education sciences

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Financial Literacy Games—Increasing Utility Value by Instructional Design in Upper Secondary Education

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Abstract: Empirical findings show that students often have insufficient financial literacy, even though they increasingly make independent financial decisions. Financial education at school can provide a foundation for a lifelong proactive approach to financial matters with increasing utility value and financial interest. This includes the simulation of future financial decisions with serious games. Despite a wide range of serious games to promote financial literacy, there is a lack of empirical research on the instructional design of such games. This includes the instructional design of game mechanics as action-guiding and reflection prompts for debriefing. In a quasi-experimental intervention study with a 2×2 research design, upper secondary students were assigned to four groups ($n = 293$). They played the game *Moonshot* with different combinations of game mechanics and reflection prompts. Based on mixed ANOVA analysis, the combination of strategic game mechanics and direct reflection prompts significantly increased students' utility value for a financial literacy game, which underlines the importance of the instructional design of game mechanics and reflection prompts in serious games. But only a group-independent time effect was found for financial interest. Theoretical and practical implications are discussed.

Keywords: financial literacy; utility value; financial interest; game mechanics; reflection prompts

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Academic Editors: Carlos Vaz de Carvalho and Hariklia Tsalapatas

Received: 15 January 2025
Revised: 7 February 2025
Accepted: 8 February 2025
Published: 13 February 2025

Citation: Platz, L., & Zauner, M. (2025). Financial Literacy Games—Increasing Utility Value by Instructional Design in Upper Secondary Education. *Education Sciences*, *15*(2), 227. https://doi.org/10.3390/educsci15020227

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1. Introduction

Promoting financial literacy (FL) is becoming increasingly important as individuals take more responsibility for their finances due to demographic change and technological developments (Lusardi, 2019). Despite young people's growing interest in the financial market, studies show a lack of FL, which can lead to poor financial decisions (Förster et al., 2017; Rudeloff, 2019). Promoting FL is particularly relevant for upper secondary school students transitioning towards financial autonomy (Barry, 2014). Experience-based learning and serious games (SGs) have the potential to effectively promote financial literacy (Amagir et al., 2018; Arnab et al., 2015), although research on instructional design in SGs to promote financial literacy is still lacking (Platz, 2022).

This is relevant insofar as educational games as a learning medium have inherent motivational potential. However, this often cannot be empirically supported (Wouters et al., 2013), while a proactive financial education, which lays the foundation for lifelong engagement with the topic of finance, is particularly relevant in school-based financial education (Pfändler, 2021; van Campenhout, 2015). School interventions can potentially reach an entire generation and thus prepare lifelong proactive engagement with financial matters (van Campenhout, 2015; W. Walstad et al., 2017). This can be supported by promoting utility value and increasing motivation to actively engage with the subject matter

(Hulleman & Harackiewicz, 2021). Utility value interventions have empirically shown that changing the instructional design of learning environments to increase subjective meaningfulness impacts cognitive performance and motivational variables such as interest (Eccles & Wigfield, 2020). There is also evidence that game-based learning can increase students' utility value, which, in turn, can increase motivation (Baptista & Oliveira, 2019); however, this effect cannot be automatically assumed, even when applying SGs in educational contexts (Wouters et al., 2013). What has hardly been studied so far is how the utility value of SGs can be increased through instructional design in SGs. The extent to which game-based learning environments are effective in terms of learning outcomes also depends on their instructional design (Mayer, 2019).

Regarding the content-related design of these games, two building blocks are essential: game mechanics that structure the players' actions and the design of reflection prompts for debriefing. However, little research has been conducted into the impact of game mechanics and how reflection prompts should be designed (Pawar et al., 2019; Taub et al., 2019).

To find out how utility value can be increased through the instructional design of game mechanics and reflection prompts, a quasi-experimental study at upper secondary schools in Germany (n = 293) was conducted to improve the effectiveness of SGs and, thus, the instructional effectiveness of SGs in school-based financial education.

1.1. Financial Literacy

The OECD defines FL as "knowledge and understanding of financial concepts and risks, and the skills, motivation, and confidence to apply such knowledge and understanding in order to make effective decisions across a range of financial contexts, to improve the financial well-being of individuals and society, and to enable participation in economic life" (OECD, 2013, p. 144). FL encompasses knowledge, skills, attitudes, and behavior necessary to make informed financial decisions, similar to Weinert's (2001) definition of competence.

