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Corso di laurea triennale in Economia e Commercio

"B come Bill"

Educazione finanziaria e efficacia della gamification nelle scuole superiori: evidenze da una ricerca quasi-sperimentale

"B come Bill"

Financial education and effectiveness of gamification in high-schools: evidence from a quasi-experimental research

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Contents

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Abstract

This thesis investigates the effect of financial education on financial literacy in a small sample of high-school students in Civitanova Marche, Italy. Students in the treated class were taught a game-based course in economics and finance and interviewed before and after the course, while Control ones were only interviewed.

The principal result is that the difference-in-difference estimate suggests that the game-based course has enhanced financial literacy of the treated class. Boys began with a higher level and ended up with the most relevant gain. Treated students also discovered and appreciated a new way of learning through competition and through the regular use of easily available technology.

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1 Introduction

To start discussing about financial literacy it is convenient to bear in mind the global context with particular attention to the italian situation. This could be done through some figures from the last report of the Organisation for Economic Co-operation and Development, furthermore OECD (OECD (2020), OECD/INFE 2020 International Survey of Adult Financial Literacy [1]).
In Italy, with regard to the financial knowledge section, only a 43.8% of the sample achieved at least the minimum target score (five correct answers out of seven) compared with the 52.5% average of the whole sample of 26 countries[5].
Italy's mean financial knowledge score is also disappointing. A bare 3.9 against a global 4.4, placing as the twentiest of twentysix[6].
Things don't change when the focus is moved to youngsters. In fact insights from OECD/PISA (2020) study [2] reveal that even Italian high-school students are less literate then their peers. Italy's score (476 points) was the fourteenth out of twenty and was quite far from the sample average (505 points)[7]. Moreover, Italy also underperformed with respect to its economic dimension (measured through per-capita GDP)[8].
These figures give the idea of the necessity of the work to bring about in Italy,hence this paper attempts to add a piece to the mosaich of courses, activities and research recently put in place to solve the "italian question". Among these it is impossible not to mention the activity of the *Comitato per la programmazione ed il coordinamento delle attività di educazione finanziaria* (henceforth *Comitato*) which produces tremendously useful insights into financial education activities and suggests the most advanced treatment strategies.
Then there are the web pages of some financial institutions such as *Banca d'Italia*, *Commissione Nazionale per le Società e la Borsa* (CONSOB),

[5] Pag. 22 of the aforementioned report
[6] Pag. 21 of the cited report
[7] Pag. 74 of the paper
[8] See Fig. IV.2.6 in the report

Commissione di vigilanza sui Fondi Pensione (COVIP), *Istituto per la Vigilanza sulle Assicurazioni* (IVASS) and *Fondazione per l'Educazione Finanziaria e al Risparmio* (Feduf) which offer precious didactic materials for teachers, students and everyone who wants to get the basics of economics and personal finance, in addition to several seminaries.
However, in approaching high-schools the most active subjects on the Italian territory (after only Banca d'Italia) are commercial banks. Almost all of them keep some financial education webpages but three of the biggest ones, Intesa San Paolo, Unicredit and Monte dei Paschi di Siena sponsor "Young Factor", a project consisting of web materials, an application for teachers and some projects taken on through lectures in high-school classes. Yet data on these projects are not publicly available and so it is hard to assess the quality and the effectiveness of their works.
The issue with the aforementioned activities is that they are generally designed focusing too much on contents rather then on learning process, resulting in a boring kids' perception (Hoffman et al. 2019)[3].

The project presented here was born to bring financial education into high-schools and to make it an entertaining subject through the use of high visual impact materials, interactive lectures and gamification. It was structured as a 10-hour course brought on along 10 weeks. The mission was to enhance the understanding of technical concepts of financial education by involving students into those topics. To assess the effect of the course, the sample has been split in a Treatment group and in a Control group and then a difference-in-difference analysis was carried out, firstly without any controls and then accounting for gender and for some socio-demographic variables related to families to further investigate some of the findings showed in the OECD/PISA report[9]. However, the reader has to notice that the small sample

[9]Pag. 80 "Parents [...] are students' most common source of information about money matters: 94% of students reported obtaining such information from their parents, on average across OECD countries/economies"

set some limits to the significance of the figures presented below.

Thanks to the growing literature on the effect of school-based courses (e.g. Lusardi, Menkhoff, Urban, Kaiser (2021)[4]; Amagir (2018)[5]; Urban (2018)[6]), it can be stated that a well structured program can impact financial attitude as well as knowledge. Thus, this study will not investigate long-term financial attitude assuming that, if there is a positive effect (as it is) on financial knowledge, we can expect some positive effects also on financial attitude.

The choice to follow a new teaching approach, different from the traditional "one-man speech", to enhance the effectiveness of the course, springs from several trials brought about among different subjects at different ages, many of them reporting some good results.

For instance Lusardi (2015)[7] focused on the need of delivering educational contents in new different ways that engage the user emotionally or physically by testing visual tools and narratives; Amagir (2018)[5] found that "Experiential learning" is the most effective learning process for finance courses; Berg and Zia (2013)[8] proved this through the emotional involvement produced by a TV soap opera; Carpena et al. (2017)[9] measured the positive effect of video-lessons and Kaiser and Menkhoff (2022)[10] observed, via a RCT, that "Active learning" is way more effective than traditional "lecturing"

The employment of a game-based approach follows these hints and the building process takes a cue from Clark, Tanner-smith, Killingsworth (2015)[11] who analyzed the effect on learning of single-player games in different subjects; from Fotaris' works on game-based learning (2017)[12], in particular when supplying specific tools to build gamified activities (2016)[13] as also Guarascio et al. (2017)[14] and, in the end, it was inspired by Onodipe's findings about the use of mobile devices at school (2020)[15].

The paper is divided into five sections. In the second section the experimental design is outlined. In the third section data are described and the descriptive

results illustrated. In the fourth section findings from the econometric models are discussed. In the fifth section, conclusions are drawn.

