แบบจำลองการกระตุ้นโดยใช้เกมมิฟิเคชันกับปัญหาทางการเงิน

Gamification Stimulus Model (GSM): Financial Issue

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บทคัดย่อ

บทความนี้เป็นการทบทวนวรรณกรรมที่เกี่ยวข้องกับปัจจัยในการลงทุนและเกมมิฟิเคชัน โดยมีวัตถุประสงค์เพื่อค้นหาและแสดงตัวอย่างเกี่ยวกับแนวคิดของเกมมิฟิเคชันในแง่ของการกระตุ้นพฤติกรรม จากการทบทวนพบว่าองค์ประกอบของเกมมิฟิเคชันจะแตกต่างกันไปตามกลไกของแต่ละเกม และยังพบว่าแนวคิดเกมมิฟิเคชันสามารถเป็นเครื่องมือในการกระตุ้นและเป็นกลยุทธ์ในการเปลี่ยนแปลงพฤติกรรมได้ ดังนั้นแอปพลิเคชันเกมมิฟิเคชันจะต้องใช้เทคโนโลยีที่ขับเคลื่อนด้วยเกมมิฟิเคชันเอง แบบจำลองที่นำเสนอนี้ประยุกต์จากคุณลักษณะที่สำคัญของความรู้เกี่ยวกับการเงินในประเทศไทย กิจกรรมในเกมสามารถมีอิทธิพลต่อพฤติกรรมของผู้เล่นผ่านการฝึกฝนเพื่อให้เกิดความเชี่ยวชาญ และการจัดระเบียบเป้าหมายทางการเงิน การศึกษาครั้งนี้เป็นการออกแบบ แบบจำลองการกระตุ้นด้วยเกมที่มุ่งเน้นไปที่การโน้มน้าวพฤติกรรมของผู้เล่น โดยพฤติกรรมจะมีอิทธิพลมาจากความรู้สึกว่าสามารถทำงานสำเร็จ เกิดแรงจูงใจและแรงจูงใจที่ได้รับจะขับเคลื่อนจากความรู้ ความเข้าใจทางการเงิน ทั้งนี้ความรู้ความเข้าใจเป็นการกระทำเชิงจิตวิทยา เป็นกระบวนการของการรับความรู้และความเข้าใจผ่านความคิดจากประสบการณ์และความรู้สึก ข้อมูลในงานวิจัยที่ได้นี้ช่วยให้เกิดความเข้าใจว่าพฤติกรรมในการทำกิจกรรมในเกมมีอิทธิพลต่อพฤติกรรมของผู้เล่นผ่านการมีส่วนร่วมในกิจกรรมจากข้อเสนอแนะและประสบการณ์ทางการเงินที่ได้รับ

Abstract

This paper presented a review of investment factor and gamification. The objective aims to illustrate and explore the conceptual gamification model in terms of stimulus behavior. This review shows that gamified elements vary according to each game mechanic. The finding shows gamification concept can be a tool for stimulus and strategy for change behavior. Thus, gamified application requires a technology-driven of gamification itself. The model is applied from the crucial characteristics of financial literacy in Thailand. The gamified activities can influence behavior through the mastery of tasks and organizing financial goals. This study designs the Gamification Stimulus Model (GSM) that focused on the persuasive behavior. The behavior influences from the sense of achievement. The achievements are stimulated

from motivation that drive by the cognition. Th cognition defines as the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses. The data have provided a better understanding as to how in-gamify activities that influence a player's behavior through engagement in and mastering activities and learning from the feedback and financial experience.

1. Introduction

With the recent technology advances, communication networks and new skills of the new generation, there is a need to adapt driven methodologies to make games much more interactive and attractive in order to motivate people's attention in terms of behavior changing. With an increasingly progress of digital technology that widely affects many industries, both products and services have to be changed along the period. Nowadays, there are many ongoing application software developments released on portable devices to enhance engagement and interactivity between user and software [1][2]. Human and computer interaction is playing an important role, such as learning by doing which therefore provide valuable experience as a gamification while we are in the learning phase. For instance, gamification may encourage positive financial literacy practices in Thailand.

However, the research background indicates that gamification can help people to change their behavior by using persuasive, usable technology and the motivation for engagement. There is the limitation of gamification researches in Thailand. Although, gamification activities could be designed by using new technology to offer free choices for autonomy, rewards and feedback, and the outcomes can be measured during the activities. They are lack of the way to design how people are stimulated from new technologies.

Thailand is a crisis of financial issue such as the literacy. Financial literacy is the education and understanding how money is made, spent and saved. The skills are the ability to use financial resources to make decisions. The concept of financial literacy decisions includes how to generate, invest, spend, and save money. There is growing evidence that individuals who possess higher financial literacy have better economic outcomes as it improves financial decision making [3].