FL is considered an independent dimension of economic literacy (Retzmann & Seeber, 2016) and includes five content facets: money and payment transactions, savings, credit, insurance, and monetary policy (Rudeloff, 2019). Although the promotion of FL, especially among young people, is important, the impact of these interventions is not always measurable (Fernandes et al., 2014). Financial education influences financial knowledge rather than financial behavior (Kaiser & Menkhoff, 2020), although there are positive effects on savings and investment behavior (Lusardi, 2019). To date, research on the promotion of motivational facets of FL is limited (Fürstenau et al., 2020). However, motivational facets are crucial for lifelong proactive engagement with a topic (van Campenhout, 2015).

1.1.1. Financial Literacy for Adolescents and Young Adults

Despite the importance of FL, young people often do not perform well on FL tests (Aprea & Wuttke, 2016; Lusardi, 2019). As young people come into contact with financial services such as current accounts and smartphone contracts at an early age, managing their finances is crucial (Rudeloff, 2019). The increasing over-indebtedness of young adults is problematic, often due to inefficient household management (Creditreform Wirtschaftsforschung, 2024). Although they are interested in capital market activities, they often lack sufficient knowledge to participate safely (Hoffmann & Matysiak, 2019).

However, solid financial literacy is associated with higher quality of life and economic stability in adulthood (Burrus et al., 2018; Henager & Cude, 2016), which underlines the importance of early financial education. The OECD PISA study shows that only 10% of 15-year-olds reach the highest financial literacy level, while around 20% do not have basic skills (OECD, 2017). Comprehensive research is lacking in some countries, but studies point

to similar deficits (Erner et al., 2016; Schürkmann, 2017), with proficiency levels linked to the level of experience of students (Barry, 2014; Schuhen & Schürkmann, 2014).

1.1.2. School-Based Financial Education

Various findings have shown that institutionalizing financial education in schools can help to promote financial literacy and reach as many people as possible in the next generation (Amagir et al., 2018; W. B. Walstad et al., 2010). The school context provides a practical framework for financial education, and attending economics courses has been shown to strengthen financial literacy (Förster et al., 2017; W. B. Walstad, 1992).

Meta-analyses show that traditional financial literacy programs often fail to achieve their goals (Fernandes et al., 2014; Miller et al., 2015). However, research suggests that experiential learning methods, particularly SGs, are potentially more effective (Amagir et al., 2018; Platz, 2022). SGs have the advantage of simulating financial decision-making processes, which traditional forms of education may not achieve (Schultheis & Aprea, 2021).

The simulated scenarios allow learners to experience the consequences of their decisions (Henager & Cude, 2016). The interactive nature of games can also lead to increased motivation (Mandell & Klein, 2009), especially for learners who are not yet financially independent and have previously had little exposure to complex financial decisions (Huang & Hsu, 2011).

1.2. Game-Based Learning and Serious Games to Promote Financial Literacy

The discussion about the relationship between games and learning is complex due to the broad concept of games (Plass et al., 2015). Salen and Zimmerman (2003) define games as "a system in which players engage in an artificial, rule-defined conflict that leads to a quantifiable outcome" (p. 80). Mayer (2014) expands on this approach by describing games using five defining characteristics: games are rule-based, simulated systems that use causal rules; they are responsive, allowing players to act promptly and decisively; they are challenging; they are cumulative, reflecting previous actions; and they are inviting, providing an interesting and engaging environment (Mayer, 2014). SGs pursue learning goals and, therefore, a balance between learning and engagement strategies is needed concerning instructional design questions (Arnab et al., 2015; Boyle et al., 2016). The successful integration of GBL into the educational process requires a careful design to minimize learners' cognitive load by avoiding superfluous information and focusing on essential learning objectives (Mayer & Johnson, 2010). Instructional support like reflection prompts can be used in such learning environments to improve learning processes and motivation by facilitating the selection and integration of relevant information (Taub et al., 2019).

In summary, SGs offer comprehensive activation possibilities on an affective, social, and cognitive level (Plass et al., 2015). However, this requires a clear idea of which educational purposes should be pursued, in order to avoid potential conflicts of objectives and thus exploit the full potential of SGs as a learning tool.

1.2.1. Promotion of Utility Value Through Financial Literacy Games

Motivational potential is considered one of the most important aspects of games. Consequently, there is an intention to transfer this motivational potential to learning environments (Plass et al., 2019).

Based on the expectancy–value theory by Eccles et al. (1983), it can be assumed that the perception of the subjective value of an activity (valence) and the expectation of one's success can have a positive effect on persistence and performance (Eccles et al., 1983; Wigfield & Eccles, 2000). Utility value defines how a specific task or learning environment is aligned with an individual's future plans (Wigfield & Eccles, 2000, p. 72). As financial literacy should also serve to increase one's own financial well-being (Lusardi, 2019) in

addition to taking on responsibility in civil society, FL games can simulate such processes in a playful way (Schultheis & Aprea, 2021).