2 Empirical methodology

2.1 The project structure

The project was born whitin the Contamination Lab of the *Università Politecnica delle Marche* as a business idea. The trial was carried out on a sample of 40 students of two classes enrolled in the fourth year of classical and scientific curricula[10], in Civitanova Marche. It was designed as a 10-hours course and brought on along ten weeks.

The sample has been split into two groups:

Treatment group (T) which has been taught a 10-hours course on finance and took a survey right before (pre-test) and after the course (post-test);

Control group (C) which only took pre-test and post-test at the same time intervals, without receiving the course.

Control and Treatment group have been chosen between the two classes of the teacher assigned to the project by taking the most numerous as the Treatment group and the other as the Control group.
The amount of hours of the course has been chosen following the indications supplied by Amagir et al.[5] which state that it takes at least 10 hours for a program to be effective.
Lecture time, actually 54 minutes, was subdivided into three key activities:

20 minutes Lecture with slides

15 minutes Interactive case-study

15 minutes Quiz on lecture's topics

(4 minutes Time to make up for any delays)

[10] *Liceo classico* and *Liceo scientifico* have historically been considered the most prestigious types of high-school in Italy. Their curricula covers the humanities (Latin, Greek, Italian, art and philosophy) and the sciences (mathematics, physics, chemistry, and biology).

Questionnaires have been answered by the students in the presence of the teacher.

While carrying out the analysis, it is necessary to be aware of the fact that both the treated and Control group were exposed to the survey twice within approximately 3 months, therefore, both treated and Control group might have learned how to answer the specific questions of the test. To muffle this effect, pre-test and post-test questions were different in formulation but similar in meaning. The selection of pre-test and post-test questions was made on the basis of the OECD FinLit measurement toolkit [16] and of the financial culture questionnaire webpage of CONSOB. The project is drawn up in Italian yet it can be entirely translated to every language by simply adapting some parts[11] and, in case, currency.

The material used within the course consisted of:

1. a set of 10 dynamic slides presentations crowded with pictures, charts, videos and memes (Fig. 1);
2. a set of 10 case-studies arranged with interactive spreadsheets, pdf documents, websites and physical games (Fig. 2);
3. a set of 10 quizzes focused on the topic of each lecture which gave points to climb the class leaderboard (Fig. 3).

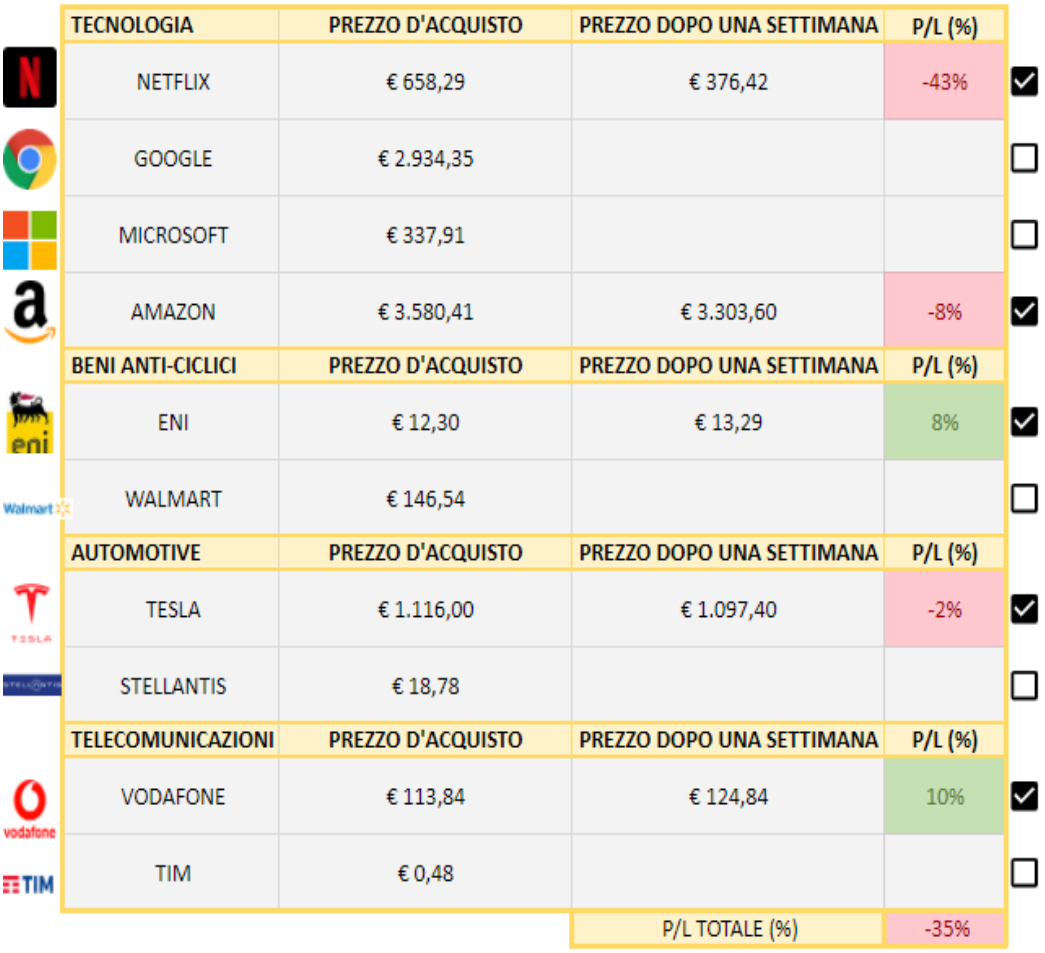
To build the educational program different sources were employed.

The frame structure was inspired to the 2020 edition of *Quaderni didattici* by *Banca d'Italia*. There are two of them, one for kids and one for teachers which, combined, helped in creating slides that were entertaining and technical at the same time. Following edits were made based on university text books (e.g. "Microeconomics"[17]) and teachers educational materials.

