Learning Finance through Play: Assessing Gamified Environments in Agricultural Board Game Education

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***Abstract*—This study investigates the effectiveness of gamified and non-gamified physical board games in promoting financial literacy among undergraduate agricultural students at Mae Fah Luang University. Using a quasi-experimental design, 96 participants were randomly assigned to either a gamified board game group, which incorporated points, leaderboards, and badges, or a non-gamified group with identical content but no gamification elements. Financial literacy was assessed through pre- and post-tests, while engagement was measured using the Social Presence in Gaming Questionnaire (SPGQ), and perceptions were collected through open-ended questionnaires. Results demonstrated that both groups achieved significant improvements in financial literacy, confirming the educational potential of board games. However, no significant differences were found in knowledge gains between the groups. In contrast, the gamified version produced higher behavioral engagement and more positive perceptions of motivation, enjoyment, and satisfaction. These findings suggest that board games provide an effective platform for financial literacy education, and gamification elements further enrich the learning experience by enhancing engagement and perceived value. The study contributes to the growing body of research on game-based learning and offers practical implications for integrating gamified strategies into agricultural and financial education.**

***Keywords*—financial literacy, gamification, board games, agricultural education, student engagement, social presence, experiential learning**

I. Introduction

The importance of financial literacy has increased, particularly for younger people. Projections indicate that as pension and social security systems shift internationally, people will bear more responsibility for their financial choices [1]. To make effective financial choices and obtain financial well-being, individuals are required to have the awareness, knowledge, abilities, viewpoints, and acts known as financial literacy [2]. The OECD broadens the notion of financial literacy to include young people's ability to overcome future obstacles and actively engage in economic activities [3]. Numerous financial difficulties and problems may arise from a lack of money management abilities [4]. Young people consistently demonstrate lower financial literacy levels than adults, regardless of its rising significance [5]. According to data from the Indonesian Central Bureau of Statistics, Generation Z, or those born between 1997 and 2012, made up the greatest proportion of the population in 2020 (27.94%) [6]. In a different survey, 68% of Generation Z reported using e-wallets. The habit is influenced by reasons including convenience and the use of credit/pay-later services [7]. Cashless modes of payment encourage 81% of Generation Z to engage in purchases on impulse, based on research by Rahadi *et al*. [8]. Angelica and Zen [9] found that Generation Z mostly accesses financial knowledge and guidance using platforms, such as Instagram (57%) and TikTok (52%). Furthermore, 75% follow financial influencers, 45% seek advice from unknowns, and 37% take suggestions without first verifying their accuracy. To address these issues, it is essential to implement and determine financial education programs for youths. The OECD (2020) suggests incorporating financial literacy into the curriculum of schools since early support enables a more complete approach to developing financial skills [10]. Youth is a period of major change regarding financial choices, especially risk and time preferences, according to a recent study. In contrast to their younger counterparts, older adolescents generally display higher levels of fear of risk along with greater forward-looking action [11]. These results highlight the significance of adapting financial literacy interventions to learners' developmental stages while guaranteeing the content aligns with their cognitive and social maturity [12].

Gaming is a well-recognized method of learning, and numerous studies have demonstrated the benefits of incorporating games into various disciplines [13]. Games have emerged as a highly effective tool for disseminating knowledge, with evidence showing increased student engagement and enjoyment [14]. Board games, in particular, have become a popular medium for fostering computational thinking, cooperation, and creativity [15]. Research also indicates that playing the Monopoly board game can enhance students' understanding of accounting fundamentals [16].

However, there is still a lack of studies exploring how board games can be used to enhance financial literacy. Moreover, although board games are widely acknowledged for their potential in interactive learning, empirical research comparing gamified and non-gamified environments of the same board game in the context of financial literacy among agricultural students remains limited. To address this gap, the present study aims to develop and evaluate a gamified physical board game for agricultural students at Mae Fah Luang University. The study examines both learning outcomes and levels of engagement by comparing students who play the board game in a gamified environment with those who play it in a non-gamified environment.