Increasing utility value in interventions can be achieved by creating personal, specific, and contextual connections through tasks in general or the application of post-task reflection prompts (Hulleman & Harackiewicz, 2021). Scientists argue that increasing a task's utility value can also impact individual interest in the topic in general (Eccles et al., 1983; Renninger & Hidi, 2021). Thus, according to the person–object theory of interest (Prenzel et al., 1986), individual interest also consists of a stable cognitive, value-related valence and affective activation that can also develop through the repeated activation of situational interest (Krapp & Ryan, 2002; Renninger & Hidi, 2002).

Studies show positive and negative correlations between educational games and such motivational variables (Connolly et al., 2012; Partovi & Razavi, 2019; Wouters et al., 2013). Due to these inconsistent results on the effects of educational games on motivation, this divergence is studied by taking a more differentiated look at the instructional design of two main building blocks of SGs (Mayer, 2019).

1.2.2. Game Mechanics Which Shape Tasks in Serious Games

Game mechanics refer to key actions or tasks that are repeated by players (Sicart, 2008) and include rule systems that shape interactions (Plass et al., 2011). Findings show that the design of game mechanics influences learning outcomes (Arnab et al., 2015; Pawar et al., 2019). Game mechanics and learning content must be aligned (Plass et al., 2011)—if they are not designed accordingly, there may be a lack of motivation to learn (Plass et al., 2015). In so-called design comparison approaches, the effectiveness of different mechanics can be studied, providing enlightening insights into instructional design (Mayer, 2019; Plass et al., 2019).

In financial education, it can be assumed that an approach that offers a higher degree of autonomy and control is a recommended strategy for teaching financial literacy (Aprea et al., 2018). In addition, game mechanics that emphasize managing limited resources and considering changing economic conditions are highlighted (Arnab et al., 2015). Resource management has also proven to be a successful game mechanic in other areas (Plass et al., 2011). When we look at existing financial literacy games, however, it is noticeable that although financial decisions and their consequences are simulated, these decisions or questions are selected randomly—e.g., via a dice in the globally popular SG *Cashflow*©.

1.2.3. Reflection Prompts for Debriefing

Reflection prompts as a learning tool are recognized and considered crucial for knowledge acquisition and understanding (Cavilla, 2017; Radović et al., 2021). Dewey (1933) defines reflection as the process of evaluating experiences to deepen learning. Metacognition, thinking about one's thinking, promotes active learning (Flavell, 1979) and is the focus of several studies that consistently show positive correlations between reflection and academic achievement (Davis, 2000; Guo, 2022).

In GBL, reflection processes support the connection between play, learning, and the individual's life (Moreno & Mayer, 2005; Yang & Liu, 2021). Studies show that reflection in GBL leads to better learning outcomes (Ter Vrugte et al., 2015; Wouters & van Oostendorp, 2013), while Yang and Liu (2021) empirically highlight the need to apply what has been learned in real-life contexts.

When it comes to the design of these prompts, there is open debate about the effectiveness of open versus direct reflection prompts. Open prompts promote autonomy but can overwhelm learners (Ifenthaler, 2012; Mayer & Johnson, 2010). Direct prompts support complex problems and are helpful for structured reflection (Davis, 2000; Lee et al., 2014).

Empirical results on this are contradictory, with advantages on both sides, also depending on students' cognitive development (Taub et al., 2019).

1.3. Research Question and Hypotheses

Against this background, the following study focusses on how game mechanics and reflection prompts can be designed to effectively promote perceived utility value while playing a financial literacy game, testing the following hypothesis:

H1. *Players with strategic game mechanics and direct reflection prompts perceive a higher utility value than players without strategic game mechanics and/or direct reflection phases.*

Since it can be assumed that utility value can influence individual financial interest due to the instructional design, the following hypothesis is also tested:

H2. *For players with a strategic game mechanic and direct reflection prompt, the individual financial interest will increase more than those without a strategic game mechanic and/or direct reflection prompts.*

2. Materials and Methods

2.1. Intervention Design of Moonshot

To test the present research question and hypotheses, a quasi-experimental 2 × 2 field design was conducted in which the SG *Moonshot* was systematically varied in terms of its main game mechanic and reflection prompts.