[11] The peculiar details of the Italian system to be adapted are: Lecture 1: taxation scheme, ISEE statement;
Lecture 3: Central bank aims, inflation calculation; Lecture 5: bank transfer method, example of issuers, payments regulation, cash ceiling; Lecture 6: inflation calculation, example on inflation; Lecture 8: *Centrale dei rischi*, credit regulation, TAN and TAEG acronyms.

Case-studies were realized trying to cover topics sticking to the lecture and experiences that high-school students already face or will face in a short period of time while keeping them amusing and interactive. Examples are tuition fees calculation based on students' favorite faculty, sustainability Game of the goose played in two teams and the stock picking game.
Quizzes were developed by taking them from external sources, mostly from university books and websites (e.g. okpedia.it) and adapting them to the details of the course.
All the materials are freely available in view-mode via this link: *bcomebill.com/materials*.
The slides used as a support for the lectures and the pdf of the case-studies have been built in the graphic editor Canva, while quizzes and spreadsheets have been dispensed via Google's free tools "Forms" and "Spreadsheets". So the course has been built completely with free and easy manageable softwares.

Figure 1: An example of slide from the fourth lecture.



TECNOLOGIA	PREZZO D'ACQUISTO	PREZZO DOPO UNA SETTIMANA	P/L (%)	
NETFLIX	€ 658,29	€ 376,42	-43%	☑
GOOGLE	€ 2.934,35			☐
MICROSOFT	€ 337,91			☐
AMAZON	€ 3.580,41	€ 3.303,60	-8%	☑
BENI ANTI-CICLICI	**PREZZO D'ACQUISTO**	**PREZZO DOPO UNA SETTIMANA**	**P/L (%)**	
ENI	€ 12,30	€ 13,29	8%	☑
WALMART	€ 146,54			☐
AUTOMOTIVE	**PREZZO D'ACQUISTO**	**PREZZO DOPO UNA SETTIMANA**	**P/L (%)**	
TESLA	€ 1.116,00	€ 1.097,40	-2%	☑
STELLANTIS	€ 18,78			☐
TELECOMUNICAZIONI	**PREZZO D'ACQUISTO**	**PREZZO DOPO UNA SETTIMANA**	**P/L (%)**	
VODAFONE	€ 113,84	€ 124,84	10%	☑
TIM	€ 0,48			☐
		P/L TOTALE (%)	-35%	

Figure 2: An example of case-study from the sixth set.
«The stock market game is an effective form of "Experiential learning"»
Amagir (2018)[5]

Figure 3: An example of question from the fourth quiz. Translation: "How are public goods financed?" 1) By taxes and duties, 2) By labourer's contribution, 3) Directly by who uses them, 4) With free-riders' money.

2.2 The difference-in-difference model

The model used to assess the effectiveness of the course is the difference-in-difference model which is a quasi-experimental method[12] that compares the changes in outcomes over time between a population enrolled in a program (the Treatment group) and a population that is not (the Control group)[13]. For an application on a wider scale see Becchetti et al. (2011)[18]. The pure difference-in-difference estimator (DID) can be calculated by simply subtracting the differences in the scores of the pre-test and post-test of both Treatment and Control group. In formula:

$$(Y_1^C - Y_2^C) - (Y_1^T - Y_2^T) = DID \tag{1}$$

where the first term refers to the difference of pre- and post-test scores of the Control group (Y_1^C and Y_2^C) and the second to the difference of the scores of the Treatment group (Y_1^T and Y_2^T).
However, to further investigate the effect of some (time-invariant) characteristics on the increase in the financial literacy level of the sample, a regression can be performed controlling for additional variables. The model then would turn into:

$$\Delta Y = const + \beta_1 d_{DID} + \beta_2 X_1 + ... + \beta_n X_n + \varepsilon \tag{2}$$

where d_{DID} is the difference-in-difference dummy calculated as the interaction $T \cdot S$ of the time dummy (T), which is 1 when the observation comes from the post-test and 0 otherwise, and the group dummy (S) which is 1 when it comes from Treatment group, while the interaction coefficient β_1 is the quantification

[12] Quasi-experimental methods are used when perfect randomization is difficult to perform
[13] Definition from the World Bank website

of the DID estimator calculated as a marginal effect of the regression. The coefficients after β_1 are the effects of each variable over the first difference of the tests' outcome (ΔY).

To expect reliable results from the difference-in-difference model it is necessary to check the validity of the Equal Trend Assumption, this means that no time-varying differences exist between the Treatment and Control groups. Though the Equal Trend Assumption cannot be proved, this paper try to assess its validity by choosing two groups that are similar for their socio-demographic characteristics (see 3.1.2 "Treatment and Control group characteristics" in section 3).

Three variations of this model have been specified:

1. The first one to calculate the pure DID estimator without any control variable:

$$\Delta outcome = const + \beta \cdot \mathbf{did} \tag{3}$$

2. The second one is a wide specification to compute the DID estimator controlling for all the variables of control:

$$\begin{aligned} \Delta outcome = const + \beta \cdot \mathbf{did} + \\ + \gamma_1 \cdot \mathbf{gender} + \gamma_2 \cdot \mathbf{mean\_ed} + \gamma_3 \cdot \mathbf{family\_income} + \\ + \gamma_4 \cdot \mathbf{f\_works} + \gamma_5 \cdot \mathbf{m\_works} \end{aligned} \tag{4}$$

3. The third one to evaluate the effect of the most significant controls:

$$\begin{aligned} \Delta outcome = const + \beta \cdot \mathbf{did} + \gamma_1 \cdot \mathbf{gender} + \gamma_2 \cdot \mathbf{mean\_ed} + \\ + \gamma_3 \cdot \mathbf{family\_income} \end{aligned} \tag{5}$$

The dependant variable used above, $\Delta outcome$, is the difference of pre- and post-test scores.

