



Experimentation of the Table Game Appendix to the Angle Project results Output 3

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Tell me and I forget. Teach me and I remember. Involve me and I learn.

(Attributed to) Benjamin Franklin

Introduction

Economic and financial literacy (FL) is an essential set of knowledge and skills that individuals can acquire early in life to make informed and effective financial decisions. FL promotes wise money management, including saving and investing, as well as responsible borrowing and debt management, thereby helping to avoid costly mistakes. It also provides the foundational principles necessary for navigating critical life transitions, such as the transition from education to the workforce and for participating more effectively in the rapidly evolving and technologically-driven labor market. In addition, FL is essential for ongoing learning and retraining throughout one's career. Numerous studies have demonstrated that possessing a general understanding of FL has a significant positive impact on an individual's ability to make informed financial decisions and the quality of those decisions (Lusardi and Mitchell, 2011). Finally, FL is a vital component of citizenship and democratic participation.

Unfortunately, the potential benefits of financial education are not accessible to most of the population. Many individuals struggle to comprehend basic financial concepts such as compound interest, diversification, and time value of money (Bucher-Koenen and Lusardi, 2011; Lusardi and Mitchell, 2011). Despite efforts to improve financial literacy, many OECD countries still have unsatisfactory levels of FL. The latest OECD PISA and PIAAC reports reveal that a significant number of young people worldwide lack proficiency in financial topics, with potentially negative implications for their future financial wellbeing, including issues related to debt, savings, investment, and retirement planning. Some financial decisions can be so consequential that they can push individuals into a poverty trap from which they may never recover.

According to the OECD PISA and PIAAC report, almost half of the population aged 16-64 lacks the ability to read a basic financial line graph, and most adults struggle with more complex calculations, such as determining discounts. In France, 21.5% of fifteen-year-old students have the lowest proficiency level in FL, which is higher than the OECD average of 20% (OECD PISA 2015). This lack of literacy is especially detrimental to individuals who are hesitant or feel they lack the time to acquire the necessary skills and knowledge in this critical field.

Active involvement and participation through game-based learning can be an effective way to acquire knowledge. Serious games used in training and education have a significant impact, as they offer excellent opportunities to develop skills such as problem-solving, decision-making, multitasking, and teamwork. For instance, using games to teach young individuals to consider long-term horizons and anticipate the future consequences of their decisions can be highly effective. Games that provide players with a



life-cycle perspective can be particularly helpful in this regard. By engaging participants in playful activities, games can make learning more enjoyable and accessible to those who might be put off by reading textbooks in the field.

Our project aims to test the effectiveness of a one and half-hour board game in enhancing youth financial literacy through a field experiment. The game is designed to simulate real-life experiences, such as deciding whether to continue education or enter the workforce. Our target audience is young Europeans, specifically university students pursuing bachelor's degrees in various academic fields. We have developed this game because existing targeted initiatives on financial literacy often lack engaging and personalized tools, leaving many young people underprepared to make informed financial decisions. Our goal is to fill this gap by providing a fun, interactive, and tailored approach to financial education.

Our experiment aims to assess the effectiveness of the game in improving financial literacy among university students with diverse personal, socio-economic, and cultural backgrounds. We will explore how different cognitive capacities, such as logic and mathematics skills, attitudes toward risk, and time (in)consistency, impact the game's functionality and outcomes. By examining these factors, we hope to gain a better understanding of how the game can be adapted to meet the needs of various groups of players and enhance its overall effectiveness in improving financial literacy.

To assess the effectiveness of our game in improving financial literacy among university students, we have developed a protocol that focuses on individual knowledge acquisition. To avoid issues with unobserved variables in control groups, we have chosen a within-subject framework that compares each student's financial literacy level before and after playing the game. We have designed two sets of canonic questions, each covering the same financial literacy concepts but with different wording to reduce learning effects. By comparing the results from these question sets, we can measure the impact of the game on each student's financial literacy and evaluate its effectiveness in improving their knowledge and understanding.

Our study is focused on evaluating the effectiveness of a board game in improving financial literacy among university students in a short period of time, specifically after playing the game for just over an hour. While we do not aim to compare the pedagogical effectiveness of a board game against other teaching methods, we do aim to determine whether students can retain key basic concepts of financial literacy through the game. As financial literacy levels among young people are generally low, our main research question is whether there is a significant improvement in post-game test responses compared to pre-game test responses.

Another advantage of using the board game is the opportunity to study the cooperative behaviors of young people during the game and their impact on knowledge acquisition. Through the game, we can also measure the level of confidence that young people have in their ability to explain concepts to their peers or their confidence in their mathematical knowledge, and how this confidence affects their knowledge acquisition. By examining these additional factors, we can gain a deeper understanding of how the game contributes to the acquisition of financial literacy and identify any potential areas for improvement.

Aside from determining whether one and half hour of educational gaming can sufficiently impart basic financial knowledge to young people, our project aims to investigate which students benefit the most from the experience and which factors contribute to their success. Is it those with high levels of mathematical or logical ability, or those with greater patience and enjoyment of the game? We also seek to explore at the theoretical level how students apply the knowledge and information provided in the game, and





the impact of inattention on learning. Why does an individual not register a given piece of information? Ultimately, our study aims to shed light on the mechanisms underlying effective learning in the context of educational gaming.