Game *Moonshot* is primarily aimed at upper secondary school students but can also be used in other classes. It is intended to promote FL. The game is played in groups of three to five people and involves alternating phases of playing and reflecting. At the beginning, each player chooses one of six life dreams representing different values and allowing for individual identification (Platz et al., 2021). The life dreams are divided into three phases of increasing complexity, which the players must achieve one after the other by managing scarce resources under changing economic conditions.

The game field reflects different economic conditions. Each player receives starting capital and must subsequently manage their own income and expenditure. The game is based on drawing event cards related to resources such as jobs, education, and investment. The focus is on achieving their life dreams by managing scarce resources. During the game, participants document their financial transactions to create a balance sheet at the end of each year. The rules of *Moonshot* are based on real-life conditions but have been simplified.

2.1.1. Random and Strategic Game Mechanic

The SG *Moonshot* was varied in its core game mechanic: In one case, rolling a die decided which event card the students received, so their only decision was whether they wanted to buy or consume the offer on their card; in the other case, a so-called worker-placemat mechanic was implement with time stones (Arnab et al., 2015), leaving the students to decide on how to manage their money strategically and their given time in the game by deciding on which event cards they wanted to choose. This meant that those with a strategic game mechanic did not have to wait as long to be offered randomly relevant events. Instead, they could decide for themselves what they wanted to focus on, and their success in the game was more closely linked to their own strategic game decisions, like in the board game *Risk*.

2.1.2. Direct and Open Reflection Prompts

Moonshot is accompanied by both open and direct reflection prompts to study their impact on utility value and financial interest. According to the literature, reflection should take place both during and after an activity, which contributes positively to learning development (Cloude et al., 2021; Schön, 1987). Therefore, two reflection phases followed the game phases. Students who received the open reflection prompts were just prompted to "stop playing and think about the gameplay", while students with direct reflection prompts were offered guided reflection tasks on their applied game strategies and linked gameplay to their individual lives (e.g., "Name three game strategies that have brought you closer to your goal"; "Discuss your game strategies in pairs: Choose one strategy each and discuss the impact of such decisions in your own life, for you and for others.").

2.2. Research Design and Intervention

The study examines the effect of varying types of reflection and game mechanics on students using a 2 × 2 factorial design comprising four groups. Groups I and II use a randomized game mechanic, while groups III and IV implement a strategic game mechanic, with groups I and III using direct reflection and groups II and IV using open reflection. The school classes are allocated according to availability, which makes the study a quasi-experimental investigation (Döring & Bortz, 2016). This increases external validity through several treatment variants. An online questionnaire was used, created with SoSci Survey, which conducts surveys before, during, and after the intervention and includes a follow-up measurement two weeks later (Döring & Bortz, 2016) (Figure 1).

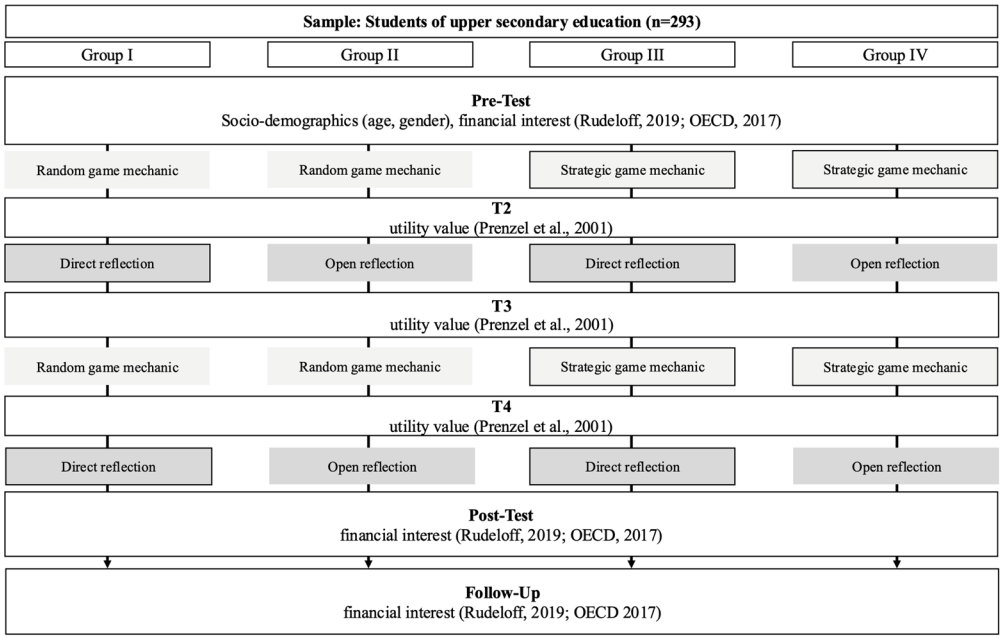


Figure 1. Research and intervention design (OECD, 2017; Prenzel et al., 2001; Rudeloff, 2019).