2.3 Econometric models on Treatment group

In addition to the model presented above, another estimation was carried out to evaluate the impact of students' performances during the course on their financial literacy level together with the time-invariant variables used in the previous estimation. Even this model was developed through three specifications but using the post-test score, *outcome*, as dependant variable:

1. The first specification takes into account all the collected variables of control:

$$\begin{aligned} outcome = const + \alpha_1 \cdot \mathbf{pretest} + \alpha_2 \cdot \mathbf{gender} + \alpha_3 \cdot \mathbf{mean\_ed} + \\ + \alpha_4 \cdot \mathbf{family\_income} + + \alpha_5 \cdot \mathbf{f\_works} + \alpha_6 \cdot \mathbf{m\_works} + \\ + \alpha_7 \cdot \mathbf{quiz\_av} + \alpha_8 \cdot \mathbf{quiz\_sd} \end{aligned} \tag{6}$$

2. The second is a wide specification in which the parents' employment status was cut off.

$$\begin{aligned} outcome = const + \alpha_1 \cdot \mathbf{pretest} + \alpha_2 \cdot \mathbf{gender} + \alpha_3 \cdot \mathbf{mean\_ed} + \\ + \alpha_4 \cdot \mathbf{family\_income} + + \alpha_5 \cdot \mathbf{quiz\_av} \end{aligned} \tag{7}$$

3. The third specification is the leanest one and it only accounts for the most significant controls.

$$\begin{aligned} outcome = const + \alpha_1 \cdot \mathbf{mean\_ed} + \alpha_2 \cdot \mathbf{family\_income} + \\ + \alpha_3 \cdot \mathbf{quiz\_av} \end{aligned} \tag{8}$$

3 Descriptive analysis

3.1 Sample description and control variables

3.1.1 The sample

The overall sample was composed of 40 students (15 boys and 25 girls) of the fourth year of high-school that in Italy usually harbors boys and girls around 18 years-old. To describe the sample and also to test the Equal Trend Assumption, three social characteristics are now deepened: 1) the mean educational level of kids' parents (calculated as the average level between father and mother), 2) the number of employed parents and 3) household income as reported by kids. The sample has an average of 3.212 about parents' mean educational level, encoded as a 1-5 Likert from elementary school to post-graduate titles, that means that the average parent has a high-school degree; the vast majority of parents work, with a 5% and 10% of, respectively, fathers and mothers which are retired or unemployed; eventually kids reported that, in their perception, their own families enjoy a level of income between medium and medium-high, with an average of 3.175 in the 1-5 Likert prompted, that is very near to medium income.

3.1.2 Treatment and Control group characteristics

The Control group (C) was composed of 15 students from a fourth class of *Liceo Classico*. The Treatment group (T) was composed of 25 students from a fourth class of *Liceo Scientifico*. The analysis of the groups composition is used, as said above, to asses the validity of the Equal Trend Assumption and in this way a comparison table comes in handy (Tab. 1).

	Mean parents' education	Mean family income	Father employed	Mother employed
Control group	3.200 (1.983, 4.417)	3.200 (2.388, 4.011)	12/15 (80%)	12/15 (80%)
Treatment group	3.220 (1.775, 4.665)	3.160 (2.427, 3.893)	23/25 (92%)	21/25 (84%)
Whole sample	3.212 (1.865, 4.560)	3.175 (2.421, 3.930)	35/40 (87.5%)	33/40 (82.5%)
	1: Elementary s., 2: Middle s., 3: High s., 4: University, 5: Post-college	1: Very low, 2: Low, 3: Medium, 4: High, 5: Very-high	One of the unemployed fathers among the Control group is retired	No one among the mothers is retired

Table 1: Comparison table of groups composition with 95% confidence intervals

The difference between Treatment and Control group about the mean parents' education is very tiny ($3.220 - 3.200 = 0.020$) with a p-value of 92.7%, meaning that even statistically they are not so different. The difference between Treatment and Control group about the mean family income is trivial too ($3.160 - 3.200 = -0.040$) with a p-value of 76,2% and so with a high significance. Also the figures about the employment of fathers and mothers of the guys among the two subsamples are rather similar, though accounting for the smaller number of students from the Control group.
Just one significant difference has to be noticed: females in the Control group are 12 on 15 while in the Treatment group are 13 on 25.

3.1.3 Control variables

The variables employed to carry out both descriptive and inferential analysis are now introduced:

did, the difference-in-difference dummy obtained as explained in section 2.2;

gender, that is the gender dummy (1 if he is a boy, 0 if she is a girl);

mean_ed, that is parents' mean educational level, encoded as a 1-5 Likert from elementary school to post-graduate titles;

family_income, a variable that tells the kids' perception of the income that their own families enjoy encoded as a 1-5 Likert from very-low to very-high;

f_works, a dummy that is 1 if the kid's father is employed and 0 otherwise;

m_works, a dummy that is 1 if the kid's mother is employed and 0 otherwise.

pretest, that is the pre-test score

quiz_av, the average score achieved across the ten financial quizzes;

quiz_sd, the standard deviation of the quizzes' scores for each student.

3.2 Activities on Treatment group

Some descriptive results of the activities taken on within the course are now shown.

The first descriptive figures to look at are the scores' distribution and average from the quizzes submitted after every lecture. The average score of 8.352/10 with a standard deviation of 0.725 points reports a good and widespread level of understanding and indeed 44% of the students lay between 8.300 and 8.950 (Fig. 4). It can also be observed that boys achieved a slightly better result, on average, than girls (8.550/10 for boys against 8.170/10 for girls).