II. Related Work

A. Financial Literacy

Financial literacy is an important skill for entering the 21st century, encouraging people and promoting financial well-being [2]. Financial literacy impacts several parts of everyday living, including managing health insurance [17], retirement planning, and improving financial decision-making and budgeting skills. Financial literacy covers three elements: financial knowledge, attitude, and behavior. Financial knowledge includes technical abilities like comprehending interest calculations and fundamental financial mathematics. While financial behavior emphasizes financial preparation and making informed purchase decisions, financial attitude describes the tendency of people to save or spend. While financial behavior emphasizes financial preparation and making informed purchase decisions, financial attitude describes the tendency of people to save or spend [2]. People have to display the knowledge and abilities required to comprehend financial activities, including managing cash flow, managing credit, saving, loans, and investing, as well as the financial comprehension required to acquire, assess, and comprehend the data demanded for financial decision-making [18]. Financial self-belief, which includes financial viewpoint, perceived behavioral control, and financial self-efficacy, is essential for coping with daily financial pressures [19]. Financial capacity is an essential principle in developing financial literacy. It is an idea bigger than financial literacy, encompassing both the capacity and the possibility to act. People with financial capabilities have access to financial products and institutions, increasing their involvement in the industry of financial services [20]. Although the term "financial literacy" is widely acknowledged, there is a major gap in empirical measurement methods. Lusardi and her co-authors have demonstrated an influential method. This method connects financial literacy to an understanding of financial concepts [18]. In contrast, the OECD [21] has adopted an alternative method by involving attitudes, such as preparation or short-termism, and actions, like comparing other products [21].

B. Gamification-Driven Financial Learning

Recent research suggests that gamification, rather than digital financial behavior, provides a more relevant foundation for understanding how learners engage with classroom-based financial literacy activities. Gamification frameworks highlight that game elements such as challenges, rewards, feedback, and structured decision-making can enhance motivation and deepen learners' cognitive involvement when aligned with educational objectives [22, 23]. In financial literacy education, game-based approaches enable learners to explore budgeting, risk management, and investment concepts in safe, simulated environments, facilitating active knowledge construction and reflective decision-making. Empirical reviews further show that well-designed gamification improves engagement, persistence, and learning satisfaction across educational contexts [24]. These principles directly informed the design of the board game used in this study: Natural Disaster cards provide challenge and uncertainty, Investment cards promote strategic financial choices, and Knowledge Cards deliver immediate feedback that reinforces conceptual understanding. By grounding these mechanics in established gamification and learning theories, the intervention emphasizes experiential, meaningful learning pathways rather than digital financial behavior.

C. Gamification in Education and Financial Literacy

Incorporating game elements and technologies into non-gaming environments is known as "gamification" in education. As technology advances, gamification has been employed increasingly in a few online learning settings [25]. Both education and gamification work well together, and both require constant motivation and involvement during the gamification stage [26]. Gamification can enhance the motivation, involvement, and satisfaction of learning activities since every game includes a feature that improves the sense of anticipation and competitiveness required to achieve certain objectives [27]. Game features like leaderboards, challenges, points, or feedback have been utilized to accomplish this [28]. As a result, it has been demonstrated that games may effectively increase students' enthusiasm for studying. Game simulations demonstrate students' use of critical thinking in resolving challenging challenges by helping them comprehend how abstract ideas may be applied in the actual world [29]. The best learning settings include games and simulations, which provide students frequent interactions with feedback and enable learners to experience mistakes that are seen as opportunities for learning [30].

Research on the effects of gamification on financial behavior, learning, and design of systems has grown in the field of finance. Gamification can assist individuals in adopting educated choices about money and achieving long-term goals by combining learning with enjoyment. Gamification can improve the performance, entertainment, and involvement of personal financial education by including elements like competition, awards, progression, and interaction [31]. Games can imitate actual-life financial issues, such as debt management, investing, budgeting, and retirement planning. Anyone can gain insight from the errors they make in these safe virtual environments without having to suffer the consequences in actual life. Gamification allows for real-time feedback on user decisions and actions. In in-game notifications, rankings, or assessments of performance, players get instant feedback on their spending habits, assisting in their understanding of the results of the decisions they make. Several studies adopt gamification to teach financial literacy to students or users, as shown in Table 1.

Several gamified platforms have been developed to support financial literacy, each offering distinct advantages through different formats and mechanics. Board-game systems such as Mind Your Money, Life, and Monopoly [31] allow learners to practice saving, spending, and investing across life scenarios, providing the advantage of a tangible, risk-free environment for understanding long-term financial consequences. Mobile applications like MOneyQU [32] enhance personal financial management through challenges, leaderboards, and badges, offering real-time feedback that sustains user engagement. Simulation-based platforms such

as Bursa Marketplace [30] replicate real-time stock-market dynamics, giving learners the advantage of authentic investment practice without financial risk. Other gamified applications, including Givling [33] and Long Game [34], use rewards, prizes, and virtual economies to motivate consistent participation and promote saving behaviors. Collectively, these platforms demonstrate how gamification can improve financial literacy by increasing motivation, providing feedback, and enabling safe experimentation with financial decisions.