The participants are upper secondary school students in Germany, with classes selected through randomized sampling. Before the start of the study, the questionnaire was repeatedly tested for clarity and functionality (Mooi et al., 2018).

The intervention, conducted in 2022, involved seventeen classes in upper secondary schools in Germany, with a number of participants ranging from 13 to 23 students per class. Before the quasi-experiment started, the students (or, if minors, their parents) had to sign a data protection consent form and were informed about the voluntary, anonymous participation.

To conduct the study, research assistants were instructed to follow a standardized approach and learn and instruct the *Moonshot* game. Clear guidelines and standardized materials were used to ensure high implementation objectivity (Döring & Bortz, 2016; Herrmann et al., 2008). The intervention lasted 270 min (six school hours).

2.3. Data Analyses and Instrument

We analyzed the data using the Statistical Package for the Social Sciences (IBM, 2022). Both hypotheses are analyzed using a mixed ANOVA that combines repeated measures and independent designs (Field, 2017). Group membership is the in-between-subject factor, while time is the within-subject factor due to multiple measurement points. The mixed ANOVA calculates various effects, whereby the interaction effect is particularly relevant as it shows whether the variable under investigation changes significantly differently over time in one group than in other groups.

A fully standardized online questionnaire was divided into four parts to collect the data. In the pre-measurement, socio-demographic data and financial interest were recorded, followed by surveys after each game and reflection phase on utility value. Two weeks later, the post-test and a follow-up survey re-examined financial interest to identify changes (Figure 1). Utility value was measured using six items according to Prenzel et al. (2001) and adapted for the GBL context, while financial interest was measured on a 5-point Likert scale (OECD, 2017; Rudeloff, 2019) (Table 1).

Table 1. Overview of the instruments.

Variable	Items	Exemplary Item	Scaling	Reliability **	Source
Game mechanic and reflection prompts					
Utility value	6	*While playing/reflecting, I realized I can also do something with the topics outside of school.*	5-point Likert scale	0.83/0.90	Adapted from Prenzel et al. (2001)
Financial Literacy					
Financial interest *	5	*How interested are you in the following financial topics? (e.g., insurances)*	4-point Likert scale	0.64/0.75	Adapted from OECD (2017); Rudeloff (2019)

Notes: * The two values regarding reliability refer to the first and last measurement time. ** Reliability is measured using Cronbach's alpha.

Reliability analysis, assessed by Cronbach's alpha, demonstrated that these constructs show high internal consistency (α-values > 0.70 are considered consistent; Cortina, 1993; Cronbach, 1951). In particular, *utility value* proved internally reliable pre- and post-measurement, confirming the instrument's suitability (Döring & Bortz, 2016).

There were very few missing values at the item level, with the maximum being 10 missing entries (approximately 3%). As such, it was reasonable to assume that the item responses had no systematic pattern. Listwise deletion was applied to any missing value.

2.4. Sample

As outlined in the research design (Section 2.2), the study involved four groups of upper-secondary students, totaling 293 participants. These students attended either general or vocational high schools. Table 2 details the sample distribution by groups of similar sizes. Most participants were male and native German speakers, and their ages were typical for the grade level. Slight differences in group distributions arose due to the class-level assignment method used in this quasi-experimental design.

Table 2. Sample description.

	Gender *		School Type **		Mother Tongue		Age	
	Female	**Male**	**General**	**Vocational**	**German**	**Other**	**M**	**SD**
Group 1 (random, direct)	28 (37%)	47 (63%)	57 (78%)	16 (22%)	63 (82%)	14 (18%)	17.1	0.73
Group 2 (random, open)	35 (47%)	39 (53%)	45 (63%)	27 (37%)	61 (82%)	13 (18%)	17.0	1.00
Group 3 (strategic, direct)	33 (44%)	42 (56%)	53 (73%)	20 (27%)	63 (84%)	12 (16%)	16.7	0.82
Group 4 (strategic, open)	26 (39%)	41 (61%)	52 (80%)	13 (20%)	61 (91%)	6 (9%)	17.3	0.71
Total	**122 (42%)**	**169 (58%)**	**207 (73%)**	**76 (27%)**	**248 (85%)**	**45 (15%)**	**17.0**	**0.85**

Notes: M = mean, SD = standard deviation. Random/strategic describes the game mechanic, and direct/open describes the reflection prompts (Section 2.1). * Two students declared "diverse" (not shown in the sample statistics); ** 10 students declared "both" or "other" (not shown in the sample statistics).