Current providers of financial education in Thailand are small in scale, and target students and/or potential users of formal financial products [4]. Surveys on financial literacy in Thailand revealed that, on the whole, the overall score for

financial literacy is broken down into the three main components, i.e., financial knowledge, behavior, and attitude [5]. The survey also found that areas with fewer financial transactions typically have lower financial literacy scores [4]. Financial literacy can be supported by technology for life-long learning. Thais also know that budgeting can help people to keep track of how much money they can spend by using educational game technology [4].

This research aims to determine the gamification workflow which encourages people to conduct their lives using advanced technology and how the activities can stimulate the behavior that focuses on the financial issue. Then, the awareness in the literacy will use for influencing a persuasive behavior gamification design.

2. Background

2.1 Gamification

Gamification is defined as the use of game elements and game mechanics in a non-game environment to improve and emerge as an innovative and effective solution [6]. It is about applying game-based thinking through both intrinsic and extrinsic motivation in which participation and the fun factor are essential [7]. For instance, points, objectives, levels, rankings, missions, challenges, notifications, and obstacles. Thus, gamification consists of game elements, game design, and non-game context leverages the intrinsic human motivations to keep gathering rewards and learning through play [8]. This paper outlines and reviews the possibility and framework literature involving the study of gamification being applied to mutual fund investment. The systematic review affords materials to shape a list of recommendations for the application of gamification in investment areas, regarding the enhancing engagement and motivational aspects, such as increasing users' satisfaction, increasing users' knowledge, and commitment of stakeholders.

Many gamified applications have been applied across various domain especially serious games, such as education [8][9], health [41][11], marketing [6][43], business [1] [6][13], society [14][15], and sports. Nike+ uses gamification as personal fitness trainer and weight loss program and location-based application Foursquare uses rewards and promotion as digital solution in business area [16]. Most applications incorporate gamification concept such as educational games [8][9], hotel loyalty program [6], frequent flyer program [17], login rewards system, and resource conservation campaign.

2.2 Gamification Mechanics

According to game-design elements (see in Table 1) consist of dynamics, mechanics and components that are all incorporated each other.

They generate the user engagement and encourage user's enjoyment and curiosity. For example, ranking can be more competitive among user and other users. It is impossible to use all gamified elements within one gamified module, therefore before applying, it should be considered and figure out what goals is aimed to achieve [7]. Furthermore, it should be care about creating an experience that user can feel engagement with service or product, motivate them to learn, and feel gamified experience.

Table 1 Game-design elements [2]

Dynamics	Mechanics	Components
Constraints	Challenges	Achievements
Emotions	Chances	Avatars
Narrative	Competition	Badges
Progression	Cooperation	Collections
Relationship	Feedback	Unlockable contents
	Resource	Leaderboards
	Rewards	Dashboards
	Turns	Levels/Tiers/Difficulty
	Win-Lose status	Points/Scores
	Exchange	Virtual Goods

Gamification brings benefits to users. These benefits include, but are not limited to, reducing stress, maintaining an active lifestyle [18], and regular planning activities which may be behavior change agents [18], and regular planning activities which may be behavior change agents. The agents are technologies that are used to assist individuals in achieving goals, including helping them to self-monitor behaviors and encouraging commitment. Gamification is one such technology that employs rewards, competition, social comparison, goal setting, challenge, self-monitoring, feedback, and entertainment to promote certain behavior [20]. Users can develop activity plans and continuous feedback and suggestions are provided on how to achieve goals, monitor behaviors and obtain rewards for the achievement of the set goals [18].

1) Reward : Gamification combines two motivations using extrinsic rewards such as levels, points, badges to improve engagement, and striving to raise feelings of achieving mastery, autonomy, sense of belonging [21], as intrinsic rewards. Motivation has been employed by both persuasive and gamified system designers, and reward is the most frequently used [18]. Motivation is demonstrated by an individual's choice to engage in an activity and the intensity of effort or persistence in that activity [22].

The efficacy of persuasive technologies, like gamification in financial literacy, relies on the human potential to do better and foster their intrinsic motivation to seek a better quality of life [18]. While the goal is to create and maintain intrinsic motivation, gamification is the application of extrinsic motivators [23].

2) Goal: Achievement goal orientation is a general motivation theory that refers to the fact that the type of goal toward which a person is working has a tremendous impact on how they pursue the goal. Designing a good model of a mastery-oriented by goal setting, learner can do in learning environments [24]. In order to evaluate whether a game goal or sub-goal has been achieved, some kinds of cognitive processing need to occur [25]. Users can achieve goals, monitor behaviors and obtain rewards for the positive achievement.