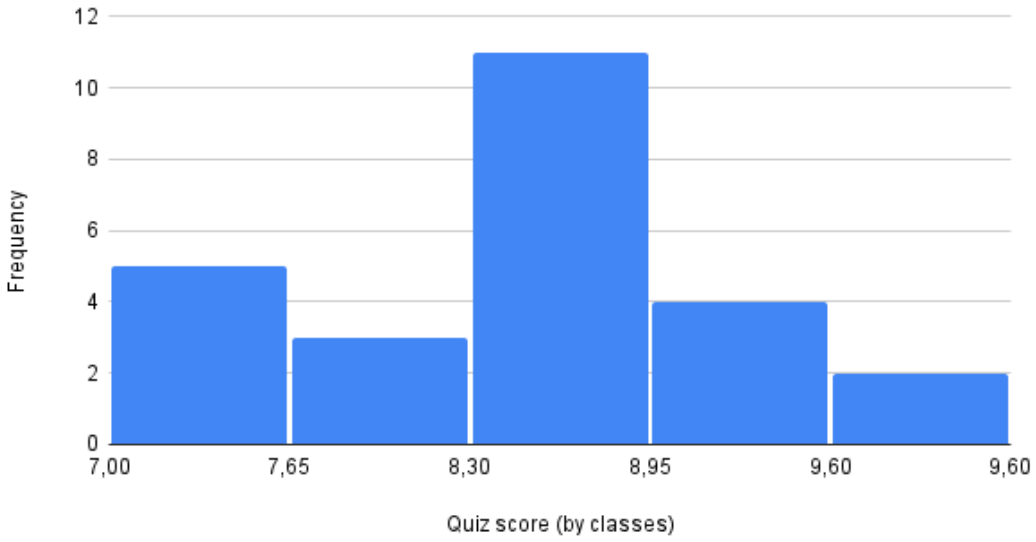


Figure 4: Quiz scores distribution

Then there is an interesting result: students who have shown less volatile scores (i.e. whose scores have smaller standard deviation) are also those with a higher average (Fig. 5).

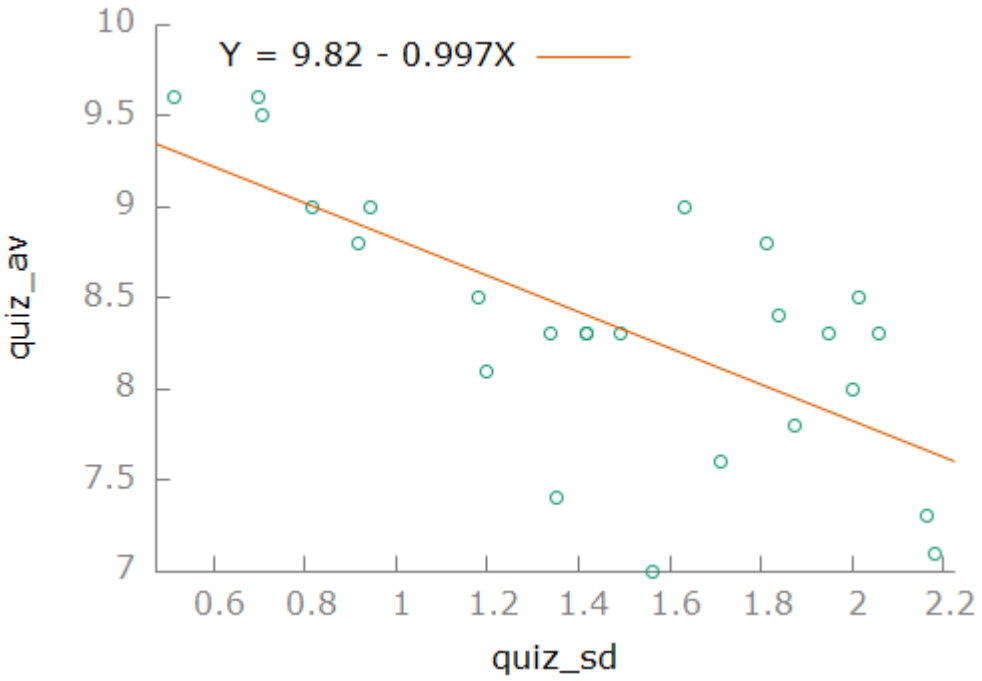


Figure 5: Negative relationship between quiz average and standard deviation with least squares fit

This analysis was performed by regressing, for each student, the values of quiz scores' standard deviation against the average values; that means that as independent variable it has been chosen the student's standard deviation of the 10 observations that each guy produced over the 10-hours course and as dependent variable the final average score reported after the tenth lesson. The coefficient that is really close to -1 (and very significant) warns that, on average, one additional point of standard deviation is associated to an almost 1 point smaller quiz mean.

Dependent variable: quiz_av

Heteroskedasticity-robust standard errors, variant HC1

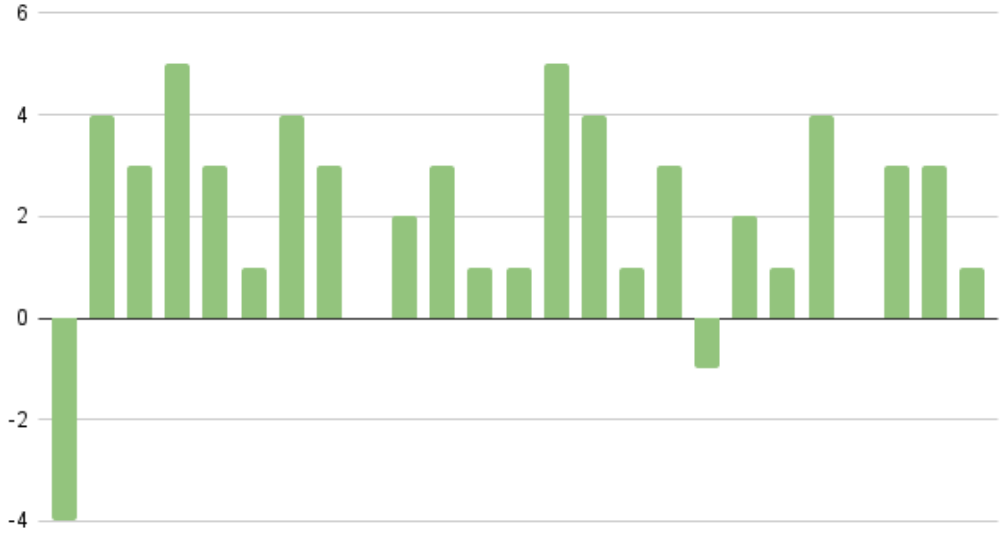
	Coefficient	Std. Error	t-ratio	p-value
const	9.820	0.246	39.950	0.000 ***
quiz_sd	−0.997	0.175	−5.706	0.000 ***