3. Results

3.1. Descriptive Statistics

Table 3 presents the descriptive statistics by group. Regarding *utility value*, except for T1, where group I shows the highest mean value, group III consistently shows the highest mean values, while group II achieves the lowest. Group I often outperforms group IV. All groups show a general increase in scores from T1 to the post-test. During the intervention, the mean values of financial interest increased but returned to the initial level in the follow-up measurement. The group-specific differences were then examined in detail by applying two mixed ANOVA tests.

Table 3. Descriptive statistics (mean values and standard deviations).

Variable	Group 1 (Random Direct)	Group 2 (Random Generic)	Group 3 (Strategic Direct)	Group 4 (Strategic Generic)	Total
Game mechanic and reflection prompts					
Utility value (T1)	3.79 (0.76)	3.46 (0.74)	3.73 (0.67)	3.77 (0.64)	**3.69 (0.70)**
Utility value (T2)	3.75 (0.80)	3.32 (0.95)	3.84 (0.80)	3.49 (1.04)	**3.60 (0.90)**
Utility value (T3)	3.84 (0.76)	3.51 (0.92)	4.04 (0.76)	3.84 (0.76)	**3.80 (0.80)**
Utility value (Post-Test)	3.97 (0.77)	3.72 (0.82)	4.23 (0.64)	3.93 (0.94)	**3.96 (0.79)**
Financial Literacy					
Financial interest (Pre-Test)	3.46 (0.67)	3.25 (0.57)	3.36 (0.64)	3.20 (0.58)	**3.32 (0.62)**
Financial interest (Post-Test)	3.69 (0.76)	3.34 (0.57)	3.44 (0.66)	3.42 (0.41)	**3.47 (0.60)**
Financial interest (Follow-Up)	3.47 (0.76)	3.21 (0.62)	3.29 (0.76)	3.39 (0.57)	**3.34 (0.68)**

Notes: Numbers in brackets represents standard deviations.

3.2. Group-Specific Differences Due to Game Mechanics and Reflection Prompts

Six preconditions must be met in order to carry out a mixed ANOVA (Field, 2017):

1. Interval-scaled dependent variable: This condition applies to all variables under study.
2. Nominally scaled between-subjects factor: Group membership is categorical, and each person belongs to only one group.
3. Nominally scaled within-subject factor (time): The same person is measured at multiple timepoints.
4. Normal distribution within the groups: Tested with the Kolmogorov–Smirnov test. For large samples ($n > 30$), the normal distribution is considered to be fulfilled by the central limit theorem (Döring & Bortz, 2016).
5. Homogeneity of variances: Checked with the Levene test. ANOVA is robust to slight violations of this assumption, and post hoc tests such as Bonferroni (for homogeneity) or Games–Howell (for heterogeneity) can be performed (Hsu, 1996).
6. Sphericity: Tested with the Mauchly test in SPSS. Depending on the epsilon value (ε), the Greenhouse–Geisser correction ($\varepsilon < 0.75$) or the Huynh–Feldt correction ($\varepsilon > 0.75$) is used for violations (Girden, 1992).

3.2.1. Test of Hypotheses 1

For Hypothesis 1, *a mixed ANOVA examined utility value* as the dependent variable over four measurement points. Due to a lack of sphericity, the Huynh–Feldt correction was applied. The Levene test confirmed the homogeneity of variance for all variables. The results can be found in Table 4.

Table 4. Mixed ANOVA utility value.

Source		df	F	*p*	η_p^2
time	Huynh–Feldt	2.90	35.29	<0.001	0.112
time * group	Huynh–Feldt	8.70	2.61	0.006	0.027
error(time)	Huynh–Feldt	809.08			
group		3	5.51	0.001	0.056
error(time)		279			

p significance, η_p^2 partial eta-square.

The results show a significant interaction between time and groups, Huynh–Feldt F(8.70, 809.08) = 2.61, $p = 0.006$, partial $\eta^2 = 0.027$, indicating different changes in *utility value* over time in the groups. A significant time effect, F(2.90, 809.08) = 35.29, $p < 0.001$, partial $\eta^2 = 0.112$, and a significant group effect, F(3, 279) = 5.51, $p = 0.001$, partial $\eta^2 = 0.056$, were also found.