2.3 Gamification Workflow

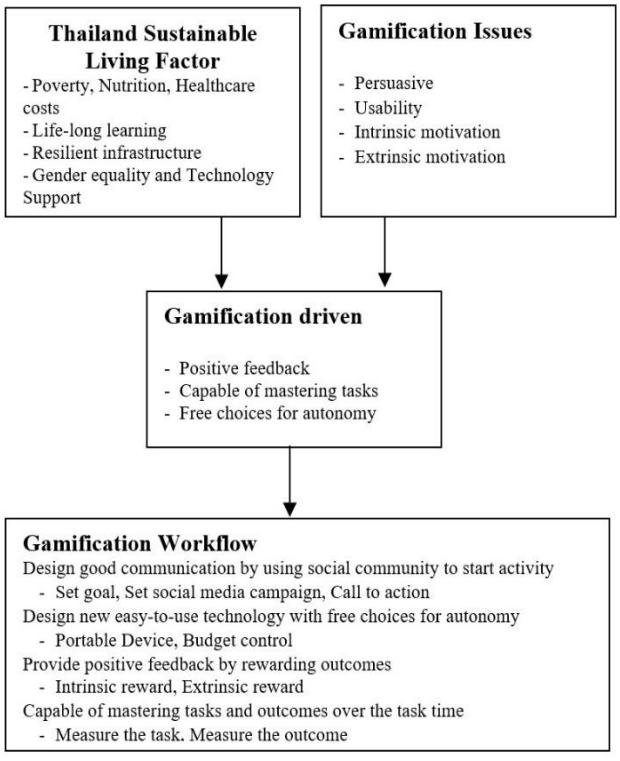

Figure 1 The design process of gamification for sustainable society [26].

One of the main issues in mutual fund application, however, is engagement with and commitment to start investment. In such a situation, gamification can be applied in order to enhance motivation through intrinsic rewards and feedback. However, there is not yet any clear application of gamification. From this review, it is possible to spot possibilities regarding the gamification in several type of elements. For example, knowledge-based system tends to focus on self-learning and self-training in order to improve and understand the concept of mutual fund. There is a focus on simplicity, positive rewards and positive outcomes. This indicates that the system might require an implementation of gamification which denotes as user-centred design to get the gamification driven: positive feedback, capable of mastering tasks, free choices for autonomy, and good communication [15].

The workflow can apply to the GSM model in terms of the gamification driven that stimulates the motivation. The stimulus is positive feedback, capable of mastering tasks and free choices for autonomy.

3. The Interaction of Cognitive Stimulus

The study examines the functionally specific effects of motivational states on cognition and behavior. People need to achieve many

subsidiary goals, including affiliation, self-protection, status, mate acquisition, and mate retention [27]. Allocation of cognitive resources should be especially selective when self-protection goals are aroused. Fundamental motives have effects across a wide range of cognitive and behavioral domains, with important implications of real-world significance. Thus, an understanding of evolutionarily fundamental human motives (and their consequences) is not only of substantial theoretical interest but also of potentially profound practical importance [27][1].

Some research addresses the behavior that involves the joint control of external stimuli, internal cognition and goals [29]. The cognitive processes are direct trigger to behavior. A stimulus is assumed to have a certain strength of tendency to produce the response. Stimuli played a central role in triggering fixed action patterns.

Gamification claims as a stimulus tools for engaging activity. Engaging learners during game play is delivered by achievable challenges and experiences within the game [30]. Challenges must support player skill development and mastery. According to Loveless [31], engagement relies on players having the ability to acknowledge risk and uncertainty within challenges. Games should be sufficiently challenging and match the player's perceived skill level [32][33].

Motivation can modulate the efficacy which stimuli are able to elicit behavior. The efficacy stimuli depend upon such internal factors [29].

The core elements in gamified to designing for persuasive behavior leverage called Self-Determination Theory [34], which provides a mature and empirically validated approach to examining factors that promote sustained motivation. SDT identifies a small set of basic psychological needs deemed essential to people's self [35], that could be foster the behavior. Behavior is also a function of cognitive processes. As a cognitive process, goal can evoke such behavior [29]. Certain stimuli evoke orientation [36].

These basic needs are:

- Autonomy (feeling agency, acting in accordance with one's goals and values),
- Competence (feeling able and effective),
- Relatedness (feeling connected to others, a sense of belonging) [35].

Due to technological evolution and the advent of mobile computing, it has become increasingly challenging to engage people in their environment, gain their attention and involve them in some activities [37]. Game design principles to change behavior in non-gaming contexts can

increase engagement. Then, the application of game-design principles in order to change behaviors in non-game situations [38] is examined.