D. Board Games

Board games, according to the Oxford online dictionary, involve moving counters or items across a pre-marked board. They differ from electronic games in that they need physical contact [35]. Most board games have made the switch to digital platforms, combining modern developments with classic gameplay. According to earlier studies, board games are very useful teaching resources for a range of disciplines. They establish accessible environments that accommodate various learning preferences, such as kinesthetic, visual, and auditory learners, who learn from the engaging and social elements of the game mechanics [36]. Games have the potential to render complicated disciplines like engineering, economics, and science more accessible as well as interesting, leading to improved conceptual comprehension and favorable attitudes toward learning [15]. Board games assist students in improving their concentration and ability to focus throughout learning [37]. Martín-Lara and Calero stated [38] that using a board game to educate on biomass and biofuel greatly improved the learners' interest and motivation, created a positive learning atmosphere, and improved their social skills such as collaboration and communication. According to studies [39, 40], board games enhance learning outcomes, which is consistent with research demonstrating that social interaction has a favorable influence on learning outcomes [41]. Digital board games have the potential to use computational approaches to improve gameplay and acquire strategic insights [42]. For instance, an algorithm is capable of automating game advancement by organizing resources, calculating points, and verifying winning requirements. AI players can utilize computing resources and archive data from prior games for competition [43]. Based on a perspective of computer science, representation methods and data structures for players, game states, actions, and rules are important because they make it possible to employ algorithmic techniques and gather data that would not be possible in real-world board games [44].

III. Research Questions and Hypotheses

The study aims to develop and analyze a physical board game for promoting financial literacy among agricultural students at Mae Fah Luang University. Specifically, the study compares two learning environments: a physical board game in a non-gamified environment, and a physical board game in a gamified environment enhanced with leaderboards, badges, and point systems. The research investigates the effectiveness of gamification in enhancing both academic outcomes and student engagement, recognizing gamification as a motivational tool that can influence learners' experiences and behaviors. The following research questions and hypotheses guide the study:

RQ1: How effective is the gamified physical board game in improving financial literacy among agricultural students compared to the non-gamified version?

RQ2: What differences emerge in student engagement between the gamified and non-gamified versions of the physical board game?

RQ3: How do agricultural students perceive and experience learning financial literacy through gamified and non-gamified physical board games?

These research questions highlight the importance of understanding how game-based approaches can support the teaching of financial literacy. Insights from this study can help instructors and curriculum developers identify how gamification elements embedded in physical games shape learning experiences, motivation, and social interaction. Such knowledge is essential for designing effective learning environments that maximize the educational potential of game-based activities.

H1. Gamified physical board games enhance students' financial literacy acquisition more than non-gamified versions by integrating structured game elements (leaderboards, badges, points) that align with learners' skills and preferences.

H2. Playing the gamified version of the physical board game increases student engagement more than playing the non-gamified version, as the game elements foster motivation, enjoyment, and satisfaction in the learning process.

H3. Students in the gamified board game group perceive the learning of financial literacy as more engaging, competitive, and motivating compared to the non-gamified group, due to the inclusion of game mechanics that heighten excitement and goal achievement.

IV. Research Methodology

This study analyzed the effects of gamified and non-gamified physical board games on agricultural students' financial literacy acquisition, engagement, and satisfaction at Mae Fah Luang University using a quasi-experimental research method [45]. Quasi-experimental designs are particularly suitable for educational settings because they allow systematic comparison of groups while addressing the practical and ethical constraints of real-world learning environments [46]. A pre-test/post-test design was employed to assess changes in financial literacy knowledge, ensuring comparability between the gamified and non-gamified groups. The gamified board game incorporated leaderboards, points, and badges to enhance competition, motivation, and enjoyment, while the non-gamified board game maintained the same rules and financial literacy content but deliberately excluded these elements. By keeping the learning objectives and instructional content constant across both groups, any variations in outcomes could be attributed to the presence or absence of gamification mechanics rather than differences in subject matter.

A. Participants

The participants in this study were 96 undergraduate agricultural students from Mae Fah Luang University. They were recruited and randomly assigned into two groups: (1) a

physical board game in a non-gamified environment and (2) a physical board game in a gamified environment (Fig. 1).

Fig. 1. Comparison of the board game sessions: (Left) non-gamified environment and (Right) gamified environment. These settings illustrate the different conditions used in the experimental design.

