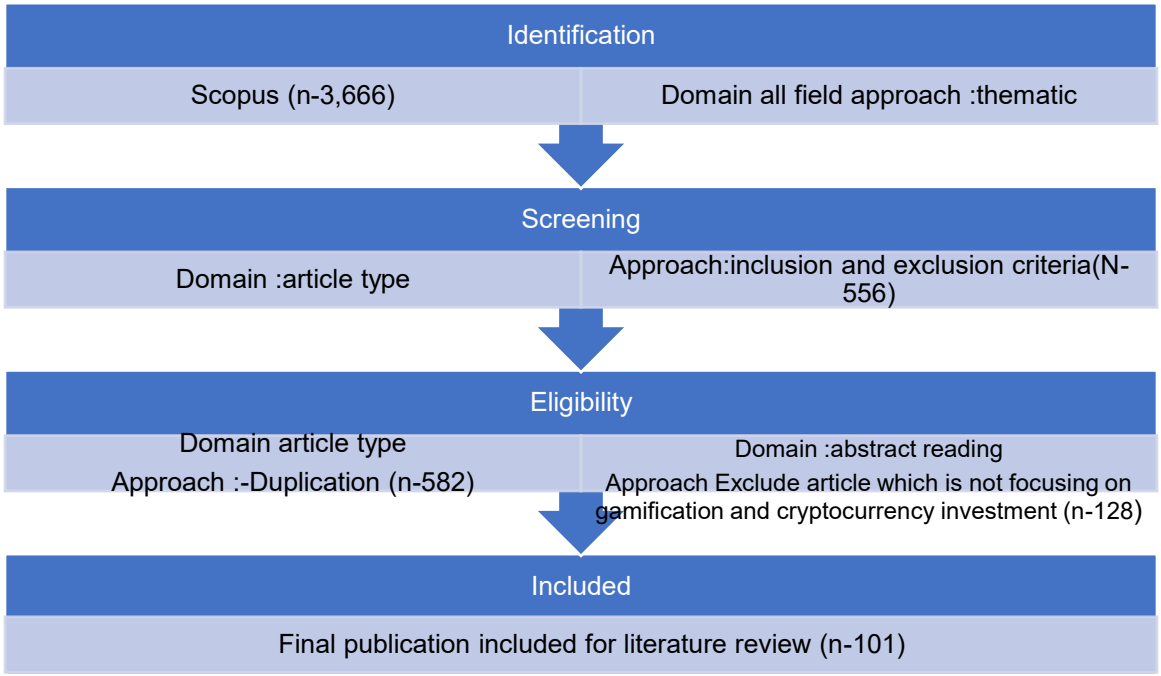
- Cryptocurrency investments
- Investor behavior
- Investment interest
- Investment perspective
- Alternative assets

Exclusion Criteria:

- Distributed ledger technology topics
- Associations with money laundering or terrorism
- Articles not discussing financial participants or investment behavior

The PRISMA protocol guides the advancement of information through every phase of our systematic review approach, which was taken from Page et al. (2021), as shown in Table 2. Initially, we discovered 3,666 articles and eliminated 2,110 of them using automated algorithms and quality criteria. Next, we evaluated 1,556 papers, discarding 814 that did not fulfill our qualifying criteria. Finally, during the inclusion step, our method yielded a final sample of 101 articles.

Table 2: PRISMA Flowchart for Screening Process on Systematic Literature Review.



Source(s): Authors' Creation

After following the above-mentioned steps of the PRISMA flowchart, we got to know about various antecedents that work between gamification and investor sentiments, which leads them to cryptocurrency investment decisions.Even though there is an information gap about the elements that influence investors to invest in cryptocurrency, crypto investment has recently become an excessively popular financial tool among the younger generation for a variety of reasons.The following literature study begins by describing the case for investing in cryptocurrencies against other traditional assets, as indicated in Table 3. All literature reviews are grouped into themes for simple understanding of how gamification plays a part in behaviour finance. Following that, gamification is added as a moderating variable to explain how it influences financial behaviour and cryptocurrency investing. Finally, based on the preceding explanation, crypto behaviour is studied and hypotheses are

Table 3 ADO Framework

Particular	**Themes**	**Particular's**
Antecedents	FinancialBehavior related antecedents	Transformative Theory, Explicit, management, Mediator Function

	Gamification-related antecedents	Game-based learning,Continuance intention, Cognitive skills, Communication skills, digitalization,Emerging technologies.
	Financial literacy related	Practical intelligence, Social exchange,SFK, OFK
	Cryptocurrency investment-related antecedents	Symbolic expression, Herding behavior,Momentum and investor attention, Liquidity, Crypto bubble, Volatility and risk, Portfolio diversification, hedging,
Decision	Financial behavior and cryptocurrency investment as a key construct	Investment intention, Investor financial behavior, Willingness to invest in crypto,and Financial literacy affect transfer and crypto acquisition
Outcomes	Gamification has a moderating effect on individual investment	• The impact of social factors or collective sentiment, coupled with solid financial understanding and needed resources • Investors are motivated by substantial gains and a tendency towards risk-taking

Source(s): Authors' Creation

Antecedents

Antecedents are factors that can either encourage or discourage specific behaviors and consequently, they may exert a direct influence on decision-making or an indirect influence on outcomes (Paul & Benito, 2018). The review identified a total of 300 associations corresponding to 30 antecedents across four categories. Of these, 162 associations were found to be directly related to decision-making, while 138 associations were indirectly related to outcomes.

Decision

Decisions regarding financial behavior, whether manifesting as performance or non-performance, represent a direct reaction to antecedents and act as precursors to subsequent outcomes (Paul & Benito, 2018). The review highlights five primary decisions related to cryptocurrency investment: investment intent, investor financial conduct, readiness to invest in cryptocurrencies, the effect of financial knowledge on investment decisions, and the acquisition of cryptocurrencies.

Outcomes

Outcomes refer to the assessments that result from behavioral performance or the lack thereof (Paul & Benito, 2018). The review highlights two key outcomes of gamification's moderating role in individual investment decisions: social impact or societal sentiment, combined with a significant amount of financial knowledge, as well as the offering of crucial assets, lead investors to look for significant returns and risk-taking behaviour.

Insights from the ADO Review:

- The review provides scholars with a comprehensive understanding of how antecedents, decisions, and outcomes are interrelated.
- The investigation emphasizes the necessity for more study on the impact of gamification on financial behaviour.
- It equips industry practitioners and policymakers with advanced insights into gamification, financial behavior, and cryptocurrency investment.

2.1 Cryptocurrency Investment

The term 'cryptocurrency' originates from 'cryptography'. Cryptocurrency is a sort of decentralised digital currency, which implies it isn't managed by a centralised authority(Frankenfield, 2019). This property makes cryptocurrencies resistant to government intervention and manipulation (Frankenfield, 2019). In a decentralized currency system, the absence of central banking institutions overseeing consumer

balances eliminates the imposition of high transaction fees, while concurrently reducing transaction processing times.(Maria, 2016).

Cryptocurrencies' value has skyrocketed, surpassing the most significant speculative bubbles in the previous three centuries (Al-Yahyaee et al., 2019). According to the Blockchains and Crypto Assets Council (BACC), a division of India's Internet and Mobile Association (IAMAI), India holds approximately 6 lakh crore in crypto assets. Indian investors are exhibiting a strong interest in digital currencies. As reported by Fortune India, the leading ten cryptocurrencies globally—namely Bitcoin, Dogecoin, Cryptocurrency Cash, Litecoin, Filecoin, Ethereum Classic, Cardano, Ethereum, Helium, and Monero—With a combined market capitalisation of $1.45 trillion, have attracted significant investor interest(Keshavdev, 2022). In contrast to traditional financial assets, it is critical to understand the factors influencing individuals' investment intentions in India, especially in the context of emerging economies. Cryptocurrencies exhibit considerable volatility compared to conventional assets such as bonds, stocks, and paper money(Chen et al., 2018, Li et al., 2020).