Lessons from the experiment

Our experiment aims to answer several questions related to the effectiveness of educational games in transmitting financial literacy to young people. Specifically, we aim to investigate:

1. Whether a one and half hour educational game is sufficient to transmit basic financial knowledge to young people on average.
2. Which financial concepts are better understood by students, such as risk or financial numeracy.
3. Which types of students benefit the most from the experience, including factors such as math background, initial financial literacy score, gender, and feelings during the game.
4. Whether the standard deviation of errors is statistically reduced or accentuated after the game and the transmission of financial knowledge, and whether students need prior knowledge to fully benefit from the game.
5. The role of self-confidence in the acquisition of financial knowledge during the game.
6. The impact of peer effects on student learning, including whether progress is positively correlated with the progress of classroom peers and whether poor acquisitions are evenly distributed or concentrated.
7. Which types of students volunteer to explain concepts to others, including those who perform the best or those who are the most confident.
8. How students use the response "I don't know" and whether there is a significant change in its use over time.

By answering these questions, we hope to gain a better understanding of the effectiveness of educational games in promoting financial literacy among young people and to identify strategies for improving financial education.

Experimentation

First questionnaire

Before the board game, all participants answer a first questionnaire. This first questionnaire allows us to do two things.

Idiosyncratic characteristics

1. Identify idiosyncratic characteristics. Their:
 - gender and age;
 - social/family background;
 - Math skills and cognitive abilities (Raven matrices and numeracy tests);
 - risk aversion or degree of impatience; and





- subjective financial knowledge.

Financial literacy questions

2. Evaluate the participants on their initial level in finance by using canonical financial literacy questions used in the literature. The questions are presented in the Appendix A.

Second questionnaire

After the board game, all participants answer a second questionnaire. This last questionnaire rephrases the financial questions (loans, savings, retirement, etc.) from the first questionnaire and add some questions regarding their feedback on the game, such as:

- their score during the game.
- their character during the game.
- their interactions with other players during the game; and
- their feeling during the game: fun, boring.

We create two sets of financial literacy questions, namely questions set A and questions set 2. We divide by two groups the participants in an idiosyncratic way (the date of birth).

Two different treatments

Treatment A: Survey part 1 (FL questions set A) – Board Game – Survey part 2 (FL questions set B)

Treatment B: Survey part 1 (FL questions set B) – Board Game – Survey part 2 (FL questions set A)

Processing

The comparison of the answers obtained from the two questionnaires makes it possible to determine whether the game improves the quality of the answers. If this is the case, we conclude that 1 to 2 hours of fun training (this game) offers the opportunity to significantly improve young people's financial literacy.

Qualtrics link to online questionnaire

Overall, you can access the following Qualtrics link to see the online questionnaire (in French) the students will have to respond to:

The first quiz before the game:

https://dauphinem1.eu.qualtrics.com/jfe/form/SV_daL49wucByVTWXY

The last quiz after the game:





https://dauphinem1.eu.qualtrics.com/jfe/form/SV_6qWfDPSqGFSoc4u

Timing

The timing of the experimentation is about 2h30, with the following schedule:

Welcome of the students – Presentation of the experimentation - 5 minutes

First quiz, using Qualtrics on their personal phone (they will scan a QR code to access to the quiz) – 20 minutes

Game – 1h30

(Rules of the game: <https://www.carloalberto.org/wp-content/uploads/2023/02/ANGLE-game-rules.pdf>)

In a nutshell: You can earn points by taking crucial choices at Checkpoints and answering quizzes that will test your knowledge of financial and economic concepts. Sometimes choices are influenced by the dice, while chance cards can either boost the score or have a negative impact on it. The game ends when players reach retirement. Each character has three different endings according to the final score achieved.

Each game table consists of 4 groups of two players each, i.e. 8 students per game table. Each experiment is conducted with 5 tables playing in parallel, supervised by student volunteers and teacher-researchers who can re-explain the rules if necessary. Each group chooses a character at random to follow from youth to retirement. During the game, the students must answer financial questions and read them out loud. The game is collaborative, and everyone can be helped by the other teams. All tables answer the same financial questions that have been arranged in the same order beforehand. Some of the questions are about the same concepts tested in the quizzes, but the number of questions seen in the game is far greater than the number of questions seen in the quizzes.

The characters proposed to the participants during the game are the following:

- o Venla: You are a creator. You love to spend your time inventing videos for digital platforms, especially for metal music fans. You have 452 000 followers.
- o Smarteus: You are a young Smarteus, who is passionate about chemistry. Your only goal during the chemistry program is to find a new element. You show your chemistry abilities at parties, which you love to take part in.
- o Octave: Your goal is to reduce inequalities in the world. You speak three languages, and you were three months old when you attended your first protest.
- o Ilyesse: Born into a wealthy family, you spend your time watching TV. You find that a book is always too long to read.

Depending on the character obtained, players receive different initial endowments in terms of experience points, money, and academic knowledge. These characters allow players to identify with and entertain students. However, they have no impact on the questions the players will have to answer and therefore should not normally have any





impact on the acquisition of knowledge during the game. We will nevertheless test this hypothesis to make sure that there is no self-determination bias in the acquisition of knowledge: "My character is described as uneducated, so I don't focus on the questions because I play the game expected of my character".

When forming the tables, we let the students choose their pair and their game table.