The active engagement of financial literacy could influence the quantity of motivation through enjoyable activities. To what extent does the technology improve psychological need satisfaction with respect to the behavior that the technology is intended to support? (e.g. financial).

4. The Financial Factors of Gamification

The potential impact of gamification can be used to encourage investment. Many relevant applications use gamification concept to enhance incentive and provide knowledge in financial and economics terminology. The gamified application must be able to demonstrate the potential reward as well as the risks of investing. For example, allowing potential investors to understand about investing through gaming processes rather than overwhelming them with technical requirements and complexity [14]. Especially amongst young people, it must be simple and relatable to the main point. Once they feel comfortable and satisfied, they can be open-minded to learn new things smoothly [8].

In the sense of investment, there is no application which simulates the investment situation refer to GAC - Government Application Center. Most of them provide only one-sided information for investment such as trends of investment, guides for investment, sharing center, etc. For example, investing.com gives the user about stocks, bond, and debenture based on the economic world calendar function. eToro social trading has been the sharing center for investors that are seeking for techniques, portfolios, and guidelines.

Table 2 Game mechanics and elements

Games	Mechanics	Elements
ChartGame.com	Challenges Chances (Randomization)	Achievements Dashboard
Tradeaminute.com	Challenges Feedback	Achievements Dashboard
FuteBank	Challenge Competition Feedback	Avatars Achievements Badges Leaderboard Dashboard Points/Scores
Bull ranger	Resource Win states Rewards	Unlockable contents Leaderboards Levels/Tiers/ Difficulty Points/Scores

By the way, some of them have tried to combine with gamified elements and set up a game for the interested user. Stock trading is famous for simulating the situation. Table 2 shows the game elements which are included in this

stock trading game. ChartGame.com uses the mechanics of randomization trading graph and modifying challenges by given initial budget. This game reveals feedback by virtual cash detail and profit-loss percentage on the dashboard. Tradeaminute.com simulates the stock trading by providing an initial budget, and users can try to make the decision by themselves or follow the mentor suggestion in the game. The game will collect the record and proceed to make portfolios which indicate the transactions between game period. The Business application called FuteBank is mutual funds portfolio management using an animated model of a football league. The relationship between a football team with a portfolio investment funds and the positions of the players on the field are the gamification approach that are assigned for users with mutual funds in their portfolio with the main objective to transform a complicated process of choosing, selecting and funds, in a simple way [7]. Furthermore, Bull ranger is also a fun game which provides knowledge of the technical word in investment and economics domains for rookie players. Interests, capital gain, and dividend are included as game elements which are calculated for point or score. This research aims to seek the gamification approach for simulating and demonstrating the investment situation for gamified application.

Some researches address the way of gamification in terms of financial. Gamified application has a positive impact on the acceptance in financial technology. The positive technology bases on the ease of use, enjoyment and usefulness [7]. The gamification can be powerful experiences, leveraging both motivation and engagement. The recent trend toward “gamifying” applications depends on the complexity of a well-designed and balanced game down to its simplest components, such as badges, levels, points, and leader boards [21] to generate both a technical toolset and a set of best practices for implementing successful gamified experiences in educational contexts [30], such as the financial literacy.

5. The Investment Factors of Gamification for Mutual Fund Investment

In this paper we have analyzed gamification in investment contexts in terms of how the gamification has been implemented and what kind of possibilities it has been expected to lead to. The findings of the analyses indicate that the gamification studies in the context of investment strongly considers with the general research on gamification with regards to enhance engagement and provide perceptions of investment. The findings can be analyzed into 3

parts: investment factors, gamified experience,

and gamification mechanics.

Table 3 The investment factors of gamification for mutual fund investment [39]

Factors	Contexts	Game Design
Capital/ Initial budget	Mutual Funds are designed for every individual investor and money management, even for small investors who invest low amounts [18]. It is a strong predictor of attitudes toward users to start and have intention with related services. It should be set for any user to make the developing investment skills.	Provide the initial budget depending on the risk and investment unit
Type of Funds	Mutual funds varieties are categorized on the base of investment objective, structure, and schemes. The investment objective mutual funds can be equity or growth funds, fixed income funds or debt mutual funds, tax saving mutual funds, money market or liquid funds, balanced funds, gilt funds, exchange-traded funds (ETFs) [18].	Provide knowledge of each type of fund and structure or strategy for earning revenue.
Risk	The rate of risk can be implied as the rate of profit or loss at the same time [41]. Generally, when the rate of risk increases, the potential return also increases. It is an indicator and strong motivative factors in order to convince new investors. The mutual fund has the level of risk with their own risk depending on the objectives of the fund.	Survey the user behavior and objectives to assess the risk and investment unit
Mindset	There are many different facets and investment mindsets which primarily consider beforehand. Mutual fund is just to collect money from investors, sometimes these kinds of investors intend to do by taking all responsibility to fund manager. Some people can consider about the budget, and in the light of those people want to learn invest systematically to have a plentiful retirement and be financially independent. Therefore, people can have their own mind set before using application and we can design various types of game depending on the user's objective and mindset.	Survey the behavior and objectives to design suitable game situation that reach achievement.