Recent studies (Mikhaylov, 2020; Abubakar et al., 2019; Mosteanu&Faccia, 2020).Affirm that cryptocurrencies have secured their foothold in the digital financial ecosystem and are expected to become a key component of practically every investor's strategy in the coming years. (Delfabbro et al., 2021).Cryptocurrency dealers are more concerned with severe investor sentiment regimes (Yu & Yuan,2011). The allure of cryptocurrencies, characterized by their high-risk and high-return potential, has led an increasing number of investors to seriously contemplate investing in these digital assets. further empirical data is required to analyse the aspects influencing investors' decisions about cryptocurrency investing, as illustrated in Figure 1.

H1Financial behavior positively impacts cryptocurrency Investment.

2.2 Financial Literacy

Understanding economic principles involves an individual's ability to grasp financial concepts, enabling them to assess monetary data effectively and make informed decisions about their financial matters(Bhushan, 2014). According to Abdeldayem (2016), financial knowledge may substantially assist people in making logical investment decisions. According to Krische (2019), an individual's grasp of core financial concepts has a considerable influence on investment-related decisions. Financial understanding is typically related toseveral financial behaviours, including borrowing, saving, and specific choices regarding investments(Van Rooij et al., 2011,Lusardi and Mitchell, 2014). As a result, Financial literacy is progressively crucial for individuals from diverse socioeconomic backgrounds, as it equips them with the knowledge required to make

informed financial decisions and to assume greater accountability for their financial health.. Despite the multiple benefits of financial literacy, a 2019 poll conducted by the National Centre for Financial Education found that only 27% of Indians are financially knowledgeable,that is why promoting financial literacy remains a constant issue.

In addition, those with inadequate financial literacy are less likely to make investments in financial assets or engage in trading activities(Van Rooij et al., 2011, Yoong, 2011). In addition, individuals with less financial experience are more prone to borrow at high interest rates (Stango and Zinman, 2009, Lusardi and Tufano, 2015), and have a less diversified collection of investment options (Guiso and Jappelli, 2008, Abreu and Mendes, 2010).Numerous studies have shown that a grasp of fundamental economic and monetary concepts is crucial for making informed saving and investing decisions. Figure 1 illustrates how this study defines financial literacy by taking into account both OFK and SFK. OFK refers to an individual's understanding of financial concepts, rules, and instruments(Lusardi & Mitchell, 2007), In contrast, SFK involves a person's conviction in an individual's financial expertise(Alba & Hutchinson, 2000).

According to Akhtar and Das (2019),OFK is frequently viewed as the ultimate step in the financial decision-making hierarchy. Furthermore, persons with greater levels of OFK are more inclined to own risky financial assets, such as equities(Van Rooij et al.,2011;Thomas and Spataro, 2018) and mutual funds (Liao et al., 2017, Chu et al., 2017). SFK, on the contrary hand, is positively correlated with securities market activity(Yao and Xu, 2015),and alternative investment funds (Bannier and Neubert, 2016),in addition to investing in volatile assets like equities and mutual funds(Tang and Baker, 2016)

Furthermore, the majority of research papers that investigate the influence of financial understanding on crypto investment outcomes have been limited to more prosperous nations(Gaudecker, 2015; Landerretche and Martinez, 2013;Jappelli and Padula, 2013). Such investigations are few in underdeveloped countries (Sayinzoga et al., 2016, Karlan et al., 2014;).Which indicates that it would be intriguing to investigate how financial information influences individual decisions in one of the world's fastest growing economies, India.When looking into the impact of financial literacy on investing decisions, most prior studies employed general financial knowledge to quantify both SFK and OFK.There has been not enough focus on the impact of specific investment skills on retaining investments, particularly risky assets like cryptocurrency. To fill a gap in the literature, our study used specific investment-related questions to evaluate both OFK and SFK. It also explored whether these types of financial knowledge significantly predict investment in cryptocurrencies, a new and high-risk asset class.

H2OFkhas a positive impact on cryptocurrency investment.
H3. SFK has a positive impact on cryptocurrency investment.
H4OFkhas a positive impact on Financial Behavior.
H5SFK has a positive impact on Financial Behavior.

2.3**Gamification**

Digital games have become a part of our daily lives due to the rapid advancement of high-speed internet, the widespread use of mobile devices, and the up-gradation of mobile applications (Wanick and Bui, 2019; Kim and Lee, 2015;Park and Bae, 2014). This technological advancement creates a dynamic corporate environment, which raises the need for consumer involvement. Herein lies the necessity for gamification, which refers to the application of game-like features in non-game situations to boost the value of engagement and behavioral responses amongusers (Burke, 2012a, Warmelink, 2020), such as increasing people's usage of personal finance applications (Baptista and Oliveira, 2019,Maynard and McGlazer, 2017). Approximately 70% of Forbes Global 2000 companies have contemplated gamifying their operations (Washburn, 2017). Nick Pelling (2002) is the first person who coined this word - " a British consultant to applying game-like features to make an electronic transaction more enjoyable." Since then, gamification words have come into existence and are being used by various industries.According to Fortune Business Insights' 2019 study, the worldwide gamification market is projected to be worth US$37 billion by 2027, with a CAGR (compound annual growth rate) of 24.8% (FBI, 2019). It is now possible to create impactful and highly engaging interactions through the use of digital games and reward systems, which are key elements of gamification(Koivisto and Hamari, 2019; Hiltbrand and Burke, 2011; Wanick and Bui, 2019).

Gamification can influence investor behavior by targeting the need for knowledge in a person's life. Everyone can enjoy a game if there is a good reason for doing so. More people find it enjoyable to look after their financial well-being just like they find joy in watching Netflix and playing video games (Stromback et al., 2017; Riitsalu and Murakas, 2019;). Then more people become financially Knowledgeable. Using gamification principles in financial services can encourage a lot of people to invest in a stock, crypto, mutual funds, etc,(Platt et al. 2020). In the aforementioned context, the stock market, which has the potential to attract more and more investors, may also be seen through the lens of gamification. The stock market is in an upward direction, but it does not help everyone. According to the Economic Times report (2020), approximately 95% of Indians do not invest in the stock market due to several risk factors like culture, family, lack of financial literacy, and complex systems. Through this phenomenon, the investor can be

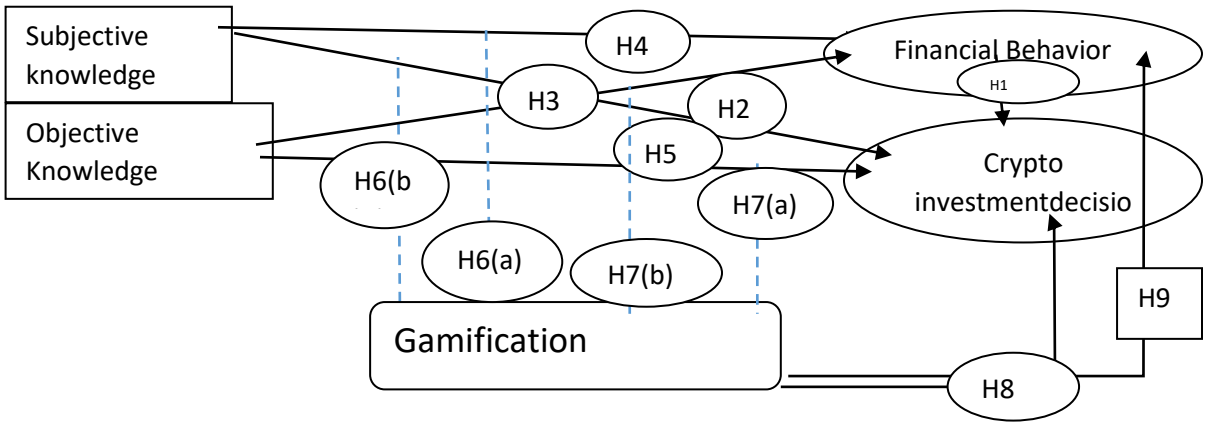
exceptional by making investment fun. It can help in building generation wealth(Zichermann and Linder, 2013).