Break - 10 minutes

Second quiz, using Qualtrics on their personal phone (they will scan a QR code to access to the quiz) – 10 minutes

Revelation of the winner and distribution of the prizes – 5 minutes

Participants

The students have an extrinsic motivation to participate and give their best. We propose the following financial scheme:

We calculate a 20-point scale for both questionnaires together. At best, a student can get 50 euros. Indeed, the first wins a voucher of 50 euros, the second 40 euros, the third to fifth 30 euros, and all the others win 10 euros if they have taken the experiment seriously. In average, the earnings were of 13,50€ (min: 10€ - max 50€) with this ranking structure.

Results

We first conducted the experiment on a small scale, as is customary before launching a large-scale experiment. There was a total of two sessions. One that took place on Friday June 9th at the Julie-Victoire Daubié high school in Val d'Argenteuil and a second one that took place on Monday June 12th at the Corneilles-en-Parisis high school. The experiment occurred during the usual hours of teaching of SES (Economic and Social Sciences). While in the Julie-Victoire Daubié high school, the experiment could only be attended by the SES class, in the Corneilles-en-Parisis high school, any high school student could participate.

There was a total of 62 participants. Only 49 participants played the game and completed the two surveys (some students could not participate to the second survey due to time constraints). The average age of the remaining 49 participants is 16.32 years old, ranging from 15 to 17. The proportion of females was 38.78%, the proportion of males was 59.18% and one high school student answered "other" to the gender question.

Since the repartition of the treatments was based on the day of birth (1-15 for treatment A and 16-31 for treatment B), the two treatments had two different sizes. Treatment A, in which participants first answered financial literacy questions set A, then played the board game, the answered questions set B, was composed of 30 respondents. There were 19 respondents in Treatment B. Overall, the number of respondents in each treatment is too small, in this small-scale experiment, to take profit of the between design. In addition, the individuals who composed these two treatments had different baseline levels of financial literacy. In treatment A, the average score on financial literacy questions answered in the first part of the survey was 3.73. It was equal to 5.00 in treatment B. We thus decided to focus on the within design, and to keep the interpretation of the between design for the large-scale experiment to be conducted later.





For both treatments, we find an increase in the FL questions score after playing the board game.¹ The respondents in Treatment A had an initial average score of 3.73/9 (FL questions set A) and scored an average of 4.33/9 when answering similar questions (FL questions set B) after playing the board game. In the second treatment, the initial average score was 5.00/9 (FL questions set B), increasing to 5.53 after the board game (FL questions set A).

Regarding the individual determinants of financial literacy, we investigate the existence of a “gender gap”, as shown in previous studies (Bucher-Koenen et al., 2017; Fonseca et al., 2012; Lind et al., 2020; Lusardi and Mitchell, 2008). Our results on the initial FL questions indicate that females score lower than males (3.83 vs. 4.63). After playing the board game, the gender gap stays about the same with females scoring 4.28 on average compared to 5.42 for male participants.

Among the determinants of financial literacy, we find that cognitive abilities significantly correlate with the number of correct answers. This result is in line with Munoz-Murillo et al. (2020) who evidence – while controlling for confounding factors - that individuals with higher cognitive abilities tend to be more financially literate. We also find that math skills have a positive and significant influence on financial literacy (as in Bottazzi and Lusardi, 2021). Other variables such as the number of books at home and whether respondents regularly read the economic press influence the score on the financial literacy questions. Contrary to Razen et al. (2021) who test for financial literacy among Austrian high schoolers, we do not find that patience matters for financial literacy. Similarly, risk aversion does not appear to have an impact either.

Finally, we observe that surprisingly, subjective financial knowledge is not correlated at all with objective financial knowledge, indicating that respondents do not know whether they know!

While the board game is designed at improving financial literacy, it may also do so on the longer run. That is, playing the board game might get participants interested in financial matters and thus facilitating future learning. Therefore, we also tested whether participants liked playing the board game. Overall, respondents rather liked playing the board game, giving a score of about 7/10 to the questions “Did you like playing this board game?”. We do not observe important differences in the feedbacks between males and females, indicating that the board game may be a useful tool to fight the gender gap. Finally, the feedback provided by the participants shows that the board game may be a useful tool of peer learning. Respondents indicate that they often asked for help, got helped and offered to help during the game.

The results are detailed in the Appendix B.

¹ The sample size is too small to assess statistical significance.





Appendix:

A. Financial literacy questions

Q1 (Big 3, Lusardi and Mitchell)

Assume you have 500€ in a savings account, and you get 3% interest per year on that savings account. No further deposits or withdrawals will be made to this account. What would be the account balance after 4 years?

- More than 500€
- Exactly 500€
- Less than 500€
- I don't know





Q2 (Big 3, Lusardi and Mitchell)

“Spending €1000 to buy the shares of 2 different companies is generally less risky than spending €1000 to buy the shares of 15 different companies”. This statement is:

- True
- False
- I don't know

Q3 (Big 3, Lusardi and Mitchell)

Now assume that you receive 2% interest per year instead and that inflation is 4% in the same period. How much could you afford after a year of the money in the account?

- More than today
- Same as today
- Less than today
- I don't know





Q4 (Big 5, Lusardi and Mitchell)

A 5-year mortgage typically requires higher monthly payments than a 10-year mortgage but the total interest over the life of the loan will be less.

- True
- False
- I don't know

Q5 (Big 5, Lusardi and Mitchell)

If interest rates rise from 1% to 4%, what will typically happen to bond prices?