B. Design of the Board Game for Financial Literacy

1) Game concept and learning objectives

The objective of Farmer's Finances is for players to build financial stability by carefully managing income, savings, and investments while responding to unpredictable risks. Each participant begins the game with an initial sum of money and advances around the board by rolling a die. As they progress, players encounter spaces that either reward them with additional resources or impose financial penalties. A central feature of the gameplay is the use of three categories of cards: Natural Disaster Cards, Investment Cards, and Knowledge Cards. Natural Disaster Cards simulate uncontrollable external shocks such as flooding or crop damage, requiring players to pay unexpected costs and underscoring the importance of having an emergency fund. Investment Cards provide opportunities to allocate resources into agricultural ventures or financial decisions, with the outcomes producing either profits or losses. Knowledge Cards test players' financial literacy through multiple-choice questions, rewarding correct answers with additional funds and thereby reinforcing the real value of financial knowledge in improving financial outcomes. The overall layout of the board and examples of card designs are illustrated in Fig. 2, which highlights how visual elements are integrated with the game's educational mechanics.

Fig. 2. Farmer's Finances game board, showing the front layout with movement paths and event spaces, and the back design used for branding. These components form the core visual structure of the board game used in the intervention.

In addition to the card system, the game board integrates spaces that create further variation and strategic choice. Certain positions offer opportunities to gain extra income or receive savings bonuses, while others result in penalties such as fines or the loss of a turn. These mechanics create a balance between chance and strategy, requiring players to adapt their decisions to both predictable and unpredictable events. In this way, Farmer's Finances replicates the realities of financial management, where success depends not only on making prudent choices but also on maintaining resilience when faced with uncertainty. Through this combination of structured decision-making and random events, the game provides an engaging and educational simulation of real-world financial challenges.

2) Integration of financial literacy content

The content of Farmer's Finances is explicitly aligned with the financial literacy needs of agricultural students. The game board and card system incorporate three major areas of financial learning. Natural disaster cards (Fig. 3) simulate external risks such as floods or heavy rainfall that damage crops, forcing players to incur unexpected costs. These cards illustrate the importance of emergency funds and risk management. The investment cards (Fig. 4) present opportunities for players to allocate resources into agricultural activities or assets, teaching students about evaluating risks, returns, and opportunity costs. Finally, the Knowledge Cards (Fig. 5) require players to answer financial literacy questions, reinforcing theoretical concepts such as saving percentages, interest calculations, or debt repayment strategies. Correct answers provide monetary rewards, thereby linking knowledge acquisition directly to tangible financial benefits.

Fig. 3. Example of Natural Disaster Cards showing the back design and a front-facing event description. These cards introduce unexpected financial setbacks that players must respond to during gameplay.

Fig. 4. Example of Investment Cards showing the back design and a front-facing investment scenario. These cards allow players to engage in opportunity evaluation and simulate financial gains or losses.

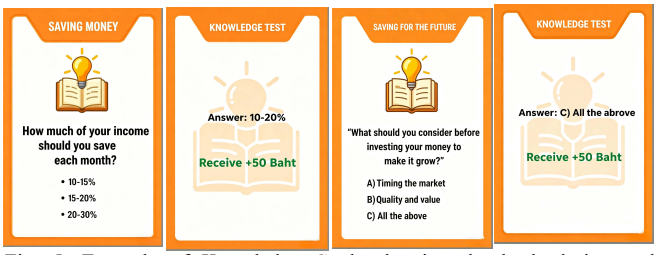

Fig. 5. Example of Knowledge Cards showing the back design and front-facing financial literacy questions. These cards provide immediate feedback and reinforce key financial concepts during gameplay.

By embedding these elements into the gameplay loop, students are consistently exposed to the financial trade-offs they are likely to face in real life. For example, players may gain short-term cash flow from an investment but face vulnerability to natural disasters if they lack sufficient reserves. Similarly, choosing to answer a Knowledge Card correctly not only rewards them with game currency but symbolically highlights the long-term benefits of financial

education. This integration ensures that the game content does not merely serve as entertainment but directly supports the development of financial literacy across cognitive, attitudinal, and behavioral dimensions.

3) Game design and game mechanics

The game design of Farmer's Finances is intended to help players build financial stability by carefully managing income, savings, and investments while responding to unpredictable risks. At the start of the game, each player receives an initial balance of 1000 baht. Players then take turns rolling a die to move around the board, encountering financial opportunities and challenges as they progress. A key rule of the game is that each time a player completes a full round of the board, they receive an additional 200 baht as income, simulating regular financial inflows. The ultimate goal is to be the first player to accumulate 3000 baht, at which point they are declared the winner. This winning condition reinforces the importance of long-term planning and consistent financial growth. The actual participation of students playing Farmer's Finances is shown in Fig. 6.