Furthermore, games affect people's future understanding of money and decision-making, suggesting that gamification mediates the relationship between financial knowledge and financial behaviour.Based on past research, this study investigates whether gamification might operate as a bridge between financial literacy and crypto investing.

H6 Gamification has a moderating effect on the SFK of an individual
H7 Gamification has a moderating effect on the OFK of an individual
H8 gamification has a direct effect on cryptocurrency investment decision
H9 Gamification has a direct effect on Financial behavior

Figure 1 Conceptual Framework (conceptual framework for gamification)

Schematic diagram showing SFK and OFK as independent variables, gamification as moderator,financial behavior acting as a mediator or dependent variable,and crypto investment decision as a dependent variable.



Source(s): Authors' Creation

3. Research Procedure.

3.1 Research Design

The investigation employed a cross-sectional methodology to evaluate the moderating role of gamification in the relationship between financial knowledge, financial behaviour, and cryptocurrency investment.Compared to secondary data, survey-based approaches were used to gather primary data, which more closely reflects individuals' behaviour about investment decisions(Lin, 2011). In the present study, respondents are users of any financial application (Sahi and Arora, 2012). The sample composition is determined by judgment technique(Sahi and Arora, 2012). We used a non-random sampling strategy to

enroll as many participants as possible to collect data on the research variable. Throughout the whole process of data gathering and statistical analysis, Dalphi approaches were utilized to reduce as many biases and mistakes as feasible. The questionnaire was first administered by two financial specialists and two administrative specialists from a prominent financial institution. To prevent bias and inaccuracy, certain aspects were deleted and others were rephrased based on their feedback.

3.2 Survey procedure

The study began by asking respondents whether they utilized any Smartphone apps and whether they were familiar with the word "gamification." Next, Employing a five-point Likert scale, from "strongly disagree" to "strongly agree," the respondent posed seven questions about gamification. After the gamification questions, the following five questions on financial behavior were posed: (On a Likert scale of five points, from "Strongly Disagree" to "Strongly Agree"). Seven questions were used to evaluate cryptocurrency investing decisions.

3.2 Sampling method

Cross-sectional research was done to evaluate the link between the underlying variables (Palys, 2008; Sedgwick, 2014). To prevent common method bias, the survey was distributed to the target demographic in both digital and hard copy formats(Conway and Lance, 2010; Chin et al., 2012;MacKenzie and Podsakoff, 2012) In the preliminary study, young investors who had saved and invested via mobile or desktop financial apps were asked to complete a standard questionnaire. Survey respondents are given an overview of the survey's main objective and how the data will be used. Furthermore, respondents can choose whether or not to engage in the survey. Participants are given the assurance that their information will be kept private and used only for academic purposes. The data would only be gathered from individuals who desired to take part in the study; individual investors would not contemplate providing information about their financial investments. As a result, the study will be suited for the judgment sampling approach (Wood and Zaichkowsky, 2004).

3.4 Sample Characteristics

550 people were invited to take part in the study. A total of 480 replies were gathered. However, 28 of these responses were incomplete or inadequately filled out. Consequently, only 452 valid responses were considered for analysis. Table 4 displays all demographic information for participants.

3.5 Ethical section

Before they participated in this study, each subject gave their informed consent. The consent process followed ethical guidelines, ensuring participants were fully informed of the study's aim, procedures, and potential dangers.Participants were informed of their right to withdraw at any point without consequences. The confidentiality and privacy of

all participants were maintained throughout the study; individual investors would not contemplate providing information about their financial investments. As a result, the study will be suited for the judgment sampling approach (Wood and Zaichkowsky, 2004). Table 4 depicts the major highlights of the respondents' demographic profiles.

Table 4 Demographic Characteristics of Respondents

Category		Percentage
1	**Gender**	
	Male	71.95
	Female	28.05
2	**Age**	
	18-25	41.55
	26-35	17.35
	36-45	23.10
	45-55	18
3	**Educational Qualification**	
	Doctoral	6.7
	Postgraduate	55
	Graduate	22.3
	Senior high school	12.4
	High school	3.6
4	**Occupation**	
	Student / Scholar	60.12
	Service	14.88
	Business	25

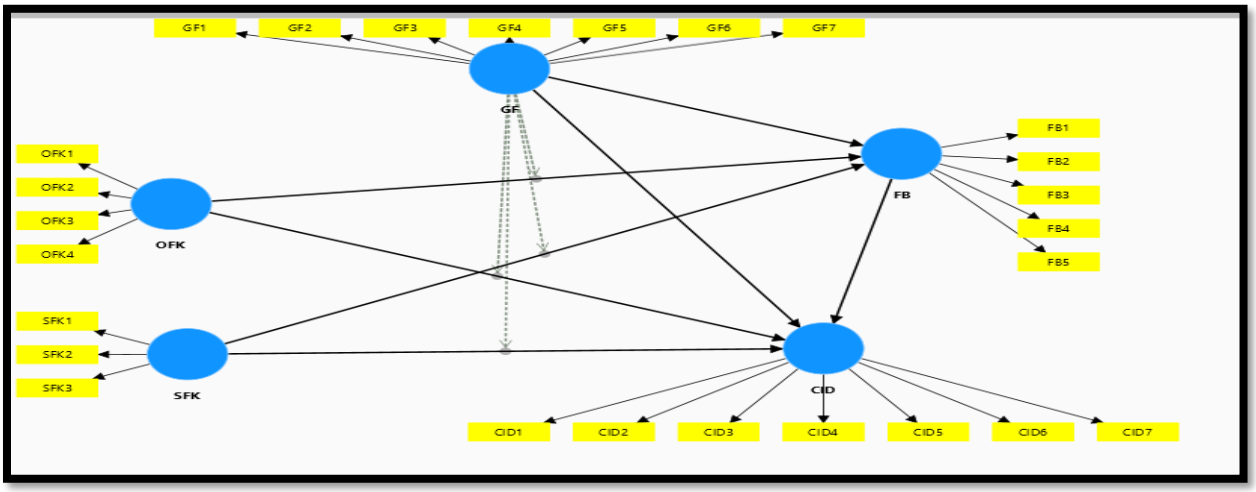
Source(s): Authors' Calculations

3.6Statistical methods

The assumptions were assessed and tested using nonparametric structural modelling through the variance-based PLS-SEM(Partial Least Squares structural equation modelling), implemented in Smart PLS 4.1.0(Ringle et al., 2024). This approach was chosen for its effectiveness in managing complex models (Hair et al., 2019)and its appropriateness for prediction within theoretical frameworks in the social and behavioural sciences (Hair et al., 2019). Additionally, PLS Software was employed to examine mediation effects and implement complex models(Saari et al., 2021). The analytical process commenced with the evaluation of both first and second-order measurement models. This was followed by performing 10,000 bootstrap subsamples with

a bias-corrected percentile technique (two-tailed).Figure 2 depicts the conceptual model created with the help of PLS Smart 4.0.

Figure 2Proposed conceptual model



Note: CID -Cryptocurrency Investment decision; FB -Financial Behavior; GF-Gamification; OFK – Objective financial knowledge; SFK -Subjective financial knowledge.
Source(s): Authors' Creation

3.7 Measurement instrument

All factors were taken from relevant previous research and tested using a 5-point Likert scale (see appendix). The gamification and financial behavior scales were adapted from Baptista and Oliveira (2016) and Venkatesh et al. (2012), respectively. OFK and SFK were measured byBayuk and Altbello (2018). Scales were taken to measure CID from Sood, Pathak,Jain, and Gupta(2023).