Table 4 The gamified experience for mutual fund investment

Experiences	Contexts	Game Design
Simplicity/ Accessibility	The diversification has also increased in terms of the existing gamified elements are being incorporated and transferred into the virtual environments [1]. Human and computer interaction being part of a game. The development of the application software and hardware industry has been supported by such as portability, accessibility, and convenience (simplicity).	User interface should be friendly and reliable. Moreover, it should be implemented on portable devices or supported technology platform to satisfy user's experience.
Motivation, Incentive, and Engagement	Motivation and engagement can be varied in different aspects. In terms of education [9], engagement may be considered as the 'behavioral intensity and emotional quality of a person's active involvement during a task'. In term of uses, we can define perceived enjoyment for users such as challenge, variety, and interactivity [1]. Users look for positive feeling, and likely to seek for difficulty to maintain interesting. Application should increase the users' interest towards the game.	Gamification can motivate user by changing behavior and maintain engagement in terms of continuing use. For learning investment knowledge, users should feel attractive and be able to use their own skills varied on the challenges.
Persuasive	Persuasive technologies can be used for enhancing a user's behavior and decision without forcing the change [42]. they have various aims: some want people to lose weight based on fitness trainer software, others are designed to promote energy efficiency through neighborhood peer pressure based on smart home applications [12].	Games are the dominant choice for simulating investment situation, and we also express investment in sense of fun game rather than serious game.

6. Gamification and Financial Literacy

6.1 The conceptual framework of Gamified activities

The gamified activities can influence behavior through the mastery of tasks and organizing financial goals.

The design process of gamification driven for the financial literacy. The design workflow will be implemented in different contexts. The workflow designs to provide tasks that will help people trust the activities. This study examines gamification strategy by establishing a technology-driven trust relationship with players, and then determining the best way to encourage the players to set goals in terms of financial literacy. The results of this findings may encourage Thai people to change their behaviors

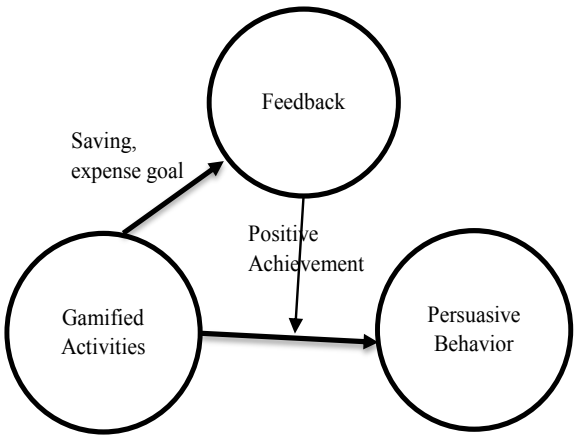

Figure 2 The conceptual framework of Gamified activities [44]

6.2 Methodology

The survey data will reveal the literacy factors for gamified design. The background research shows that positive feedback can help users to master tasks while playing. The research aims to identify the factors, design the activities and then test the conceptual methods. This methodology aims to identify the relationship between the feedback and mastering the task. The gamified tasks that players can achieve could be influenced by positive feedback to foster certain financial behavior.

6.3 Results

Data were collected through an on-line questionnaire during 1 – 15 May 2019, where there were 31 Thai respondents in total. Majority of the sample were female (93.5%). Their ages were between 19 and 65-years-old. 54.8 percent of the respondents had a bachelor's degree 32.3 percent had qualifications higher than a bachelor's degrees. Therefore, most of the respondents were well-educated. 29.0 percent of all the respondents had income less than THB 20,000, 16.1 percent had income of THB 40,001-50,000 monthly. 51.6 percent of all the respondents were full-time workers, 19.4 percent were students, 12.9 percent were self-employed, 9.7 percent were government staffs, and 6.5 percent were business owners.

There is a statistically significant association between the proportion of savings and expenses per month, the proportion of savings and the objective of financial planning, and the proportion of savings and satisfaction about investment knowledge.