- They will rise
- They will fall
- They will stay the same
- There is no relationship
- I don't know





Q6 (Allianz Survey 2016)

For the same amount of money, you can enter either one of two lotteries:
Lottery A pays a prize of 400€ and the chance of winning is 2%. Lottery B pays a prize of 90000€ and the chance of winning is 0.01%. If you do not win, you do not receive any money. Which lottery pays the higher average amount?

- Lottery A
- Lottery B
- These two lotteries pay the same average amount
- I don't know

Q7 (Allianz Survey 2016)

Suppose you have 1000€ on a savings account and the interest rate is 20% per year compounded annually. If you do not withdraw anything, at this interest rate, how much would you have on this account after five years?

- Less than 2000€
- Exactly 2000€
- More than 2000€
- I don't know





❑ Q8 (Fernandes et al. (2014)/FINRA)

You can invest in two projects. Project A will either deliver a return of 11% or 9% with either outcome equally likely. Project B will either deliver a return of 14% or 4% with either outcome equally likely. Which of the following is true? Compared to Project B, Project A has...

- ...a higher average return and a lower risk
- ...the same average return and a lower risk
- ...a lower average return and a higher risk
- I don't know

❑ Q9 (S&P Global FinLit Survey)

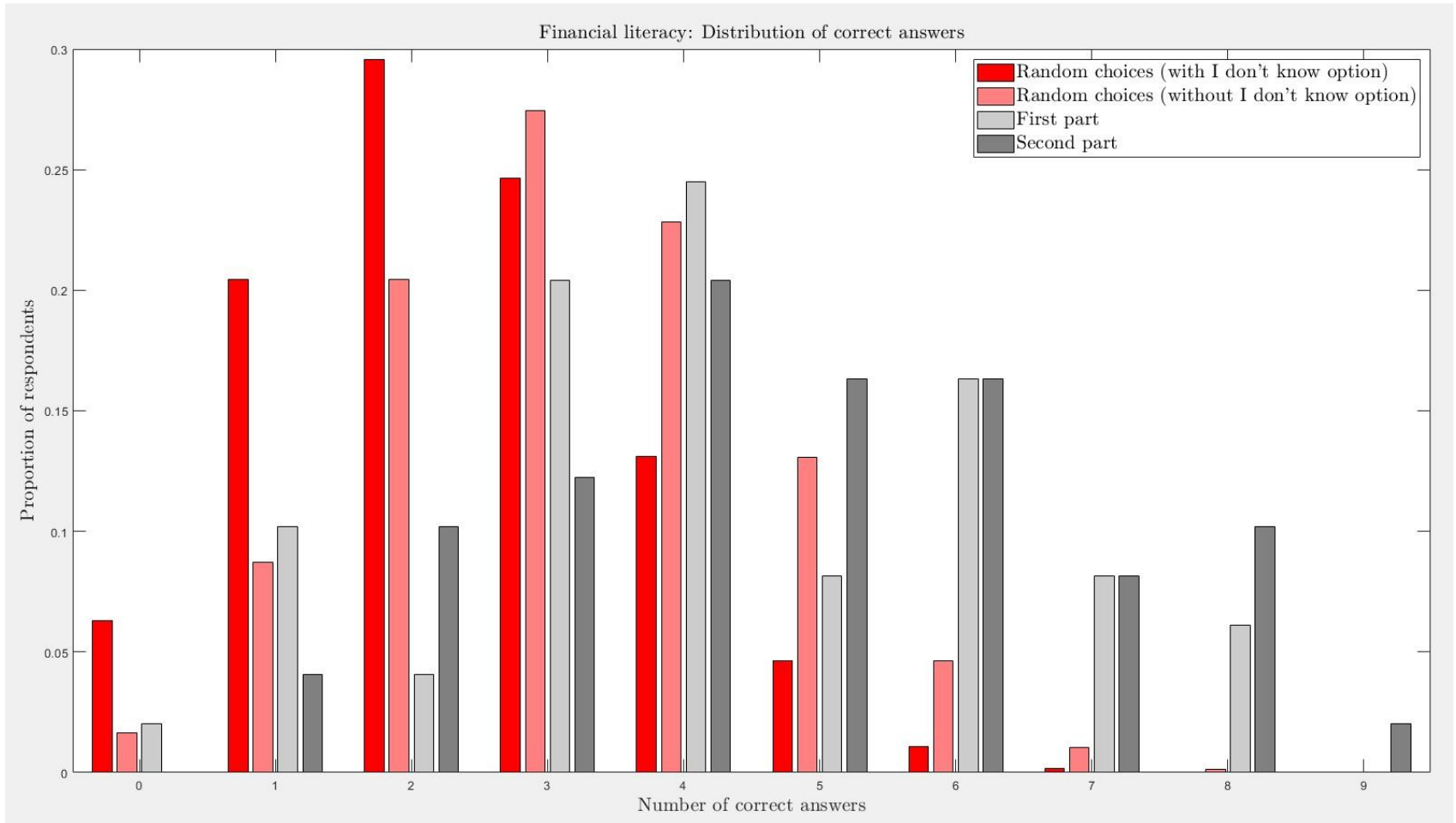
Suppose over the next 10 years the prices of the things you buy triples. If your income doubles, will you be able to buy less than you can buy today, the same as you can buy today, or more than you can buy today?