3.7.1 Reliability and Convergent Validity

PLS Sem algorithm function demonstrates that the outer loading of CID6,CID7,GF5, and GF6 is less than 0.708 (>0.708) then we check the AVE (average variance extracted) of CID and GF Construct that are more than 0.5 Thatis why we retain all items of GF and CID,as illustrated in table 5(Carmines and Zeller, 1979, Hair et al.,2011). Convergent validity was further supported by the fact that the average variance extracted (AVE) values were more than 0.5 (Iam, 2012; Fornell and Larcker, 1981).For checking Construct reliability and validity, we further calculate Cronbach's alpha and Composite reliability (rho_c),which are more than 0.70 and less than 0.9.

Table 5: Construct validity and reliability

Particular	Cronbach's alpha	Composite reliability (rho_c)	Average variance extracted (AVE)
CID	0.810	0.861	0.513
FB	0.866	0.903	0.651
GF	0.862	0.894	0.548
OFK	0.803	0.871	0.629
SFK	0.827	0.897	0.744

Note: CID -Cryptocurrency Investment decision; FB -Financial Behavior; GF- Gamification; OFK – Objective financial knowledge; SFK -Subjective financial knowledge.
Source(s): Authors' Calculations

The discriminant validity was investigated using two tests: the Fornell-Larcker criterion and the HTMT ratios. As indicated in Table 6, the square roots of the AVEs for each construct were initially validated to be bigger than the corresponding inter-construct correlations (Fornell and Larcker, 1981). Second, we verified that all HTMT values were less than 0.90 and that the number 1 was absent from the bootstrap confidence interval, as indicated in Table 4 (Hair et al., 2017).

Table 6 Fornell Larcker Criterion

Particular	CID	FB	GF	OFK	SFK
CID	0.716				
FB	0.773	0.807			
GF	0.766	0.796	0.740		
OFK	0.778	0.775	0.738	0.793	
SFK	0.711	0.655	0.639	0.744	0.862

Note(s): Diagonal components represent the root squared AVE values. Components below the diagonal represent the constructions' correlation. CID -Cryptocurrency Investment decision; FB -Financial Behavior; GF- Gamification; OFK – Objective financial knowledge; SFK -Subjective financial knowledge.
Source(s): Authors' Calculations

3.7.2 Structural Model Assessment

Guidelines provided by Hair et al. (2019, 2022) were adhered to in evaluating the structural model results for hypothesis testing, as well as for assessing the model's explanatory and predictive capabilities. Variance Inflation Factor (VIF) values were used to examine multicollinearity, and they were determined to be less than the critical limit of 5 (Ringle et al., 2015).The path

coefficients in the structural model were analysed using the methods provided by Ghasemy et al. (2020) and Saari et al. (2021).

The majority of coefficients were significant ($p < 0.05$) with small impact sizes, except for the association between Gamification (GF) and Financial Behaviour (FB),which exhibited a moderate f-square value. Significant predictors of cryptocurrency investment included financial behavior ($\beta = 0.152$, $p < 0.05$, supporting H1) and gamification ($\beta = 0.272$, $p < 0.05$, supporting H8), as illustrated in Table 7. Additionally, both subjective and OFkwere identified as crucial predictors of cryptocurrency investment decisions ($\beta = 0.199$, $p < 0.05$), supporting H2, $\beta = 0.274$, $p < 0.05$, supporting H3) followed Gamification has a significant moderating effect on OFK and SFK for Crypto Investment decision ($\beta = 0.103$, $p < 0.05$, supporting H6(a), $\beta = 0.150$, $p < 0.05$, supporting H7(a),) Together, these predictors of Cryptocurrency investment 73.4 percent variance, as illustrated in table 7. Finally,Objective and SFK are key predictors for Financial behavior ($\beta = 0.244$, $p < 0.05$, supporting H4, $\beta = 0.181$, $p < 0.05$, supporting H5)) followed Gamification has a significant moderating effect on objective and SFK for Financial behavior ($\beta = 0.161$, $p < 0.05$, supporting H6(b), $\beta = 0.228$, $p < 0.05$, supporting H7(b),) these all together predictors explained 74.7 percent variance.

Table 7 shows that gamification has a significant impact on financial behaviour, as indicated by the high f-square values ($F^2 = 0.300$). Gamification was found to be a significant (β 5 0.423, $p >$ 0.05supporting H9 predictor for financial behavior by respondents in the study.Gender and age were taken as the control variables, but these variables did not show any significant effect on the independent construct,so we dropped them.

Table 7 Structural model assessments

hypothesis	Particular	VIF	f-square	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	beta	2.5%	97.5%	significance
H1	FB -> CID	3.999	0.022	0.064	2.354	0.019	0.152	0.030	0.284	yes
H8	GF -> CID	3.093	0.091	0.070	3.872	0.000	0.272	0.122	0.397	yes
H9	GF -> FB	2.378	0.300	0.053	8.037	0.000	0.423	0.328	0.534	NO
H2	OFK -> CID	3.673	0.041	0.054	3.673	0.000	0.199	0.091	0.303	yes
H4	OFK -> FB	3.435	0.069	0.051	4.823	0.000	0.244	0.143	0.341	yes
H3	SFK -	2.821	0.101	0.048	5.671	0.000	0.274	0.181	0.370	yes

	> CID									
H5	SFK -> FB	2.689	0.049	0.051	3.520	0.000	0.181	0.078	0.279	yes
H6(a)	GF x SFK -> CID	2.572	0.022	0.046	2.237	0.025	0.103	0.024	0.205	yes
H6(b)	GF x SFK -> FB	2.425	0.061	0.050	3.230	0.001	0.161	0.045	0.242	yes
H7(a)	GF x OFK -> CID	3.208	0.052	0.033	4.523	0.000	-0.150	-0.220	-0.090	yes
H7(b)	GF x OFK -> FB	2.803	0.144	0.040	5.724	0.000	-0.228	-0.290	-0.133	yes

Note: CID -Cryptocurrency Investment decision; FB -Financial Behavior; GF-Gamification; OFK – Objective financial knowledge; SFK -Subjective financial knowledge.
Source(s): Authors' Calculation

3.7.3 Measurement mode Fitness

The measurement model was evaluated with Smart PLS4.0. Numerous prominent fitness indices, including the Normed Fit Index (NFI) or Bentler and Bonett Index, the squared Euclidean distance (d UlS), the geodesic distance (d G), the standardised root mean residual (SRMR), and the Chi-square test, were used to assess the predictive model. The fit requirements for these indices are, as per the recommendations of several scholars (Bentler and Bonett, 1980; Lohmöller, 1989; Dijkstra and Henseler, 2015;Henseler et al., 2014). values of SRMR < 0.10, d_ULS>0.05, and d_G>0.05 are considered to be well-fit, whereas the NFI returns values between 0 and 1. NFI values closer to 1 indicate a more optimal fit. model showed satisfactory model fitness with values of SRMS = 0.070 (p < 0.10), d ULS = 1.700, d G = 0.863, and NFI = 0.749,, as illustrated in table 8.

Table 8 Model fit indices

Particular	Estimated model
SRMR	0.070
d_ULS	1.700
d_G	0.863
Chi-square	1968.809
NFI	0.756

Source(s): Authors' Calculations

3.7.4 Out-of-sample predictive relevance

The investigation used the PLSpredict approach to examine the out-of-sample predictive significance of crucial dependent variables, notably cryptocurrencyinvestment decisions,and personal financial behaviour(Danks and Ray, 2018,Shmueli et al., 2019). As depicted in Table 9, all Q^2 values were found to be greater than zero, signifying predictive validity.