Mean dependent var 8.352000 S.D. dependent var 0.725213

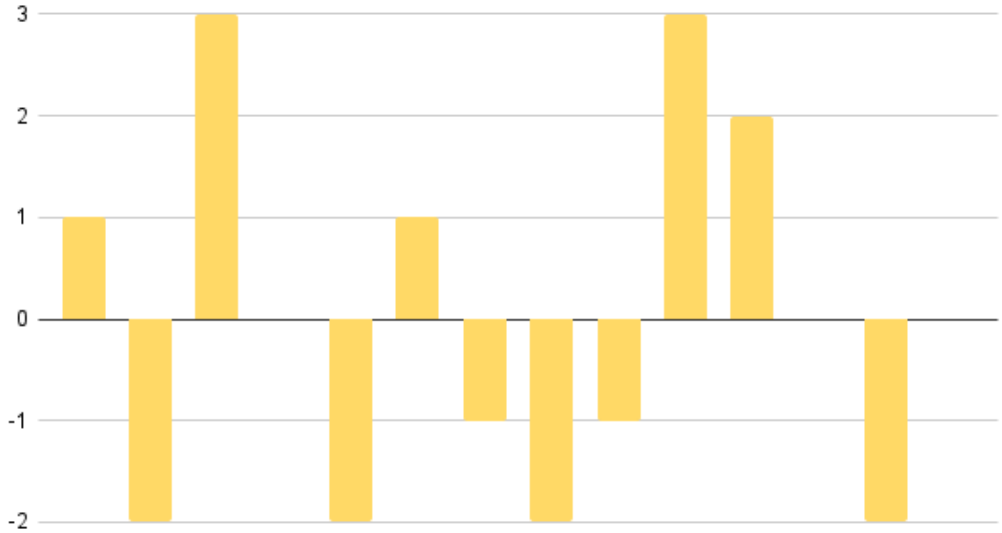
The last descriptive result focuses on the number of positive changes in the outcome of the pre-test and post-test. In other words it can be appreciated that in the Treatment group 21 out of 25 showed an increase in their outcome comparing pre- and post-test, 2 stayed flat and only 2 underperformed in the post-test. On the other group these figures are more confused: 5 students reported an increase, 4 stayed flat and 6 showed a decrease (Fig. 6a and Fig. 6b).

3.3 Satisfaction measures

At the end of the course 20 out 25 students also took an optional satisfaction questionnaire reporting that they would prefer to adopt an innovative teaching method and to enhance the use of technology. Results are summarized in Fig. 7.



(a) Treated



(b) Control

Figure 6: Score changes over pre-test and post-test outcomes.

(a) Did You like lecturing with a non-traditional method?

(b) Would You study other subjects more willingly if they were taught with similar methods?

(c) How many new things have You learned?

(d) How easy were quizzes?

(e) Did You like to often employ digital tools?

(f) Would You like to use digital tools for other subjects?

Figure 7: Answers to satisfaction questions

4 Results

To further investigate the impact of the course on the level of financial literacy six linear regression models have been specified. In particular the first three to assess the pure difference-in-difference (DID) estimator and its value with some time-invariant, socio-demographic variables of control 2.2.
The other three specifications involve only the Treatment group and have been built in order to control also for: the quiz average, the quiz standard deviation and the pre-test outcome 2.3.

4.1 DID models

4.1.1 Pure DID estimator

Results from estimating Equation 2 are reported here below.

Model 1a: OLS, Pure DID estimator ($n = 40$)
Dependent variable: delta_outcome
Heteroskedasticity-robust standard errors, variant HC1

	Coefficient	Std. Error	t-ratio	p-value
const	0.000	0.443	0.000	1.000
did	2.080	0.604	3.445	0.001 ***

The regression also shows that, consistently with the definition, the pure DID estimator can be exactly calculated via the subtraction of the outcome differences among the two subsamples (1):

$$(4.000 - 4.000) - (4.960 - 7.040) = 2.080 = \beta$$

This result indicate that the course has had a positive impact on the level of financial literacy of the treated students and this effect is evaluated as 2.080 more points out of 10 on average, with respect to the members of Control group.

4.1.2 DID with all the controls

Model 2a: OLS, DID with all the controls ($n = 40$)

Dependent variable: delta_outcome

Heteroskedasticity-robust standard errors, variant HC1

	Coefficient	Std. Error	t-ratio	p-value
const	−0.622	2.409	−0.258	0.798
did	1.866	0.736	2.536	0.016 **
gender	−0.089	0.668	−0.133	0.895
mean_ed	0.374	0.454	0.824	0.416
family_income	0.518	0.787	0.658	0.515
f_works	−1.277	0.544	−2.347	0.025 **
m_works	−0.937	0.862	−1.087	0.285

In the second specification (4) the DID estimator is computed together with other five time-invariant controls: **gender**, **mean_ed**, **family_income**, **f_works** and **m_works**.

The DID coefficient is now a bit lower than previously because part of the positive effect is now explained by **family_income** and **mean_ed**. The **gender** dummy coefficient is slightly negative, though with a very low significance. Eventually the employment status variables seems to be negatively linked to the difference in the outcome. This may be due to the fact that unemployment imposes a more austere (and so wiser) economic life.