- Less than today
- Same as today
- More than today
- I don't know



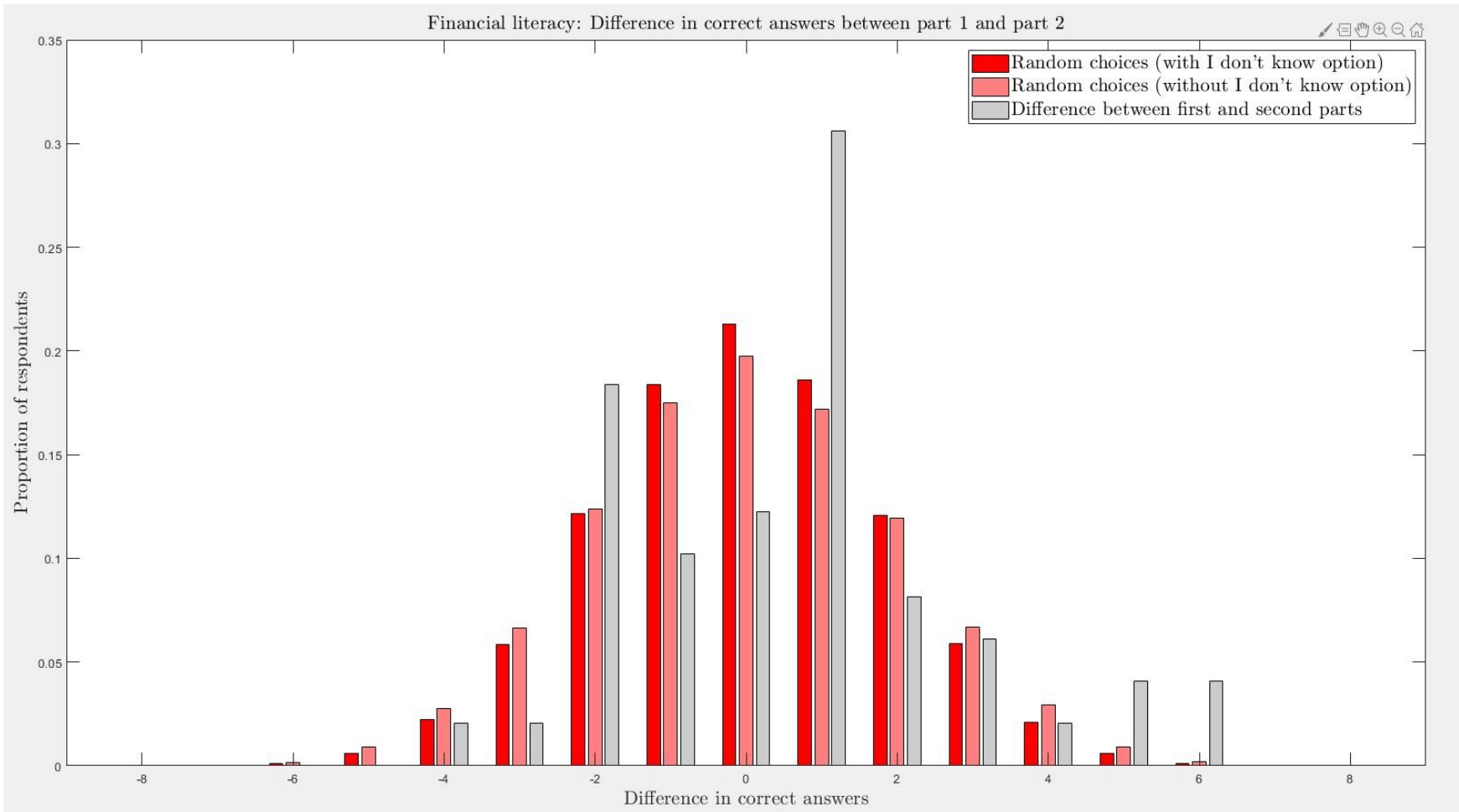
B. Results

□ Distribution of correct answers



Results

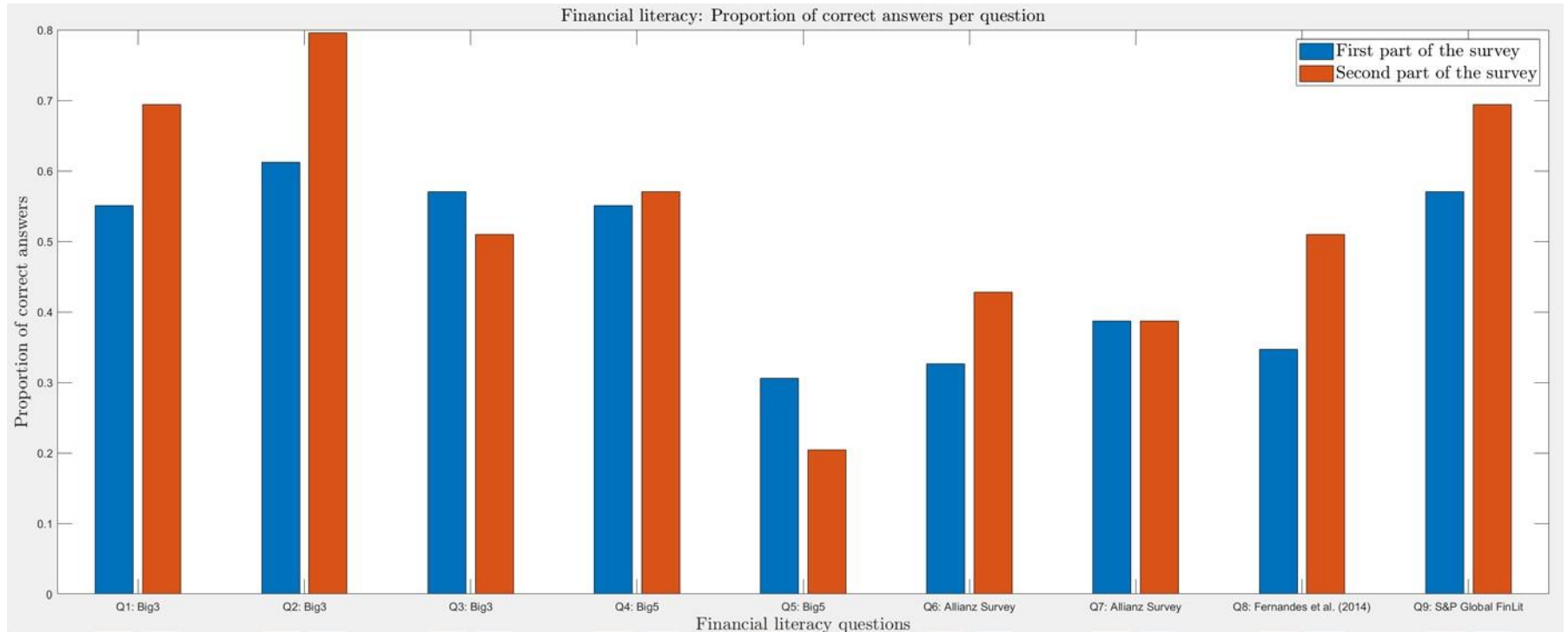