A central feature of gameplay is the use of three categories of cards: Natural Disaster Cards, Investment Cards, and Knowledge Cards. Natural Disaster Cards simulate uncontrollable external shocks such as flooding or crop damage, requiring players to pay unexpected costs and thereby underscoring the need for emergency funds. Investment Cards provide opportunities to allocate resources into agricultural ventures or financial decisions, with outcomes that can result in profits or losses, reflecting the risks and rewards of real investments. Knowledge Cards test players' financial literacy through multiple-choice questions, and the rewards depend on the difficulty of the question: easier questions provide smaller monetary gains, while harder questions yield larger rewards. This reward system was designed to create a clear link between financial knowledge and positive in-game outcomes, encouraging players to engage with more complex concepts. In addition to the card system, the board includes spaces that provide extra income, savings bonuses, or penalties such as fines and lost turns. These board elements, combined with the card mechanics, establish a cohesive balance between strategy and chance, requiring players to adapt their decisions to both predictable and unpredictable financial events.

Fig. 6. Students participating in the Farmer's Finances board game during classroom play sessions. This activity provided hands-on interaction with the game mechanics used in the intervention.

C. Instruments

1) Financial literacy measurement

Students' financial literacy acquisition was measured using a 30-question pre-test and post-test designed to evaluate the effectiveness of the board game in teaching financial literacy. The tests were developed by lecturers at Chiang Mai University and emphasized students' comprehension of agricultural financial knowledge, drawing on university-level materials. To ensure content validity and clarity, the instruments were reviewed and validated by subject matter experts, confirming their alignment with the intended learning goals. Reliability analysis indicated acceptable internal consistency, with a Cronbach's alpha coefficient of 0.72.

2) Social presence in gaming questionnaire

Students completed the Social Presence in Gaming Questionnaire (SPGQ) to assess their experiences within the board game learning environments. The instrument consists of 21 items measuring three key dimensions: empathy, negative feelings, and behavioral engagement. Responses were recorded on a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5) [47]. The SPGQ has been widely applied in gaming and educational contexts, providing reliable insights into the degree of social presence and affective engagement experienced by learners during gameplay.

3) Perception questionnaire survey

The study required students to fill out open-ended questionnaires on their opinions on and experiences with playing the game to acquire financial literacy in terms of its usefulness, happiness, and educational value. This allows us to better evaluate their learning experience and engagement, as well as optimize usability, content relevance, and game dynamics for future studies.

D. Procedure

The study was carried out in four stages, beginning with recruitment and preliminary evaluation. A total of 96 undergraduate agricultural students were recruited, and informed consent was obtained from all participants. To establish baseline knowledge, students completed a financial literacy pre-test administered via Google Forms. They were then introduced to the study's objectives and instructed on the rules and mechanics of the physical board game. A demonstration round was provided to both groups to ensure familiarity with the gameplay process and to maintain ethical transparency.

During the intervention stage, participants were randomly assigned to one of two conditions: the Gamified Physical Board Game Group (n = 48), which played a version of the board game incorporating points, leaderboards, and badges, and the Non-Gamified Physical Board Game Group (n = 48), which played the same board game without gamification elements. In the gamified group, participants could view the leaderboard either on their mobile phones or on a digital leaderboard displayed in the classroom, and after each round they were required to update their scores using their own mobile devices. Both groups played in separate classrooms to preserve controlled conditions and minimize cross-group influence. Participants engaged in multiple rounds of play during a two-hour session, after which they completed the SPGQ, the Perception Questionnaire, and a post-test on financial literacy. These instruments provided measures of knowledge acquisition, engagement, and perceptions of the

learning experience, enabling a comparative evaluation of the educational effects between gamified and non-gamified environments. The overall procedure is illustrated in Fig. 7.

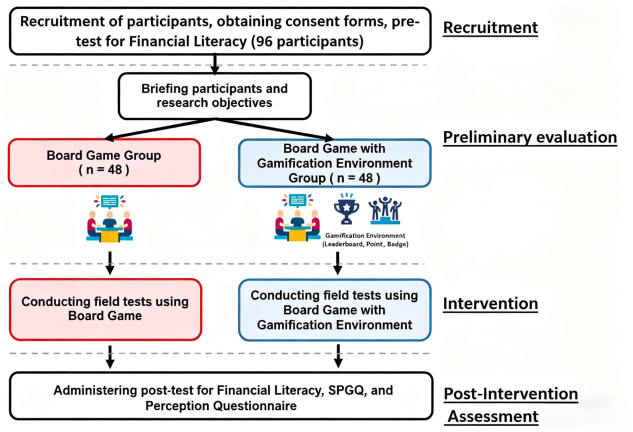

Fig. 7. Procedure of the study comparing gamified and non-gamified board games (n = 96).