4.1.3 DID with gender, mean_ed and family_income

Model 3a: OLS, DID with *gender*, *mean_ed* and *family_income* ($n = 40$)

Dependent variable: delta_outcome

Heteroskedasticity-robust standard errors, variant HC1

	Coefficient	Std. Error	t-ratio	p-value
const	−2.562	2.722	−0.941	0.353
did	2.113	0.659	3.208	0.003 ***
gender	−0.068	0.680	−0.100	0.921
mean_ed	0.306	0.446	0.684	0.498
family_income	0.499	0.731	0.684	0.499

In the last specification (5) the DID coefficient is even bigger than in the first (4.1.1) with a very high significance level. The *gender* dummy keeps reporting a near-to-zero impact though negative and with a not significant p-value. The effect of the mean educational level and of the income of students' families continues to be positive to a modest extent. This model should be regarded as a good compromise for model width and coefficients' significance.

To finish up this sub-section dedicated to DID's estimations a summary table has been built. The rows of this scheme harbor coefficient values for each of the variables seen. The columns are for the three different specifications.[14]

Coefficient \ Specification	Pure DID estimator	DID with all the controls	DID with *gender*, *mean_ed* and *family_income*
DID	2.080 ***	1.866 **	2.113 ***
gender	-	-0.089	-0.068
mean_ed	-	0.374	0.306
family_income	-	0.518	0.499
f_works	-	-1.277 **	-
m_works	-	-0.937	-

[14] *** means p-value < 0.01, ** means p-value < 0.05, * means p-value < 0.10

4.2 Treatment-only models

4.2.1 Model with all the controls

Model 1b: OLS, Model with all the controls ($n = 25$)

Dependent variable: outcome

Heteroskedasticity-robust standard errors, variant HC1

	Coefficient	Std. Error	t-ratio	p-value
const	−10.832	8.548	−1.267	0.223
pretest	−0.114	0.269	−0.422	0.678
gender	0.288	0.607	0.475	0.641
mean_ed	0.699	0.433	1.617	0.125
family_income	1.623	0.777	2.088	0.053 *
f_works	−0.402	1.071	−0.375	0.712
m_works	−0.274	0.644	−0.425	0.677
quiz_av	1.238	0.631	1.962	0.067 *
quiz_sd	0.799	1.304	0.613	0.549

Contrary to what was done above, the first model estimated is the one that allows to control for more variables (6).

As the reader can assess, the significance level of these coefficients is not so reliable. In fact only three of them have a p-value near to a significance threshold: **mean_ed**, **family_income** and **quiz_av**. For this reason, these three variables are the starting point of the further specification.

4.2.2 Wide specification

Model 2b: OLS, Wide specification ($n = 25$)

Dependent variable: outcome

Heteroskedasticity-robust standard errors, variant HC1

	Coefficient	Std. Error	t-ratio	p-value
const	−6.690	3.227	−2.073	0.052 *
pretest	−0.204	0.244	−0.837	0.413
gender	0.018	0.603	0.029	0.977
mean_ed	0.617	0.340	1.816	0.085 *
family_income	1.473	0.654	2.253	0.036 **
quiz_av	0.969	0.301	3.219	0.004 ***

Estimating Equation (7) **pretest** and **gender** were kept into account together with the three most significant controls. As it can be noted from the values in the first column, the three key regressors (**mean_ed**, **family_income** and **quiz_av**) gain consistency and have all a positive impact, especially the income level that drives almost 1.5 points per unit. The gender effect is still near to zero and very low in significance. The coefficient linked to the pre-test score variable is also near to zero although a bit negative and in particular this last value, with a 95% confidence interval between -0.714 and 0.306, may suggest that the starting level of financial knowledge did not influenced the post-test score to a relevant extent and so that the kids started from a similar baseline.

4.2.3 Lean specification

Model 3b: OLS, Lean specification ($n = 25$)

Dependent variable: outcome

Heteroskedasticity-robust standard errors, variant HC1

	Coefficient	Std. Error	t-ratio	p-value
const	−5.868	2.844	−2.064	0.052 *
mean_ed	0.574	0.343	1.679	0.108
family_income	1.298	0.418	3.105	0.005 ***
quiz_av	0.833	0.334	2.493	0.021 **

Finally, only the most significant variables were employed 8. This last specification shows a strong positive connection between the post-test result (that was the final assessment of financial literacy) and the educational and economic background of kid's family. Furthermore, not surprisingly, a positive effect was also attributed to the quiz average score indicating that students who better understood the topics increased the most their financial literacy level.

Going down deeper into the figures, given that **mean_ed** and **family_income** are expressed in a Likert 1-5, the variation of 1 point on the Likert scale is linked to a change in the expected outcome to the extent of the associated coefficient. The educational background of parents has the least positive effect ($\alpha_1 = 0.574$) while family's income weights more than twice ($\alpha_2 = 1.298$). This last finding deserves some adding lines. Seen this last value it can be logically stated that kids who lives in better economic conditions tend to better absorb economic and financial concepts and henceforth to have a savvier financial behaviour (see the assumption made in the Introduction). Wiser financial choices, of course, have a positive impact on financial conditions so the danger could be the persisting of pre-existing economic inequalities.

Eventually the last coefficient linked to the average score on quizzes suggests

that 1 additional point of **quiz_av** leads to an increase of almost one point ($\alpha_3 = 0.833$) in the post-test assessment (*outcome*). Hence the higher the understanding during the whole course, the higher the final score, as the reader could imagine.

As done above, the results are finally summarized into a table.

Coefficient \ Specification	All the controls	Wide specification	Lean specification
pretest	-0.114	-0.204	-
gender	0.288	0.018	-
mean_ed	0.699	0.617 *	0.574
family_income	1.623 *	1.473 **	1.298 ***
f_works	-0.402	-	-
m_works	-0.274	-	-
quiz_av	1.238 *	0.969 ***	0.833 **
quiz_sd	0.799	-	-

4.3 Gender gap

Lastly, despite a low significance of the gender dummy, a difference has to be faced. On average girls started at lower levels of financial knowledge than boys and finished with a lower increase (see the flatter slope of the pink line in Fig. 8). To be more accurate, the gender difference recorded before the treatment was 0.237 and after the lectures it became 0.404. Although these differences, as already said, are not statically significant they go along with Bottazzi and Lusardi (2021)[19] (see Fig. 9), Hasler (2017)[20] and Rinaldi (2017)[21] just to cite a few of the uncountable works that assess the gender gap in financial literacy. To deepen this topic, a suggested source of precious indications is The Sound of Economics podcast episode, starring Annamaria Lusardi and Maarten van Rooij, in which the first states that one third of the gender gap could be explained by women's lack of self-confidence.