All groups showed significant time effects, with group III showing the highest time effect: F(3, 219) = 26.82, $p < 0.001$, partial $\eta^2 = 0.269$. Post hoc tests with Bonferroni correction revealed that group I showed *higher utility* value than group II after g1 and r1. Group III showed higher values than group II after r1, g2, and r2. Hypothesis 1 is supported because the *utility value* in group III increases more strongly during the game and the reflection phases. Table 5 lists the post hoc results.

Table 5. Post hoc tests for utility value.

Test (AV)	Group (I)	Group (J)	*Mean Difference* (I-J)	*p*
Bonferroni (utility value after g1)	group I	group II	0.34 *	0.027
		group III	0.06	1.000
		group IV	0.02	1.000
	group II	group III	−0.28	0.110
		group IV	−0.31	0.068
	group III	group IV	−0.03	1.000
Bonferroni (utility value after r1)	group I	group II	0.43 *	0.024
		group III	−0.09	1.000
		group IV	0.26	0.525
	group II	group III	−0.52 *	0.003
		group IV	−0.17	1.000
	group III	group IV	0.36	0.127
Bonferroni (utility value after g2)	group I	group II	0.33	0.081
		group III	−0.19	0.879
		group IV	0.00	1.000
	group II	group III	−0.52 *	<0.001
		group IV	−0.33	0.116
	group III	group IV	0.20	0.949
Bonferroni (utility value after r2)	group I	group II	0.26	0.314
		group III	−0.26	0.292
		group IV	0.05	1.000
	group II	group III	−0.51 *	<0.001
		group IV	−0.21	0.753
	group III	group IV	0.30	0.162

AV dependent variable, 5-point Likert-scale, *p* significance, * mean difference is significant at 0.05 level, group I: random, direct; group II: random, open; group III: strategic, direct; group IV: strategic, open.

3.2.2. Test of Hypotheses 2

For Hypothesis 2, a mixed ANOVA was conducted with financial interest as the dependent variable over three measurement points. Sphericity and homogeneity of variance were confirmed. The results (Table 6) showed no significant interaction effect $F(6, 340) = 0.91$, $p = 0.489$, and no significant main effect group $F(3, 170) = 2.03$, $p = 0.111$. However, a significant time effect was found $F(2, 340) = 7.49$, $p < 0.001$, partial $\eta^2 = 0.042$, indicating a significant, group-independent change in financial interest. Table 7 shows the time effect results.

Table 6. Mixed ANOVA on financial interest.

Source		df	F	p	η_p^2
time	sphericity assumed	2	7.49	<0.001	0.042
time * group	sphericity assumed	6	0.91	0.489	
error(time)	sphericity assumed	340			
group		3	2.03	0.111	
error(time)		170			

p significance, η_p^2 partial eta-square.

Table 7. Time effects of financial interest.

Pre-Test	Post-Test	Mean Difference (Pre- & Post-Test)	p
1	2	−0.10 *	0.037
	3	0.00	1.000
2	3	0.10	0.058

1 pre-measurement, 2 post-measurement 3 follow-up measurement, p significance, * mean difference is significant at 0.05 level.

4. Discussion

The study examined the connection between instructional design in the context of financial SGs on utility value and financial interest. Based on the findings, the first hypothesis can be confirmed: utility value increases significantly more in group III than in other groups, which applied strategic game mechanics and direct reflection prompts. These findings emphasize the role of strategic game mechanics and direct reflection prompts to increase the personal relevance of SGs for students (Pawar et al., 2019; Yang & Liu, 2021), which can be attributed to the learning media and the learning content itself.

Hypothesis 2 expected a more substantial group-related increase in financial interest in group III, but could not be confirmed. Although there were no significant differences between the groups, there was a significant time effect, demonstrating a temporary increase in financial interest due to the intervention. This result is in line with previous studies that support the claim that SGs can be effective for the short-term promotion of interest (Huizenga et al., 2019; Zhonggen, 2019). However, the long-term stability, which could be considered individual interest, could not be demonstrated, consistent with findings from other studies indicating that only continuous activation of situational interest leads to the development of individual interest (Harackiewicz et al., 2016).

Regarding effective instructional design, the findings show that direct reflection in combination with strategic game mechanics may be an effective way to promote utility value. This suggests that such an instructional design can empower students to build a connection between an SG intervention and their individual lives (Eccles & Wigfield, 2020). However, the hypothesized differences between open and direct reflection prompts were found to be insignificant in terms of post-intervention financial interest.