□ Distribution of the difference in correct answers between part 1 and part 2



Results

Financial literacy

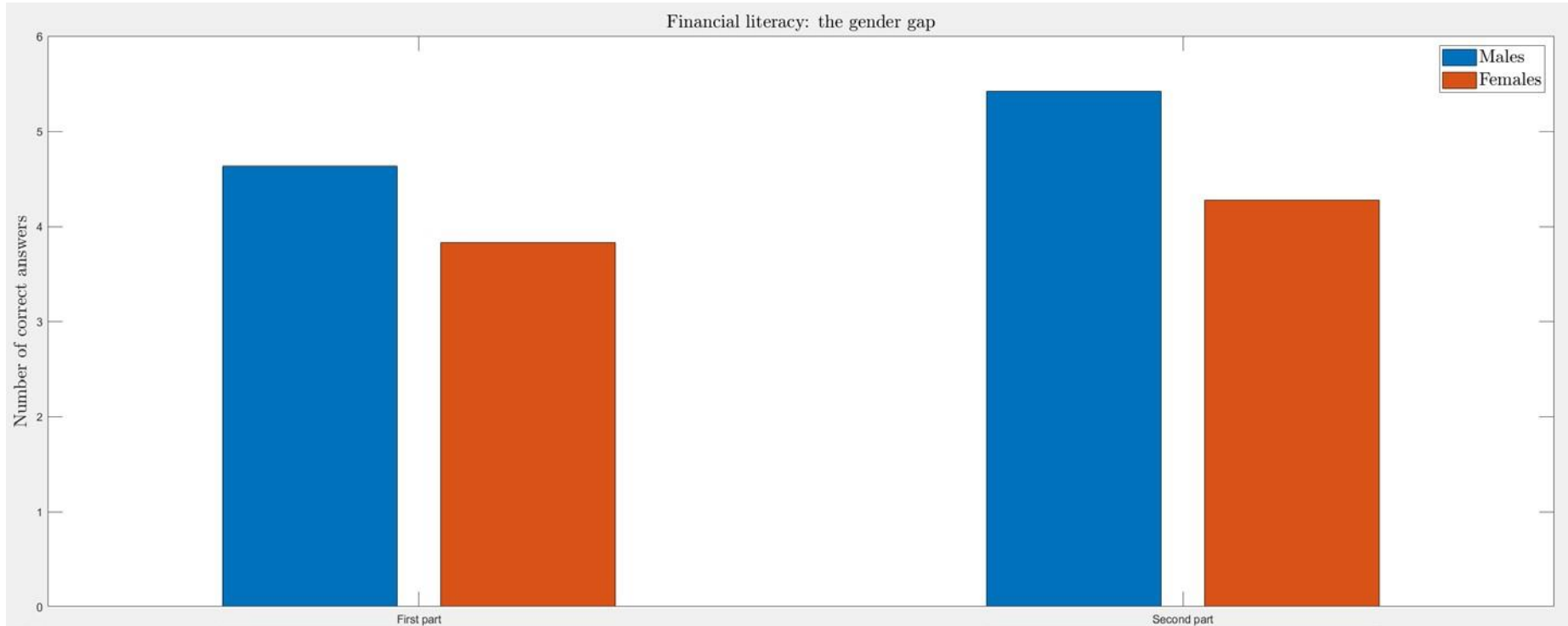
☐ Proportion of correct answers for each question