Given the study's symmetrical prediction error distribution, the root mean squared errors for the PLS-SEM model (hypothesised model) were compared to benchmarks from a linear model (LM). Certain root mean squared error (RMSE) values for PLS were lower than those for the linear model (LM). This suggests a modest amount of predictive accuracy for both Cryptocurrencyinvestment decisions and individual financial behaviour.

Table 9 PLS predicts results

Particular	Q^2predict	PLS-SEM_RMSE	LM_RMSE	Predictive power
CID1	0.454	0.810	0.771	Moderate predictive power
CID2	0.457	0.660	0.622	
CID3	0.520	0.626	0.625	
CID4	0.503	0.700	0.684	
CID5	0.589	0.620	0.628	
CID6	0.008	1.092	1.106	
CID7	0.013	0.905	0.915	
FB1	0.478	0.654	0.623	Moderate predictive power
FB2	0.323	0.789	0.781	
FB3	0.556	0.568	0.604	
FB4	0.442	0.696	0.716	
FB5	0.572	0.646	0.599	

Source(s): Authors' Calculations

Note(s): LM – Linear Model Benchmarks; PLS – Partial Least Square; RMSE – Root Mean Squared Error

3.7.5 Conditional effects

The conditional effect was analyzed and tested using a bootstrapping function with a process-based partial least square approach (PLS-Process) in SMART PLS 4.1.0 Software(Ringle et al., 2024).Figure 3(a, b, c, d)and Table10provide the conditional effect of gamification. Although it shows that at all levelsGamification positively and significantly moderated the relationshipbetween financial literacy (OFK and SFK), Financial behavior, and Cryptocurrency investment decision except for three levels i.e.

SFK -> FB conditional on GF at -1 SD, OFK -> CID conditional on GF at +1 SD and OFK -> FB conditional on GF at +1 SD. the effect of gamification was stronger at a low level in moderating effect in between OFkand financial behavior (low: β= 0.444, CI(0.309, 0.551)) as compared to a high level which shows non-significance (high: β =0.015, CI (-0.100, 0.152) of gamification. We will come back to these findings in the discussion and implications section.