Table 5 Pearson Chi-Square of Financial Factors

Source	Pearson Chi-Square		
	Value	*df*	*Asymp. Sig. (2-sided)*
Saving and Expense	25.419	15	.045
Asset * Sloan	110.110	76	.006
Expense * Sset	95.282	72	.035
Saving * Sloan	24.183	12	.019
Saving * SSet	21.823	12	.040
Rexpense * Splan	29.429	15	.014
Rexpense * Sset	31.384	20	.050
Rexpense * SindividualPlan	28.254	15	.020
SIndividualPlan * Splan	32.753	9	.000
N of Valid Cases	31		

The significance of financial literacy measures is positive implying that the higher the total amount of assets, the greater is the likelihood that an individual will acquire loan knowledge. There is a statistically significant association between the total amount of expenses per month and satisfaction about investment knowledge. The higher the proportion of expenses per month, the greater is the likelihood that participants will have

a financial plan, satisfaction about how to plan their finances, and investment knowledge. There is a statistically significant association between the total amount of expenses per month and satisfaction about investment knowledge.

Gamified activities will be designed to provide positive feedback by using a saving and expense activity. This positive feedback will persuade players to change their behavior in terms of financial literacy.

7. Gamification Stimulus Model (GSM)

From the research background, the Gamification Stimulus Model (GSM) is focused on the persuasive behavior. The behavior influences from the sense of achievement. The achievements are stimulated from motivation that drive by the cognition. Th cognition defines as the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses.

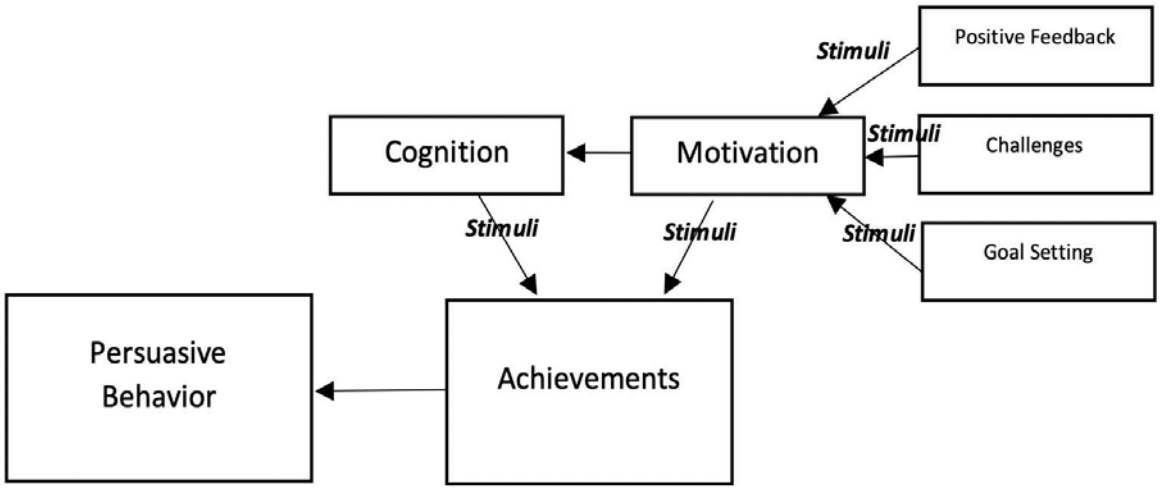

Figure 3 The Gamification Stimulus Model (GSM)

Gamification play a stimuli role that include a goal setting, challenges, and feedback activity.

This model shows the stimuli activities that provides by game mechanics. The GSM (Figure 3) illustrates the relationship between the game element and the sense of achievement. It is impossible to use all gamified elements, it should be considered and figure out what goals is aimed to achieve.

The technologies that are used to assist individuals in achieving goals, including helping them to self-monitor behaviors and encouraging commitment. Gamification employs rewards, competition, social comparison, goal setting, challenge, self-monitoring, feedback, and entertainment to promote certain behavior.

The game mechanics are designed as a stimuli tools that a good model of a mastery-oriented

by goal setting. In order to evaluate whether a game goal or sub-goal has been achieved, some kinds of cognitive processing need to occur.

Gamification can be applied in order to enhance motivation through intrinsic rewards and feedback. Clearly, this indicates that the system might require an implementation of gamification which denotes as user-centred design to get the gamification driven: positive feedback, capable of mastering tasks, and free choices for autonomy. The positive technology tools focuses on the ease of use, enjoyment and usefulness.