V. Results

A. Financial Literacy Outcomes

The results of the paired t-tests indicated significant improvements in financial literacy for both groups from pre-test to post-test, as shown in Table 1. For the non-gamified board game group, the mean score increased from 6.66 (SD = 3.20) to 13.37 (SD = 5.07), with a large effect size ($t(47) = 9.83$, $p < 0.001$, $d = 1.42$). Similarly, the gamified board game group showed an increase from 6.89 (SD = 2.92) to 14.79 (SD = 5.79), also with a large effect size ($t(47) = 10.42$, $p < 0.001$, $d = 1.51$). These results demonstrate that both gamified and non-gamified versions of the physical board game were effective in enhancing students' financial literacy.

Table 1. Paired-samples t-test results for financial literacy pre–post scores

Group	Pre-test *M* (SD)	Post-test *M* (SD)	*t*(47)	*p*	Cohen's *d*
Non-gamified board game	6.66(3.20)	13.37(5.07)	9.83	< 0.001	1.42
Gamified board game	6.89(2.92)	14.79(5.79)	10.42	< 0.001	1.51

The results of the independent samples t-test revealed no statistically significant difference in financial literacy gains between the gamified and non-gamified groups, as shown in Table 2. The mean difference score for the non-gamified board game group was 6.70 (SD = 4.72), while the gamified board game group achieved a slightly higher mean difference of 7.89 (SD = 5.24). Although the gamified group showed a greater improvement in post-test scores, the difference was not significant ($t(94) = -1.17$, $p = 0.197$, $d = 0.24$), indicating a small effect size. These findings suggest that while both approaches effectively enhanced financial literacy, the addition of gamification elements (points, leaderboards, badges) did not provide a statistically significant advantage over the non-gamified version in terms of knowledge acquisition.

Table 2. Independent-samples t-test comparing learning gains between the gamified and non-gamified board game groups

Group	Mean difference (SD)	*N*	*t*(df)	*p*	Cohen's *d*
Non-gamified board game	6.70 (4.72)	48	$t(94) = -1.17$	0.197	0.24
Gamified board game	7.89 (5.24)	48			

B. Social Presence in Gaming Results

The results of the Social Presence in Gaming Questionnaire (SPGQ) revealed mixed outcomes across the three measured dimensions, as shown in Table 3. For empathy, no significant difference was observed between the non-gamified (M = 3.50, SD = 1.11) and gamified groups (M = 3.47, SD = 1.12), $t(94) = 0.09$, $p = 0.928$, $d = 0.02$, indicating comparable levels of empathetic interaction in both environments. Similarly, negative feelings did not differ significantly between the non-gamified (M = 3.29, SD = 1.11) and gamified groups (M = 3.43, SD = 1.07), $t(94) = -0.66$, $p = 0.514$, $d = 0.13$. However, a significant difference emerged in behavioral engagement, where students in the gamified board game environment (M = 3.70, SD = 0.87) reported higher levels of engagement compared to those in the non-gamified group (M = 3.22, SD = 0.92), $t(94) = -2.60$, $p = 0.011$, $d = 0.53$. These findings suggest that gamification elements such as points, leaderboards, and badges enhanced students' active participation and behavioral involvement, even though empathy and negative feelings remained unaffected.

Table 3. Independent-samples t-test results for SPGQ dimensions between gamified and non-gamified groups

Dimension	Non-gamified *M* (SD)	Gamified *M* (SD)	*t*(94)	*p*	Cohen's *d*
Empathy	3.50 (1.11)	3.47 (1.12)	0.09	0.928	0.02
Negative Feelings	3.29 (1.11)	3.43 (1.07)	−0.66	0.514	0.13
Behavioral Engagement	3.22 (0.92)	3.70 (0.87)	−2.60	0.011	0.53

C. Perception Questionnaire Results

The analysis of the perception questionnaire was conducted using a thematic summary approach, which identified four key sub-themes: Motivation and Engagement, Collaboration and Peer Interaction, Perceived Learning Value, and Enjoyment and Satisfaction. These themes reflect students' overall experiences and perceptions of playing the board game in both gamified and non-gamified environments.

Under the theme of Motivation and Engagement, students in the gamified group frequently reported that points, leaderboards, and badges enhanced their interest and encouraged active participation. They described the gamified environment as more competitive and exciting, which helped sustain their attention throughout gameplay. In contrast, students in the non-gamified group also found the activity engaging but attributed their motivation more to curiosity about the financial content than to competitive elements. The theme of Collaboration and Peer Interaction emerged strongly in both groups, with students noting that the board game format promoted discussion, cooperation, and knowledge sharing, thereby reinforcing comprehension

through peer learning.