Figure 3(a) GF's moderating influence on CID-SFK relationship

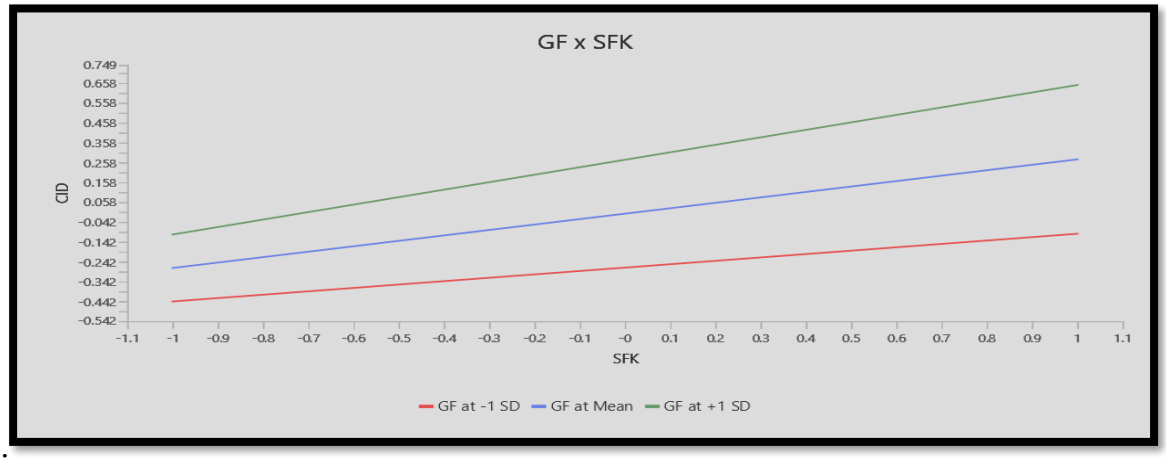


Figure 3(b) GF's moderating influence on FB-SFK relationship

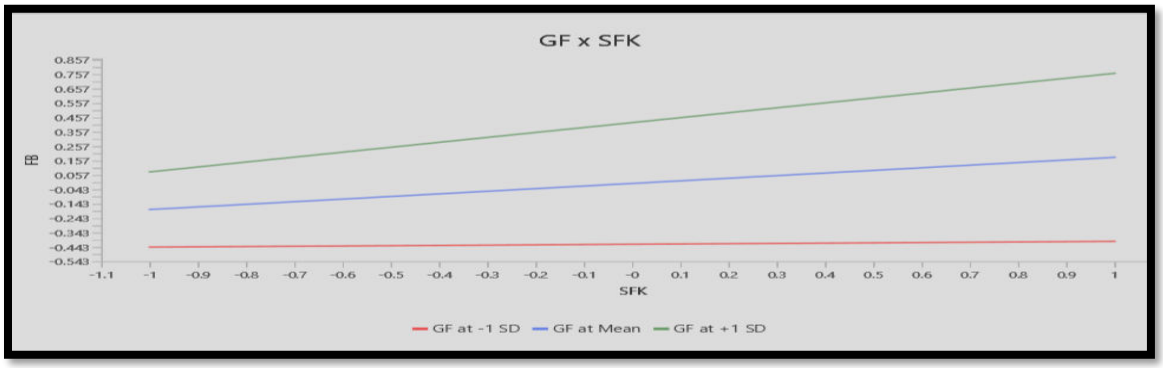


Figure 3 (C) GF's moderating influence on CID-OFK relationship

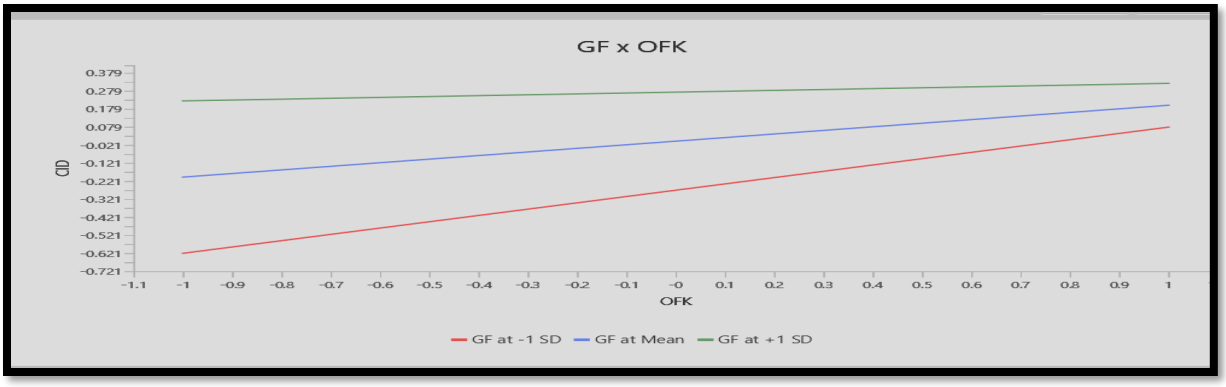


Figure 3(d) GF's moderating influence on FB-OFK relationship

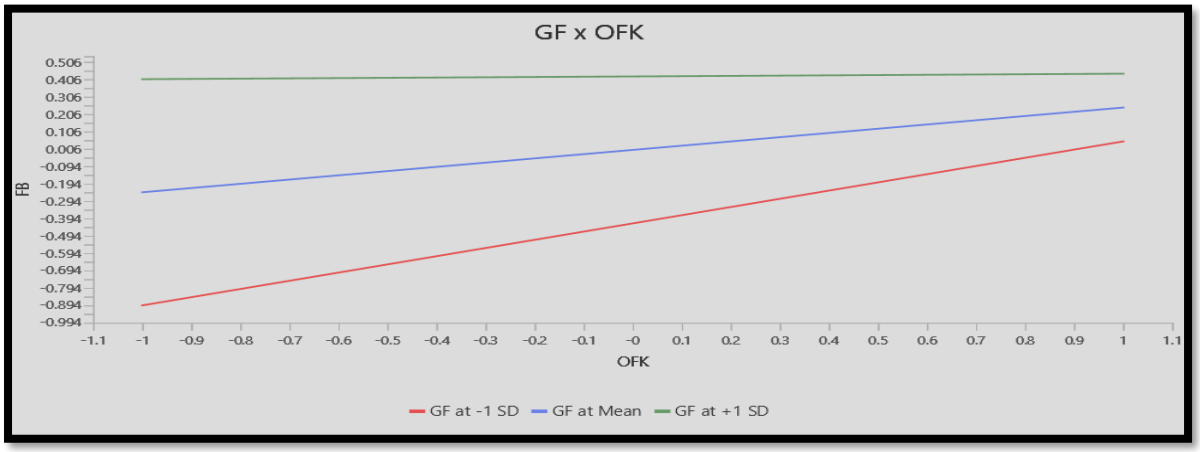


Table 10 Conditional Direct Effect

Particular	Original sample (O)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
OFK -> CID conditional on GF at -1 SD	0.248	0.062	4.030	0.000
SFK -> CID conditional on GF at -1 SD	0.147	0.055	2.685	0.007
OFK -> FB conditional on GF at -1 SD	0.444	0.062	7.105	0.000
SFK -> FB conditional on GF at -1 SD	0.020	0.055	0.365	0.715
OFK -> CID conditional on GF at Mean	0.136	0.052	2.617	0.009
SFK -> CID conditional on GF at Mean	0.218	0.037	5.924	0.000
OFK -> FB conditional on GF at	0.229	0.048	4.737	0.000

Mean				
SFK -> FB conditional on GF at Mean	0.149	0.044	3.393	0.001
OFK -> CID conditional on GF at +1 SD	0.024	0.077	0.311	0.756
SFK -> CID conditional on GF at +1 SD	0.288	0.063	4.560	0.000
OFK -> FB conditional on GF at +1 SD	0.015	0.064	0.233	0.816
SFK -> FB conditional on GF at +1 SD	0.278	0.070	3.974	0.000

NOTE: Conditional effect of gamification on the relationship between OFK, SFK, FB, and CID

Source:- Authors Calculation

4.Discussion and Conclusion

This study emphasises that GF tends to greatly attenuate the influence of OFK and SFK on the FB and CID of individuals. Using a rigorous literature review, we aim to better understand the behavior of crypto investors and the effects of gamification.We conduct a thorough examination of the literature concerning investor behavior in cryptocurrency markets by reviewing existing research. Our investigation involved querying the Scopus database for the years 2011 to 2021, mplementing a filter and using VOSviewer software to carefully evaluate the present corpus of knowledge in this topic.

In the Indian context, the results emphasize that the main factors influencing behavioral finance are strong financial literacy provided by educators and shared among students, available market courses, and the use of gamification techniques to meet literacy demands. Another notable finding is the role of research and publications in raising awareness and making contributions to both society and academia.Results also reveal that both OFK andSFK influence the investment choices of investors when selecting investment-related products.Thus, to promote enduring investor growth, there is an urgent need to make essential adjustments to the factors influencing financial behavior. The results also indicate that gamification acts as a bridging factor in fostering sustainable investment in the crypto market.

This research was the first to explore how financial knowledge and trading experience impact cryptocurrency investment decisions.After going through a systematic literature review we classified financial knowledge into two categories SFK and Second OFK(Lusardi and Mitchell, 2007). This study utilizes survey data to enhance the literature by illustrating that both SFK and OFKpositively influence cryptocurrency ownership. Notably, OFK has a more substantial effect on cryptocurrency investment behavior

compared to SFK. This suggests that individuals with greater expertise in the financial market are more likely to invest in cryptocurrencies. In cryptocurrency than those who believe more in ideas, principles, and instruments. The role of gamification in interacting with SFK and CID is significant. This work adds to the literature by providing comprehensive implications for researchers, policymakers, financial institutions, and finance specialists in India. Only SFK was found to be positively linked with investing in cryptocurrencies after accounting for the conditional effect of gamification. The correlation between SFK and cryptocurrency ownership was considerable, while the conditional effect of gamification was not as strong. The study found that SFK is more relevant than OFK in predicting CID . The findings are congruent with those of Zhao and Zhang (2021).

Cryptocurrency investors are more likely to be young adults than other individual investors in the sample.Furthermore, this study discovered that age was inversely associated with cryptocurrency investing.The findings suggest that the primary drivers of cryptocurrency investment in India today are younger individuals., especially those between the ages of 18 and 34. Young people's increased exposure to and familiarity with blockchain technology, together with their increased interest in engaging in cutting-edge technology-based financial products, may be contributing factors to these occurrences.
Additionally, older individual investors are more cautious about new investment products. They prefer to continue with their current investment patterns and invest in products they are comfortable with.This study found that GF in financial apps can significantly moderate the impact of SFK on individuals' CID and FB, which has not been extensively studied. However, the findings show that GF in financial applications has little moderating effect on the effects of OFK on people's FB and CID.

5 Practical Implications

Financial institutions and policymakers may find this study to be helpful. Individuals' financial behavior may be greatly improved by gamification in the personal finance space. This is particularly significant in developing nations with poor levels of financial literacy, such as India, where gamification might be tremendously helpful in helping the vast majority of individual saves and investors enhance their financial behaviour and, as a consequence, their overall financial health. This study advises managers about how GF may promote money-saving behaviour and what features their apps should include. Thus, financial educators and advisors are encouraged to give cryptocurrency investors with deep information about crypto assets and assist them in appropriately assessing their comprehension to avoid underconfidence and self-assurance.

Policymakers may utilize this information to develop successful laws and regulations that promote responsible investment. Researchers and academics can use this study to gain a deeper understanding of the behavior of individual investors in the cryptocurrency sector, allowing them to create more accurate models with gamification aspects for forecasting market movements and providing investment advice. Market regulators can learn from the study how gamification techniques—like avatars and badges in financial apps—can enhance investor decision-making and create a safer atmosphere. This can assist in helping stabilise the market and reduce risks for those who invest in cryptocurrency over time, while also establishing cryptocurrency as a legitimate financial tool.

6.Theoretical Implication

Our comprehension of actual investor behavior and practical market procedures has increased thanks to behavioral finance, and major advancements are anticipated in the field going forward. As a consequence, this research contributes to the theoretical contributions in the field of behavioural finance and its frameworks, which include the effect of gamification on financial behaviour, by expanding our comprehension of the behaviour of investors when gamification modifies the significance of financial literacy in the cryptocurrency space.

7.Limitation

There are certain limitations to the current investigation. It is not possible to extrapolate the findings from the current sample size and demographic to the entire population. Additionally, a person's Facebook profile is impacted by a range of other criteria, including the financial literacy of their spouse and several family members, friends from school, college, or the workplace, as well as social and demographic aspects that the current study did not consider. Due to dataset limitations, the sample only includes participants with investments outside of their retirement funds. As a result, there is a risk of sampling bias. Additionally, we could not differentiate between direct and mediated cryptocurrency investments

Research might also look into how gamification in personal finance can encourage early cryptocurrency investment and improve financial health. Researchers may also investigate the application of gamification to improve and protect the financial health of individual investors.