Results

Individual characteristics

Gender gap



Allianz 2023
report on FL

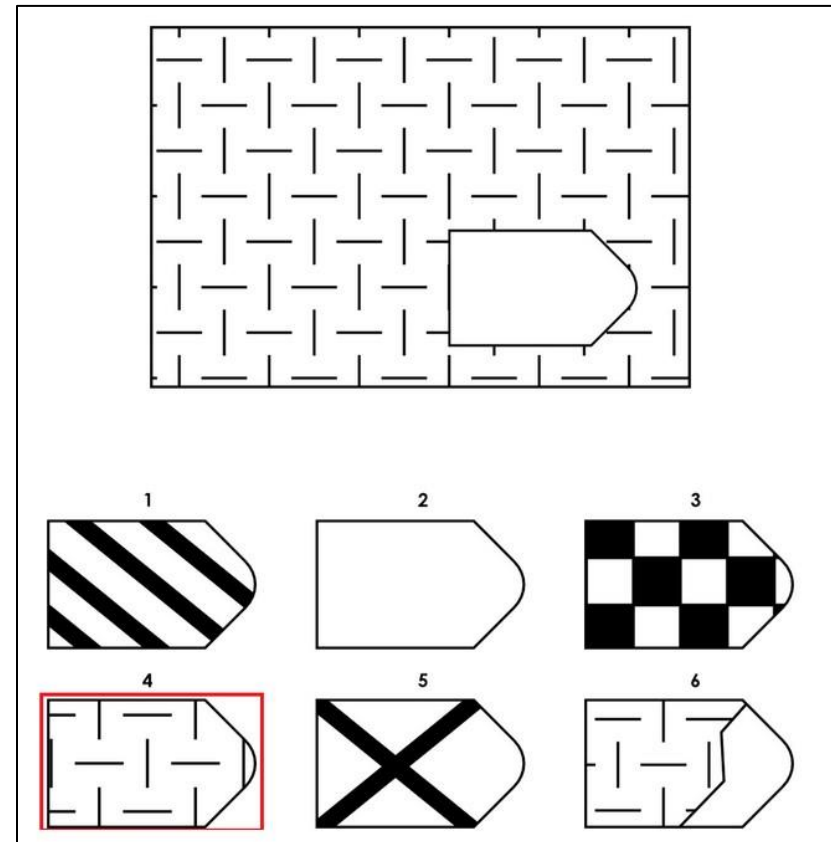
There is a persistent financial literacy gender gap. Out of the nine questions we asked to assess the level of financial literacy, the mean number of correct responses from women was 3.7 (median 4), while that of men was 4.5 (median 5).

Individual characteristics

☐ Raven matrices

- Correlation between FL questions in the first part of the survey and the score on the raven matrices test is 28.87% (p-value=0.0442)

Example of a Raven Matrix:



□ Cognitive abilities

- Number Line Estimation (NLE) task (Roger et al, 2022) — Correlation between FL questions in the first part of the survey and the error on the NLE task is -38.48% (p-value=0.0069)

Example of the NLE task

Indicate the position of number 12.20 on the line below using the slider.

Note that the boundaries of the interval are 0 and 100 and that the slider is initially at 0.



Results

□ Math skills

▪ Grade in mathematics

— Correlation between FL questions in the first part of the survey and the grade in mathematics is 24.58% (p-value=0.1036) ▪ Subjective math level

— *Please indicate whether you agree with the following statement: "My math level is higher than the average for people my age."* – 5-points Likert scale – Correlation between FL questions in the first part of the survey and the grade in mathematics is 28.12 (p-value=0.0504)

□ Financial knowledge

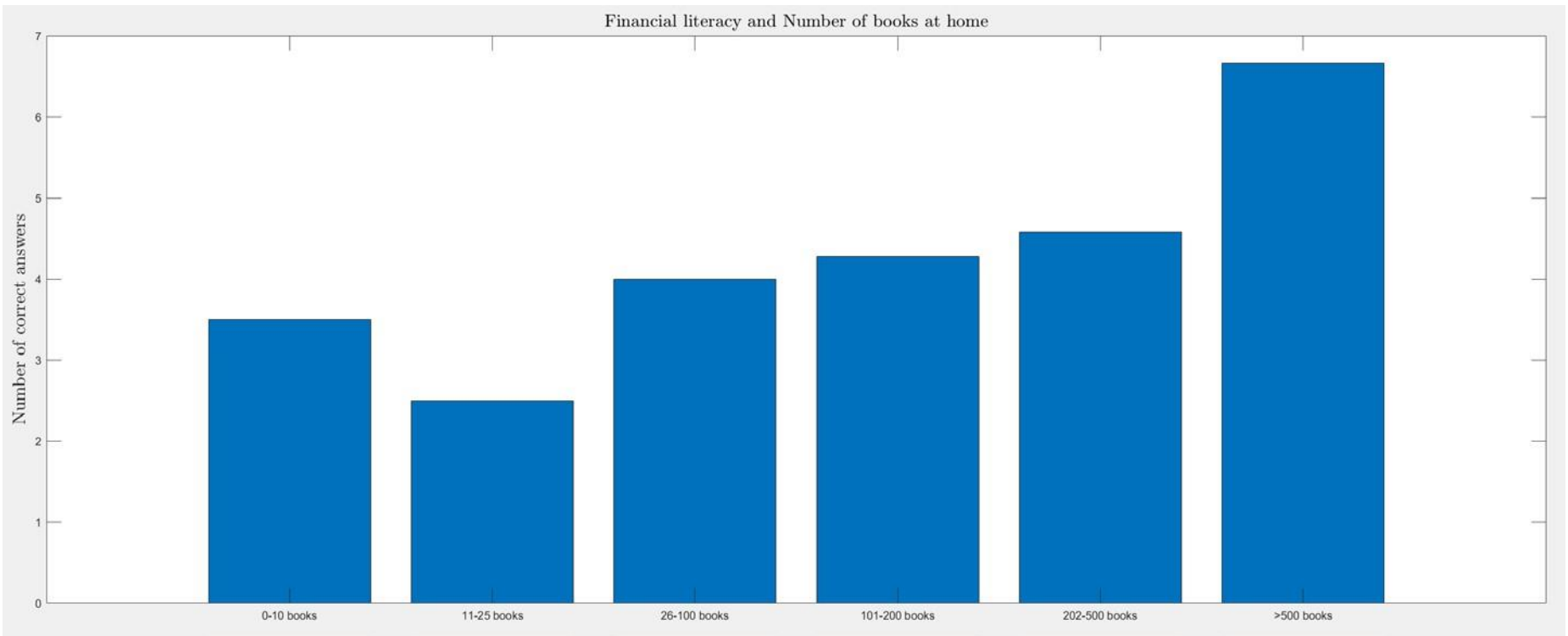
▪ Subjective financial knowledge *"What is your level of financial knowledge? Using a scale of 0 to 10, where 0 means you "have no financial knowledge" and 10 means "your financial knowledge is very developed". You can also use any number between 0 and 10 to indicate where you are on the scale."*