The theme of Perceived Learning Value indicated that participants viewed the board game as an effective tool for understanding financial literacy concepts such as saving, investing, and risk management. Gamified group participants highlighted that the competitive structure encouraged them to be more attentive to financial decisions, while non-gamified participants appreciated the clarity and straightforwardness of the rules. Finally, the theme of Enjoyment and Satisfaction revealed that both groups described the experience as enjoyable and fun, although the gamified group more often connected their satisfaction to the rewarding nature of the game mechanics. Overall, these thematic findings suggest that while both board game versions were positively received, the gamified environment provided stronger motivational and engagement benefits, complementing the quantitative results observed in behavioral engagement.

VI. Discussion

A. Financial Literacy Outcomes

Regarding RQ1, the findings indicate that both the gamified and non-gamified board game groups showed significant improvements in financial literacy from pre-test to post-test. This suggests that the board game, regardless of the presence of gamification elements, was effective in enhancing students' financial literacy knowledge. However, the results also reveal that the gamified version did not produce a statistically significant advantage over the non-gamified version, indicating that the core mechanism of the board game itself may have been the primary factor driving knowledge acquisition.

These results are consistent with prior studies that highlight the effectiveness of board games as pedagogical tools for financial learning. Reisdorfer-Da-Silva *et al.* [12] reported that board games significantly improved financial knowledge, attitudes, and behavior among public-school students. Similarly, Shanklin and Ehlen [16] demonstrated that the Monopoly® board game enhanced students' understanding of accounting fundamentals in classroom contexts. More broadly, Cannistrà *et al.* [48] found that game-based financial education interventions produced measurable gains in financial literacy across multiple countries, while Sailer and Homner [49] confirmed through a meta-analysis that gamification can generate small but reliable improvements in cognitive learning outcomes. Taken together, these findings suggest that while gamification may strengthen engagement, the fundamental design of the board game itself plays a central role in improving financial literacy.

A likely explanation for the absence of additional financial literacy gains in the gamified group is a ceiling effect: both groups demonstrated substantial score increases, suggesting that the core board game itself provided strong instructional value, leaving limited room for gamification to generate further cognitive benefits. This pattern aligns with prior findings showing that when the primary learning activity is inherently effective, differences attributed to gamification may be statistically minimal [49]. Another plausible factor is the short duration of the intervention, as financial literacy concepts typically require repeated exposure and longer-term reinforcement, while gamification tends to influence motivation and attention more readily than deep conceptual learning, particularly within brief learning sessions. This interpretation corresponds with the SPGQ results, where the gamified group showed higher behavioral engagement despite comparable knowledge gains.

Cognitive load may also account for the similar knowledge outcomes between groups. Elements such as points, badges, and leaderboards can increase motivation but may simultaneously introduce additional stimuli that divert cognitive resources away from conceptual processing during gameplay. Combined, these interpretations position the findings within ongoing discussions about whether gamification primarily enhances engagement or directly improves learning outcomes. In this study, the results support the perspective that the board game itself served as the primary driver of financial literacy improvement, while gamification contributed mainly to heightened engagement rather than additional short-term cognitive gains.

B. Social Presence and Engagement

Regarding RQ2, the results from the Social Presence in Gaming Questionnaire (SPGQ) revealed that there were no significant differences between the gamified and non-gamified groups in terms of empathy or negative feelings. However, a significant difference was observed in behavioral engagement, with students in the gamified condition reporting higher levels of active participation compared to those in the non-gamified condition. This finding suggests that gamification elements such as points, leaderboards, and badges were particularly effective in fostering students' behavioral engagement, even though other dimensions of social presence remained unaffected.

These outcomes are consistent with prior research on gamification and engagement in educational settings. Xi and Hamari [14] found that gamification features are linked to intrinsic need satisfaction, particularly in terms of motivation and active involvement. Similarly, Cahyani [30] emphasized that gamification enhances student engagement in classroom learning by increasing participation and attentiveness. Gonçalves *et al.* [47] further confirmed in their systematic review that gamification fosters higher behavioral involvement in gaming contexts, although the effects on emotional and empathetic engagement are less consistent. Taken together, these results support the interpretation that gamification in board games is most effective in stimulating behavioral aspects of engagement, while its impact on affective and empathetic dimensions may be more limited.

One possible explanation for this pattern is that gamification primarily influences task-oriented behaviors rather than emotional responses. Gamification mechanisms such as points, badges, and leaderboards directly reinforce task-oriented actions tracking scores, competing with peers, and attempting to rank higher which naturally elevates measurable behavioral participation. In contrast, emotional dimensions such as empathy typically develop through prolonged social interaction or narrative-rich activities, neither of which were central to this short, mechanics-driven intervention. This suggests that while gamification can effectively shape how intensely students participate, it may not immediately influence their emotional or relational

experiences during gameplay.