8. Conclusions and Discussion

This paper presented a review of investment factor and gamification that addressed issues regarding to financial issues with the aim to illustrate and explore the conceptual framework. This review shows that gamified elements vary according to each game mechanic. Most of the mechanics are utilized for engagement, education, motivation, monitoring, persuasion and productivity. They involve rewarding systems, points, time, leaderboards, clear goals, and badges.

Gamification can be a tool for stimulus and strategy for implementing gamified application. However, challenges might rise, particularly in terms of data analytics. As most of the applications acquired user data, there is a need for analysis of such data, including behaviors and investment factors. Thus, gamified application requires a technology-driven of gamification itself.

This study has presented a gamification model a stimulus tool with positive feedback. The model is applied from the crucial characteristics of financial literacy in Thailand. The gamified activities can influence behavior through the mastery of tasks and organizing financial goals. The data have provided a better understanding as to how in-gamify activities that influence a player's behavior through engagement in and mastering activities and learning from the feedback and experience.

In future works, the author will explore the outcome of the gamified design. The design model will guide game designers to produce activities that can change people's behavior and teach skills in regard to financial literacy. Furthermore, the proposed method will be applied and evaluated in the gamified development to support learning. For further research in this area, gamification involves fun, entertainment, engagement, learning and data-driven decision making, knowledge-based system, and big data analysis issues could be more studied, integrating not only all the financial areas but also all stakeholders involved in the process in a more engaging way and promoting innovative outcomes in the era of digital transformation.

References

[1] Anunpattana, P., Yusof, U. K., & Iida, H. "Analysis of Realm of Valor and Its Business Model on PC and Mobile Platform Comparison" Asia-Pacific Journal of Information Technology and Multimedia, 7(2–2), 2018.

[2] DeCos, L. “Opportunity for banks to utilize gamification as a tool to promote financial education to children”, 2015.

[3] Lusardi, A., & Mitchell, O. S. “The economic importance of financial literacy: Theory and evidence”, Journal of Economic Literature, 52, 5–44, 2014.

[4] Tambunlertchai, Kanittha “Financial inclusion, financial regulation, and financial education in Thailand”, ADBI Working Paper, No. 537, Asian Development Bank Institute (ADBI), 2015.

[5] Atkinson, A., & Messy, F.-A. “Measuring financial literacy”, 2012.

[6] Zuo, L., Rizani, N., Iida, H., & Xiong, S. “An Analysis of Points System of Hotel Loyalty Program Based on the Return on Investment”, Proceedings of 2018 International Conference on Electrical Engineering and Computer Science, ICECOS 2018, 357–360.

[7] Ryan, R. M., & Deci, E. L. “Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions”, Contemporary Educational Psychology, 25(1), 2000, 54–67.

[8] Ružic, I. M., & Dumancic, M. “Gamification in education”, Informatologia, 48(3–4), 2015, 198–204.

[9] Majuri, J., Koivisto, J., & Hamari, J. “Gamification of education and learning: A review of empirical literature”, CEUR Workshop Proceedings, 2186, May 2018, 11–19.

[10] Chen, Y., & Pu, P. “Healthy Together: Exploring social incentives for mobile fitness applications”, ACM International Conference Proceeding Series, April 2014, 25–34.

[11] Koivisto, J., & Hamari, J. “Demographic differences in perceived benefits from gamification”, Computers in Human Behavior, 35, 2014, 179–188.

[12] Hamari, J., & Koivisto, J. “Why do people use gamification services?”, International Journal of Information Management, 35(4), 2015, 419–431.

[13] Thavamuni, S., Ismail, H., & Iida, H. “An Analysis of Gamification on Dota 2’s Business Model”, Applied Mechanics and Materials, 892 August 2019, 55–63.

[14] Deterding, S., Dixon, D., Khaled, R., & Nacke, L. “From game design elements to gamefulness: Defining gamification”, Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments, MindTrek 2011, 9–15.

[15] Inchamnan, W. “Gamification design process for the aging society in Thailand”, Humanities and Social Sciences Reviews, 7(1), 2019, 47–54.

[16] Dale, S. “Gamification: Making work fun, or making fun of work?”, Business Information Review, 31(2), 2014, 82–90.

[17] Zuo, L., Xiong, S., Wang, Z., & Iida, H. “An Analysis of Gamification Effect of Frequent-Flyer Program”, June 2019, 53–60.

[18] Rodrigues, L. F., Costa, C. J., & Oliveira, A. “The adoption of gamification in e-banking”, In the Proceedings of the 2013 International Conference on Information Systems and Design of Communication, 2013.

[19] Kappen, D. L., & Orji, R. “Gamified and persuasive systems as behavior change agents

for health and wellness. XRDS: Crossroads", The ACM Magazine for Students, 24(1), 2017, 52-55.