Overall, the results of this study help to support the advantage of strategic game mechanics regardless of domain (Bradbury et al., 2017; Clark et al., 2016; Taub et al.,

2019). Students can be supported with the higher cognitive demands of strategic game mechanics through structured reflection prompts in task-oriented processing (Wouters & van Oostendorp, 2013).

In summary, the study provides valuable insights into the effective implementation of SGs in secondary education. It underlines the of potential SGs to promote utility value and interests, which is important for a proactive approach in school-based financial education (van Campenhout, 2015).

4.1. Limitations

The study has several limitations that should be considered when interpreting the results: concerning the research design, the quasi-experimental approach reduces the internal validity, as different prior knowledge and group dynamics in the school classes could influence the results (Döring & Bortz, 2016). In addition, the game was played in small groups, so the influence of individual group dynamics could not be included here either, which, in turn, could also be an explanation for the level of the effect sizes. In addition, long-term financial education interventions are considered particularly effective (Kaiser & Lusardi, 2024). However, the intervention described here was carried out in each class on a school morning (270 min. intervention time), which, in turn, could explain the merely short-term increase in financial interest.

Due to the selected measurement instrument based on established scales, there is also a risk of test fatigue due to repeated measurements; more implicit measurement methods can be used in digital SGs with the help of learning analytics procedures (Banihashem et al., 2023). The financial interest's reliability was limited, as $\alpha > 0.7$ was not consistently exceeded, and the measurement of individual financial interest only consisted of a self-report, which was not supplemented by other measurement methods such as leisure activities with finance-related topics (Renninger & Hidi, 2016).

Despite the limitations mentioned, the findings allow for the effective concept of utility value interventions to be transferred to the instructional design of SGs. This has implications for research and practice.

4.2. Theoretical and Practical Implications

As only one hypothesis was supported, this study points to the need for further research, especially about long-term effects of repeated interventions on utility value and interest development in SGs and debriefing (Eccles & Wigfield, 2020; Renninger & Hidi, 2016). Also, the extent to which a situated SG can impact long-term value development should be investigated. In addition, including individual origin variables using a structural equation model makes it possible to identify relationships between value-related variables and the students' individual prerequisites (Platz & Juettler, 2022). This is relevant insofar as financial literacy is strongly influenced by the family of origin (Sorgente et al., 2024).

Our research project, starting in 2025, examines socioeconomic background and its influence on financial education. It studies the potential of a digital financial education game in schools and families. The aim is to use SGs to develop an evidence-based collaborative partnership between schools and families and empower young adults and adolescents to take on more financial responsibility.

Beyond financial education, these results can form a basis for further cross-domain research into the instructional design of SGs. Since game mechanics in educational games are considered to be content-related, and reflection prompts also focus primarily on the analysis of content, further studies can investigate the effectiveness of domain-specific game mechanics and reflection prompts as the main building blocks of game-based learning (Arnab et al., 2015; Pawar et al., 2019).

For practical implications, direct reflection prompts are preferable to open reflection prompts, even for older students. Particularly with more complex, serious games, direct reflection prompts on game strategies and links to individual lives can help students focus on key learning tasks. On the other hand, challenging serious games with a high degree of strategic freedom can increase the perceived importance of play. This applies to financial games, as competent strategic management of scarce resources also forms the core of financial literacy in everyday life. Freedom in play and guidance in reflection is an effective combination for applying games in upper secondary education.

Therefore, this study extends the limited knowledge about the effectiveness of SGs in financial education and offers starting points for future pedagogical strategies in the educational context.

Author Contributions: Conceptualization, L.P.; methodology, L.P. and M.Z.; software, L.P. and M.Z.; validation, M.Z.; formal analysis, M.Z.; investigation, L.P. and M.Z.; resources, L.P.; data curation, M.Z.; writing—original draft preparation, L.P.; writing—review and editing, L.P.; visualization, M.Z.; supervision, L.P.; project administration, L.P. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: After vetting the Description of Work (DoW), the project has been found to fall outside the range of projects requiring an IRB statement. For this type of project, approval by the IRB or any regulatory body is not required according to our University's and national statutes in Germany. This study was non-invasive/minimally invasive, and any other obvious issues concerning a threat to human health, well-being, and dignity (including, e.g., deception protocols) have not been identified. All issues of data protection fall under a special regulation in Germany that is enforced independently from the IRB, and the IRB has verified that the project is fully in compliance with all national regulations concerning this issue. RefNo: IRB24KN011-05/w.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

MDPI	Multidisciplinary Digital Publishing Institute
DOAJ	Directory of open access journals
SGs	Serious games
FL	Financial literacy

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