These interpretations align with the broader literature indicating that gamification's strongest and most reliable effects occur in behavioral activation rather than affective engagement. Prior studies (e.g., Refs. [22, 49]) similarly report that participants often become more attentive, competitive, and motivated in gamified environments, yet show limited changes in emotional states or social presence. In the context of this study, the findings imply that gamification primarily served as a motivational amplifier prompting students to participate more actively while the core social and emotional dynamics of gameplay remained largely stable between conditions.

C. Perceptions of Learning Experience

Regarding RQ3, the thematic analysis of the perception questionnaire indicated that students in both the gamified and non-gamified groups viewed the board game as a valuable and enjoyable learning tool. Across groups, students highlighted that the game supported their understanding of financial literacy concepts and facilitated collaboration with peers. However, participants in the gamified group more frequently emphasized that elements such as points, leaderboards, and badges enhanced their motivation, created a sense of competition, and made the experience more interactive and rewarding. In contrast, students in the non-gamified group valued the clarity and straightforwardness of the gameplay, though they reported lower levels of excitement and competitiveness.

These findings are consistent with previous studies that have demonstrated how game-based approaches are perceived positively by learners. Martín-Lara and Calero [38] reported that board games promoted motivation, engagement, and a supportive learning atmosphere in bioenergy education. Alejandria *et al.* [39] and Hou *et al.* [40] similarly observed that board games enhanced students' perceptions of learning outcomes and promoted collaborative skills. In terms of gamification, Kaur *et al.* [31] showed that gamified financial literacy interventions improved students' perceived enjoyment and motivation to learn. Together, these studies support the conclusion that both gamified and non-gamified board games can be perceived as beneficial, but the inclusion of gamification elements tends to elevate students' motivation, satisfaction, and perceived learning value.

The differing perceptions between groups may stem from the distinct learning dynamics each version offered. In the gamified condition, performance cues—such as accumulating points or climbing the leaderboard—likely strengthened learners' sense of progress and achievement, reinforcing motivation and creating a more stimulating environment. These structural signals of improvement have been shown in prior literature to heighten learners' perceived enjoyment and drive. In contrast, students in the non-gamified group interacted with a simpler, more streamlined version of the game, which may have helped them concentrate on the financial concepts themselves but provided fewer motivational triggers.

This pattern aligns with broader evidence suggesting that gamification enhances the experiential and affective dimensions of learning more strongly than cognitive outcomes. Studies such as Hamari *et al.* [22] and Dicheva *et al.* [23] highlight that students often report greater enjoyment, satisfaction, and immersion when gamified elements are present, even when objective learning gains remain similar. In this study, both groups recognized the educational usefulness of the board game, but only the gamified group consistently associated the activity with heightened excitement and competitive energy. This indicates that gamification served primarily as a motivational enhancer, enriching learners' subjective experience while complementing the board game's underlying instructional value.

VII. Conclusion

This study demonstrated that both gamified and non-gamified physical board games effectively enhanced financial literacy among undergraduate agricultural students, confirming the value of game-based learning in higher education. Although the gamified and non-gamified groups achieved comparable gains in financial literacy, the gamified version fostered higher behavioral engagement and more positive perceptions of motivation, enjoyment, and satisfaction. These findings suggest that while the board game itself served as the primary vehicle for improving financial knowledge, gamification elements played a complementary role by strengthening students' involvement and sustaining their participation throughout the activity.

Despite these promising results, several limitations should be acknowledged. The sample size was relatively small and drawn from a single group of undergraduate agricultural students, which may limit the generalizability of the findings to broader populations or different educational settings. The intervention was also conducted over a short duration, measuring only immediate learning outcomes rather than long-term retention or behavioral changes. Additionally, the use of self-reported instruments for assessing engagement and perceptions may have introduced response bias.

Future research should address these limitations by including larger and more diverse samples, extending the investigation to students from other academic disciplines, and examining long-term effects of board game interventions on financial literacy. Further work may also explore the integration of additional gamification elements such as storytelling, adaptive difficulty, or digital tracking systems to better understand how different mechanics influence learning outcomes and engagement. Mixed-methods approaches that incorporate interviews, focus groups, or observational data could provide deeper insights into learners' experiences and help clarify nuanced factors that shape the effectiveness of gamified and non-gamified board games.

Conflict of Interest

The authors declare no conflicts of interest.

Author Contributions

S.C. and P.J. conceptualized the study, drafted the manuscript, developed the methodology, conducted the research, curated and analyzed the data, performed validation, and prepared the visualizations. P.T., P.W. and Y.T. contributed to the methodology, provided critical review and editing of the manuscript, supervised the overall research

process; all authors had approved the final version.

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