— Correlation between FL questions in the first part of the survey and the subjective financial knowledge is 2.41% (p-value=0.8693)

Results

Individual characteristics

Number of books at home

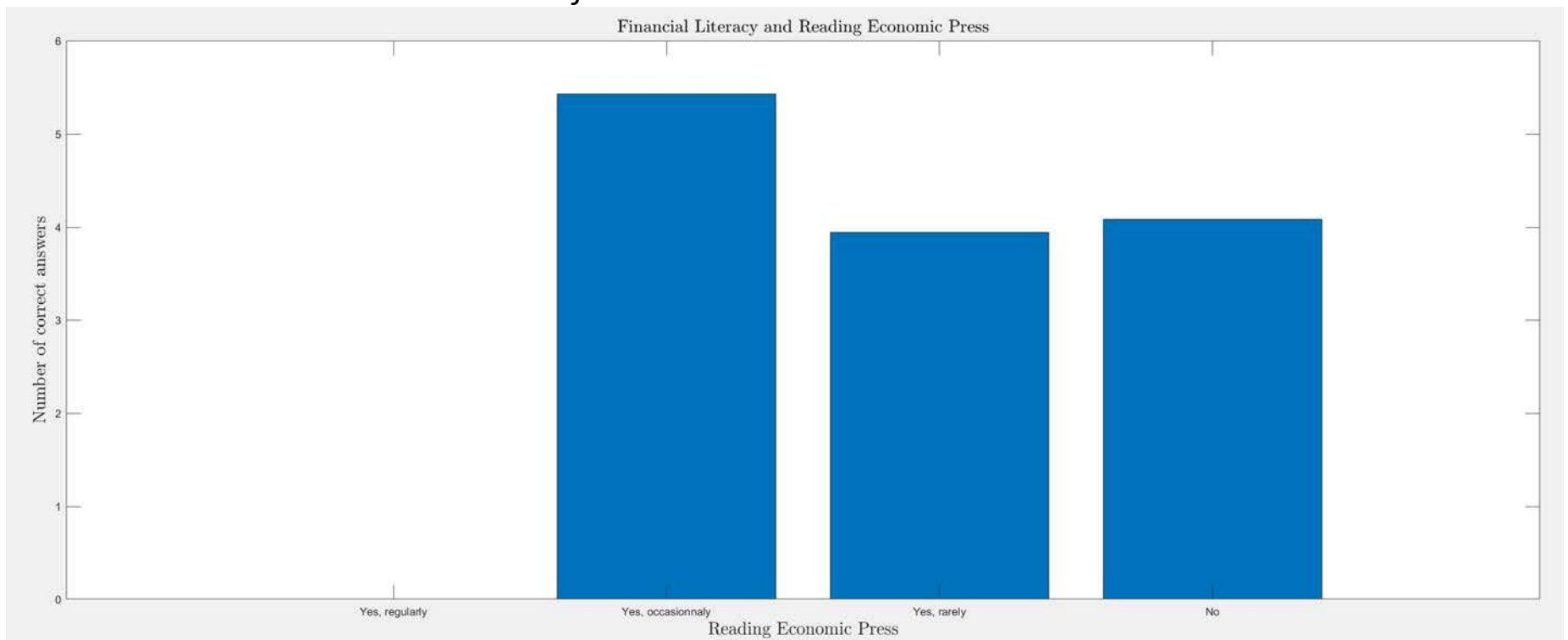


Results

Individual characteristics

Reading economic press

- *Do you read the economic and financial press, the economic pages of general newspapers, or consult websites in these fields?*



Results

Feedback on the game

- Participants liked to play the game (~7 on a 0-10 scale)
- Peer learning effects
 - Respondents often asked for help
 - Respondents often got help
 - Respondents often offered help



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