[20] Orji, R., "Why are persuasive strategies effective? Exploring the strengths and weaknesses of socially- oriented persuasive strategies", In International Conference on Persuasive Technology, 2017, 253–266.

[21] Muntean, C. I. "Raising engagement in e-learning through gamification", Proceedings 6th International Conference on Virtual Learning ICVL, 2011, 323–329.

[22] Garris, R., Ahlers, R., & Driskell, J. E. "Games, motivation, and learning: A research and practice model", Simulation & gaming, 33(4), 2002, 441-467.

[23] Richter, G., Raban, D. R., & Rafaeli, S. "Studying Gamification: The Effect of Rewards and Incentives on Motivation", Gamification in Education and Business, 2015, 21-46.

[24] Svinicki, M., "Student goal orientation, motivation, and learning", Idea Paper No. 41. Manhattan, KS: Center for Faculty Evaluation and Development in Higher Education, Kansas State University, 2015.

[25] Norman, D.A. and S.W. Draper, "User centered system design", Hillsdale, NJ, 1986.

[26] Inchamnan, W. "Therapeutic Strategy in gamification and game based Learning for Elderly People in Thailand", Humanities & Social Sciences Reviews, 6(1), 2018, 44-52.

[27] Kenrick, D. T., Neuberg, S. L., Griskevicius, V., Becker, D. V., & Schaller, M., "Goal-driven cognition and functional behavior: The fundamental-motives framework", Current Directions in Psychological Science, 19(1), 2010, 63-67.

[28] Ackerman, J. M., & Kenrick, D. T. "The costs of benefits: Help-refusals highlight key trade-offs of social life", Personality and social psychology review, 12(2), 2008, 118-140.

[29] Toates, F., "The interaction of cognitive and stimulus–response processes in the control of behaviour", Neuroscience & Biobehavioral Reviews, 22(1), 1997, 59-83.

[30] McGinnis, T., et al., "Enhancing e-learning engagement using design patterns from computer games", Conference: First International Conference on Advances in Computer-Human Interaction, 2008.

[31] Loveless, A. "Literature review in creativity, new technologies and learning", 2002.

[32] Csikszentmihalyi, M. and I. Csikszentmihalyi, "Beyond boredom and anxiety: The experience of play in work and games", Jossey-Bass San Francisco, 1975.

[33] Scoresby, J. and B.E. Shelton, "Visual perspectives within educational computer games: effects on presence and flow within virtual immersive learning environments", Instructional Science. 39(3), 2011, 227-254.

[34] Deci, E. L., & Ryan, R. M. "Self-determination theory: A macrotheory of human motivation, development, and health", Canadian Psychology/Psychologie canadienne, 49(3), 2008, 182-185.

[35] Rigby, S. and Ryan, R., "Glued to Games: How Video Games Draw Us", In and Hold Us Spellbound. Praeger, 2011.

[36] Ö hman, A. “The orienting response, attention and learning: An information-processing perspective”, In: Kimmel, H.D.; van Olst, E.H.; Orlebeke, J.F., eds. The Orienting Reflex in Humans. Hillsdale: Lawrence Erlbaum; 1979, 443–471.

[37] Ribeiro, L. A., Silva T.L. da, and A. Q. Mussi., “Gamification: a methodology to motivate engagement and participation in a higher education environment”, International Journal of Education and Research Vol. 6 No. 2018.

[38] Robson, K., Plangger, K., Kietzmann, J.H., McCarthy, I., & Pitt, L., “Game on: Engaging customers and employees through gamification”, 2016.

[39] Inchamnan, W. and Anunpattana, P. “Gamification in Mutual Fund Knowledge-Based Systems”, 17th International Conference on ICT and Knowledge Engineering, 2019.

[40] Chennai. “Fundsindia.com launches gamification in mutual fund investing”, 2016. Retrieved September 13, 2019 from https://pages.fundsindia.com/pages/media/fundsindia-com-launches-gamification-in-mutual-fund-investing/

[41] Wanick, V., & Bui, H. “Gamification in Management: a systematic review and research directions”, International Journal of Serious Games, 6(2), 2019, 57–74.

[42] Spagnolli, A., Chittaro, L., & Gamberini, L. “9th International Conference on Persuasive Technology”, Proceedings, May 2014, 324.

[43] Hamari, J., Huotari, K., & Tolvanen, J. “Gamification and Economics”, The Gameful World, 2018.

[44] Inchamnan, W., Niranatlamphong, W. and Engbunmeesakul. N., “Gamification-Driven Process: Financial Literacy in Thailand”, 17th International Conference on ICT and Knowledge Engineering, 2019