References

- Abreu, M. and Mendes, V. (2010), "Financial literacy and portfolio diversification", Quantitative Finance, Vol. 10 No. 5, pp. 515-528.
- Abdeldayem, M.M. (2016), "Is there a relationship between financial literacy and investment decisions in the kingdom of Bahrain?", Journal of Management and Accounting Studies, Vol. 4 No. 2, pp. 68-78.
- Abubakar, M., Hassan, M.K. and Haruna, M.A. (2019), "Cryptocurrency tide and Islamic finance development: any issue?", Disruptive Innovation in Business and Finance in the Digital World, Emerald Publishing Limited.
- Akhtar, F. and Das, N. (2019), "Predictors of investment intention in Indian stock markets: extending the theory of planned behavior", International Journal of Bank Marketing, Vol. 37 No. 1, pp. 97-119,
- Alba, J.W. and Hutchinson, J.W. (2000), "Knowledge calibration: what consumers know and what they think they know", Journal of Consumer Research, Vol. 27 No. 2, pp. 123-156,
- Allgood, S. and Walstad, W.B. (2016), "The effects of perceived and actual financial literacy on financial behaviors", Economic Inquiry, Vol. 54 No. 1, pp. 675-697,
- Al-Dhanhani, A., Mizouni, R., Otrok, H. and Al-Rubaie, A. (2014), "A game theoretical model for collaborative groups in social applications", Expert Systems with Applications, Vol. 41 No. 11, pp. 5056-5065,
- Bannier, C.E. and Neubert, M. (2016), "Gender differences in financial risk taking: the role of financial literacy and risk tolerance", Economics Letters, No. 145, pp. 130-135.
- Baptista, G. and Oliveira, T. (2015), "Why so serious? Gamification impact in the acceptance of mobile banking services", Internet Research, Vol. 27 No. 1, pp. 118-139
- Baptista, G. and Oliveira, T. (2019), "Gamification and serious games: a literature meta-analysis and integrative model", Computers in Human Behavior, Vol. 92, pp. 306-315.
- Bayuk, J. and Altobello, S.A. (2019), "Can gamification improve financial behavior? The moderating role of app expertise", International Journal of Bank Marketing,
- Bentler, P. M., & Bonett, D. G. (1980). Significance Tests and Goodness-of-Fit in the Analysis of Covariance Structures, Psychological Bulletin, 88: 588-600.
- Briner, R.B., Denyer, D., 2012. Systematic review and evidence synthesis as a practice and scholarship tool. In: Handbook of Evidence-Based Management: Companies, Classrooms and Research. pp. 112–129,
- Burke, B. (2012a), "Gamification 2020: what is the future of gamification?" Gartner, November, pp. 1-10, available at: www.gartner.com (accessed 20 April 2014).
- Chin, W.W., Thatcher, J.B. and Wright, R.T. (2012), "Assessing common method bias: problems with the ULMC technique", MISQuarterly, pp. 1003-1019.

- Ciaian, P., Rajcaniova, M. and Kancs, D.A. (2016), "The digital agenda of virtual currencies: can
- Cryptocurrency become a global currency?", Information Systems and E-Business Management, Vol. 14 No. 4, pp. 883-919.
- Chu, Z., Wang, Z., Xiao, J.J. and Zhang, W. (2017), "Financial literacy, portfolio choice, and financial well-being", Social Indicators Research, Vol. 132 No. 2, pp. 799-820
- Chen, C.Y., Härdle, W.K., Hou, A.J. and Wang, W. (2018), "Pricing cryptocurrency options: the case of Crix", IRTG 1792 [Discussion Paper 2018-004]
- Conway, J.M. and Lance, C.E. (2010), "What reviewers should expect from authors regarding common method bias in organizational research", Journal of Business and Psychology, Vol. 25 No. 3, pp. 325-334.
- Danks, N.P. and Ray, S. (2018), "Chapter 3 predictions from partial least squares models", in ApplyingPartial Least Squares in Tourism and Hospitality Research, Emerald Publishing.
- Delfabbro, P., King, D.L. and Williams, J. (2021), "The psychology of cryptocurrency trading: risk and protective factors", Journal of Behavioral Addictions, Vol. 10 No. 2, pp. 201-207.
- Dijkstra, T. K. and Henseler, J. (2015). Consistent and Asymptotically Normal PLS Estimators for Linear Structural Equations, Computational Statistics & Data Analysis, 81(1): 10-23.
- Fonseca, V., Pacheco, L. and Lob~ao, J. (2020), "Psychological barriers in the cryptocurrency market", Review of Behavioral Finance, Vol. 12 No. 2, pp. 151-169.
- Frankenfield,J.(2019) , "Cryptocurrency". [Online] Available at: www.investopedia.com
- Fornell, C. and Larcker, D. F. (1981), "Structural equation models with unobservable variables and measurement error", algebra and statistics.
- Guiso, L. and Jappelli, T. (2008), "Financial literacy and portfolio choice", Working Papers, EUI, ECO2008/31.
- Gupta, S. and Shrivastava, M. (2022), "Herding and loss aversion in stock markets: mediating role of fear of missing out (FOMO) in retail investors", International Journal of Emerging Markets, Vol. 17 No. 7, pp. 1720-1737.
- Gaudecker, H.M.V. (2015), "How does household portfolio diversification vary with financial literacy and financial advice?", The Journal of Finance, Vol. 70 No. 2, pp. 489-507.
- Ghasemy, M., Teeroovengadum, V., Becker, J.-M. and Ringle, C.M. (2020), "This fast car can move faster: a review of PLS-SEM application in higher education research", Higher Education,Vol. 80 No. 6.
- Henager, R. and Cude, B.J. (2016), "Financial literacy and long-and short-term financial behavior in different age groups", Journal of Financial Counseling and Planning, Vol. 27 No. 1, pp. 3-19.

- Hairudin, A., Sifat, I.M., Mohamad, A. and Yusof, Y. (2022), "Cryptocurrencies: a survey on acceptance, governance and market dynamics", International Journal of Finance and Economics, Vol. 27 No. 4, pp. 4633-4659.
- Hiltbrand, T. and Burke, M. (2011), "How gamification will change business intelligence", Business Intelligence Journal, Vol. 16, (INL/JOU-11-21248)
- Hair, J.F., Ringle, C.M. and Sarstedt, M. (2019), "PLS-SEM: indeed a silver bullet", Journal of Marketing Theory and Practice, Vol. 19 No. 2, pp. 139-152.
- Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E. (2010), Multivariate Data Analysis, 7th ed., Prentice Hall, NJ.
- Henseler, J., Ringle, C.M. and Sinkovics, R.R. (2009), "The use of partial least squares path modeling in international marketing", Advances in International Marketing, Vol. 20 No. 2009, pp. 277-319.
- lam, l. w. (2012). impact of competitiveness on salespeople's commitment and performance. journal of business research, 65(9), 1328-1334."
- Jappelli, T. and Padula, M. (2013), "Investment in financial literacy and saving decisions", Journal of Banking and Finance, Vol. 37 No. 8, pp. 2779-2792.
- Karlan, D., Ratan, A.L. and Zinman, J. (2014), "Savings by and for the poor: a research review and agenda", Review of Income and Wealth, Vol. 60 No. 1, pp. 36-78.
- Keshavdev, V. (2022), "The best crypto bets in 2022", Fortune India, available at: www.fortuneindia.com
- Koivisto, J. and Hamari, J. (2019), "The rise of motivational information systems: a review of gamification research", International Journal of Information Management, Vol. 45, pp. 191-210.
- Krische, S.D. (2019), "Investment experience, financial literacy, and investment-related judgments", Contemporary Accounting Research, Vol. 36 No. 3, pp. 1634-1668.
- Kim, J. T and Lee, W. H. (2015), " Dynamical model for gamification of learning (DMGL)" Multimedia Tools and Applications, Vol 74 No. 19, pp 8483-8493.
- Landerretche, O.M. and Mart_inez, C. (2013), "Voluntary savings, financial behavior, and pension finance literacy: evidence from Chile", Journal of Pension Economics and Finance, Vol. 12 No. 3, pp. 251-297.
- Li, Y., Zheng, Z. and Dai, H. (2020), "Enhancing cryptocurrency price fluctuation prediction using attentive LSTM and embedding network", Applied Sciences, Vol. 10 No. 14, Article 4872.
- Lusardi, A. and Mitchell, O.S. (2007), "Baby boomer retirement security: the roles of planning, financial literacy, and housing wealth", Journal of Monetary Economics, Vol. 54 No. 1, pp. 205-224.
- Lusardi, A. and Mitchell, O.S. (2014), "The economic importance of financial literacy: theory and evidence", Journal of Economic Literature, Vol. 52 No. 1, pp. 5-44.