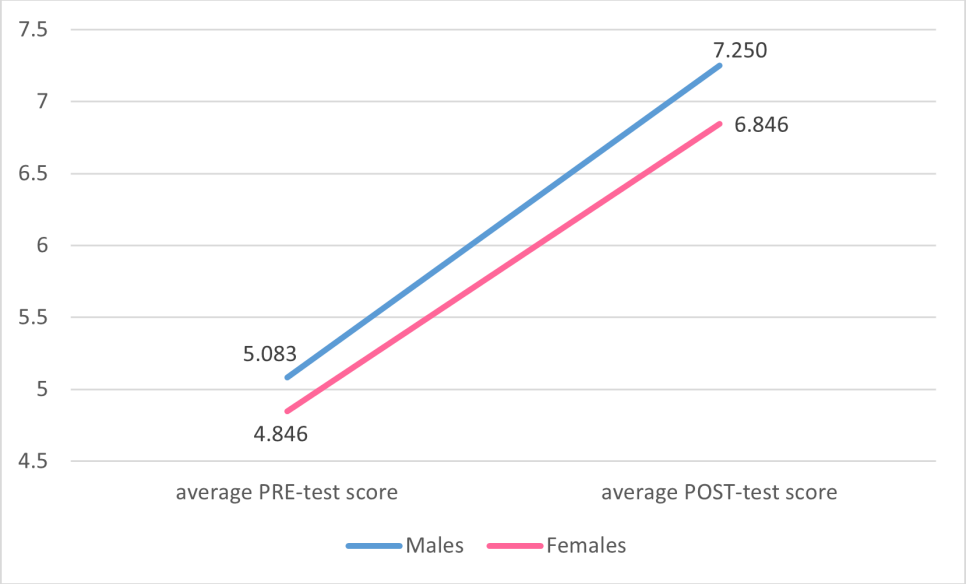


Figure 8: Average score records, Males vs Females

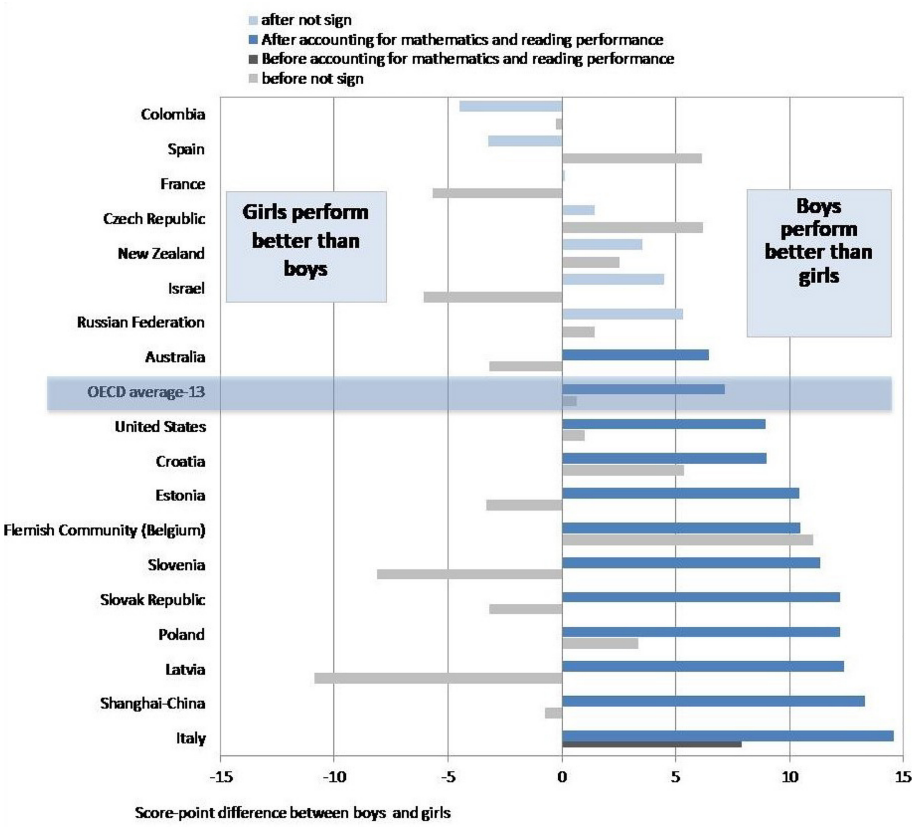


Figure 9: Males vs Females scores in Bottazzi and Lusardi's work

5 Conclusions

Financial education is an increasingly investigated dimension of human development and realization. Building a strong economic background is becoming more and more crucial to face more frequent crisis (subprime crisis, euro-debit crisis, Covid-19 and the Russia-Ukraine war in just 14 years) and, more generally, a turbulent financial environment in which people are more frequently asked to take financial decisions with relevant effects for their present and future wealth.

This thesis aims to stress the importance of teaching introductory notions of financial education in school, providing an original contribution to the analysis of the impact of financial education done with more appealing and emotionally involving tools and modalities. The results stemmed from the two types of specification indicate that the course had a positive impact on financial literacy score (+2.080/10 points) and that the variables that drove the most this positive change are parents' educational level, the economic condition of the family and the understanding of financial topics (measured with the quiz average score).

An additional observed result, although not statistically significant, is the difference in the performance of boys and girls. Males, in fact, started at a slightly higher level of financial knowledge and outperformed females after the course. Put in numbers, the difference before the treatment was of 0.237 and after the lectures it became 0.404.

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