- Lusardi, A. and Tufano, P. (2015), "Debt literacy, financial experiences, and overindebtedness",Journal of Pension Economics and Finance, Vol. 14 No. 4, pp. 332-368.
- Liao, L., Xiao, J.J., Zhang, W. and Zhou, C. (2017), "Financial literacy and risky asset holdings: evidence from China", Accounting and Finance, Vol. 57 No. 5, pp. 1383-1415.
- Lohmöller, J.-B. (1989). Latent Variable Path Modeling with Partial Least Squares, Physica: Heidelberg.
- MacKenzie, S.B. and Podsakoff, P.M. (2012), "Common method bias in marketing: causes, mechanisms, and procedural remedies", Journal of Retailing, Vol. 88 No. 4, pp. 542-555.
- Maria, M.D. (2016), "Profiting from Cryptocurrencies, How to Profit from Cryptocurrency & Other Cryptocurrencies in Just 20 Mins a Day", The LunchTime Trader.
- Maynard, N. and McGlazer, M. (2017), "The gamification effect: using fun to build financial security", COMMONWEALTH,
- Munnukka, J., Uusitalo, O. and Koivisto, V.J. (2017), "The consequences of perceived risk and objective knowledge for consumers' investment behavior", Journal of Financial Services Marketing, Vol. 22 No. 4, pp. 150-160.
- Mikhaylov, A. (2020), "Cryptocurrency market analysis from the open innovation perspective",Journal of Open Innovation: Technology, Market, and Complexity, Vol. 6 No. 4, 197.
- Mosteanu, N.R. and Faccia, A. (2020), "Digital systems and new challenges of financial management– FinTech, XBRL, blockchain and cryptocurrencies", Quality-Access to Success Journal, Vol. 21 No. 174, pp. 159-166.
- Mokni, K., Bouteska, A. and Nakhli, M.S. (2022), "Investor sentiment and Cryptocurrency relationship: a quantile-based analysis", The North American Journal of Economics and Finance, Vol. 60.
- Nakamoto, S. (2008), "Bitcoin: A Peer-to-Peer Electronic Cash System. White Paper". bitcoin.org
- Palys, T. (2008). Purposive sampling. In L. M. Given (Ed..), The sage encyclopedia of qualitative research methods.
- Park, H.J. and Bae,J. H. (2014), "Study and research of gamification design" International Journal of Software Engineering and Its Applications, Vol. 8 No 8. Pp. 19-28.
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71.
- Paul, J., & Benito, G. R. (2018). A review of research on outward foreign direct investment

- from emerging countries, including China: What do we know, how do we know, and where should we be heading? Asia Pacific Business Review, Vol24 No. 1,pp 90–115.
- Riitsalu, L. and Murakas, R. (2019), "Subjective financial knowledge, prudent behavior and income: the predictors of financial well-being in Estonia", International Journal of Bank Marketing, Vol. 37 No. 4, pp. 934-950,
- Ringle, C.M., Wende, S. and Becker, J.-M. (2024), SmartPLS 3, SmartPLS, B€onningstedt.
- Sahi, S.K. and Arora, A.P. (2012), "Individual investor biases: a segmentation analysis", Qualitative Research in Financial Markets, Vol. 4 No. 1, pp. 6-25,
- Saari, U.A., Damberg, S., Fr€ombling, L. and Ringle, C.M. (2021), "Sustainable consumption behavior of Europeans: the influence of environmental knowledge and risk perception on environmental concern and behavioral intention", Ecological Economics, Vol. 189,
- Sedgwick, P. (2014). Cross-sectional studies: Advantages and disadvantages. BMJ, 348(mar262), 2276– 2276.
- Shmueli, G., Sarstedt, M., Hair, J.F., Cheah, J.-H., Ting, H., Vaithilingam, S. and Ringle, C.M. (2019),"Predictive model assessment in PLS-SEM: guidelines for using PLSpredict", European Journalof Marketing, Vol. 53 No. 11, pp. 2322-2347.
- Stango, V. and Zinman, J. (2009b), "What do consumers really pay on their checking and credit card accounts? Explicit, implicit, and avoidable costs", American Economic Review, Vol. 99 No. 2,pp. 424-429.
- Subramaniam, S. and Chakraborty, M. (2020), "Investor attention and cryptocurrency returns: evidence from quantile causality approach", Journal of Behavioral Finance, Vol. 21 No. 1, pp. 103-115.
- Sayinzoga, A., Bulte, E.H. and Lensink, R. (2016), "Financial literacy and financial behaviour: experimental evidence from rural Rwanda", The Economic Journal, Vol. 126 No. 594, pp. 1571-1599.
- Sood,K.,Pathak,P., Jain,J. and Gupta,S.(2023), "Gauging investors' investment decisions in the crypto market through the PRISM of behavioral biases: a fuzzy AHP approach" International Journal of Emerging.
- Stromback, C., Lind, T., Skagerlund, K., Va¨ stfja¨ ll, D. and Tingho¨g, G. (2017), "Does self-control predict financial behavior and financial well-being?", Journal of Behavioral and Experimental Finance, Vol. 14, pp. 30-38.
- Tang, N. and Baker, A. (2016), "Self-esteem, financial knowledge and financial behavior", Journal of Economic Psychology, No. 54, pp. 164-176,
- Thomas, A. and Spataro, L. (2018), "Financial literacy, human capital and stock market participation in Europe", Journal of Family and Economic Issues, Vol. 39 No. 4, pp. 532-550.

- Van Rooij, M., Lusardi, A. and Alessie, R. (2011), "Financial literacy and stock market participation", Journal of Financial Economics, Vol. 101 No. 2, pp. 449-472,
- Venkatesh, V., Thong, J.Y. and Xu, X. (2012), "Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology", MIS Quarterly, Vol. 36 No. 1, pp. 157-178.
- Wanick, V., and Bui, H. (2019), "Gamification in management: a systematic review and research directions", International Journal of Serious Games, Vol. 6 No. 2, pp. 57-74.
- Warmelink, H., Koivisto, J., Mayer, I., Vesa, M. and Hamari, J. (2020), "Gamification of production and logistics operations: status quo and future directions", Journal of Business Research, Vol. 106, pp. 331-340.
- Washburn, B.D. (2017), "Gamification: a new tool for improving performance" Healthcare Financial Management, Vol. 71 No. 8, pp 46-52.
- Wanick, V., and Bui, H. (2019), "Gamification in management: a systematic review and research directions", International Journal of Serious Games, Vol. 6 No. 2, pp. 57-74.
- Yao, R. and Xu, Y. (2015), "Chinese urban households' security market participation: does investment knowledge and having a long-term plan help?", Journal of Family and Economic Issues, Vol. 36No. 3, pp. 328-339,
- Yoong, J. (2011), "Financial illiteracy and stock market participation: evidence from the RAND American Life Panel", Financial Literacy: Implications for Retirement Security and the Financial Marketplace, Vol. 76, p. 39.
- Yuan, P., Xiong, X., Lei, L., & Zheng, K. (2018). Design and Implementation on Hyperledger-based Emission Trading System. IEEE 2018, 1-8.
- Zichermann, G. and Linder, J. (2013), "The Gamification Revolution", McGraw-Hill, New York, NY, pp. 1-235.
- Zhao, H. and Zhang, L. (2020), "Talking money at home: the value of family financial socialization", International Journal of Bank Marketing, Vol. 38 No. 7, pp. 1617-1634.