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**Article**

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Article

# Causal Effects of Financial Education Intervention Aimed at University Students on Financial Knowledge and Financial Self-Efficacy

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**Abstract:** Based on a randomized controlled experiment among final-year undergraduate students, we provide an assessment of the treatment effects of financial education intervention focused on debt-financed graduate education decision-making. Specifically, this study finds positive treatment effects on both college seniors' objective financial knowledge and subjective financial knowledge and self-confidence (i.e., perceived financial self-efficacy). Individual financial well-being is thought to be enhanced by improved financial knowledge test scores and perceived financial self-efficacy. In addition, we carry out a causal mediation analysis to investigate the extent to which objective financial knowledge plays a mediating role in the effect of financial education treatment on the intervention outcome (perceived financial self-efficacy). The mediation proportion, the proportion of treatment effect on outcome explained by the intermediate variable of financial knowledge, is around 21%, which is important. Thus, policies that aim to improve financial capabilities among college students through financial education programs should be aware that financial literacy is a significant antecedent of (a prerequisite for) financial self-efficacy.

**Keywords:** financial education; financial literacy; financial self-efficacy; causal mediation analysis; randomized controlled experiment



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## 1. Introduction

Financial education programs aimed at university students to help them make sound financial decisions when incurring student loan debt are necessary and vital in the context of a considerable increase in the number of students borrowing to finance educational expenditures (Avery and Turner 2012), but also in which the default rates on student loans have been steadily climbing (Mueller and Yannelis 2019). These initiatives should show students explicit costs and risks associated with taking out loans and the consequences of debt financing their education. Experts say knowing the dangers of overborrowing and how to repay loans can help tackle student debt (Bidwell 2013). Yet, the reality is that nowadays most undergraduate and graduate students lack financial literacy and student loan literacy (Kantrowitz 2019).<sup>1</sup> Many authors already agreed that students do not have sufficient knowledge about loans and need more or better information (e.g., Holland and Healy 1989). Further, many parents of college-aged students are poorly equipped to provide financial guidance for their children due to their own lack of experience in managing high amounts of education debt (Brady et al. 2021). Students often misunderstand financial aid packages, which translates into poor financial decision-making (Rothstein and Rouse 2011). In this regard, in a qualitative study with a sample of students enrolled in a graduate degree program in public and private not-for-profit institutions in California, Dorado (2014), almost a quarter of the study participants lacked an understanding of student loan borrowing and 88% of the participants who borrowed student loans lacked knowledge of loan repayment. A similar result was found by Johnson et al. (2016), in their qualitative study many students indicated unfamiliarity with their loans and anxiety about paying them off. The Financial

Literacy and Education Commission (FLEC) also reported that many students do not fully understand student loans or available repayment plans ([Financial Literacy and Education Commission 2019](#)).

Nevertheless, financial knowledge alone is insufficient to gain the necessary understanding of what someone is capable of in terms of making financial decisions ([Amagir et al. 2020](#)). In this regard, various studies have shown that greater financial knowledge can contribute, but does not guarantee, that individuals make adequate financial decisions (e.g., [Friedline and West 2016](#)). An individual also needs a sense of self-assuredness, or self-belief, in their own capabilities. This personal attribute is known within the psychology literature as “self-efficacy”<sup>2</sup>. It is expected that financial literacy is to be a key antecedent of financial self-efficacy, which in turn may influence financial behaviors ([Singh et al. 2019](#)). One of the first works in this regard that focused on university students was that of [Heckman and Grable \(2011\)](#). These authors used a sample of college students enrolled at a midwestern U.S. university and the results from the path analysis showed a positive association between financial knowledge and self-efficacy: more knowledgeable college students (tested on a 20-item personal finance quiz) had higher levels of perceived self-efficacy (how confident they felt about making decisions that dealt with money). More recently, the path analysis by [Herawati et al. \(2020\)](#) showed a direct effect of financial literacy on financial self-efficacy among undergraduate accounting students in Bali. [Kartawinata et al. \(2021\)](#), using a sample of Indonesian college students, showed that financial literacy has a significant effect on financial self-efficacy, which in turn has a significant effect on financial inclusion. Finally, [Liu and Zhang \(2021\)](#) investigated the mediating mechanisms in the relationship between Chinese college students’ financial literacy and risky credit behavior. Financial self-efficacy partially mediated the relationship between financial literacy and risky credit behavior. College students’ objective financial literacy was positively related to their financial self-efficacy. Nonetheless, very few academic papers have focused on student loan decision-making. Among these, the work of [Shim et al. \(2019\)](#) demonstrated that individuals with greater financial self-efficacy perceived less difficulty in repaying their student loans and, in turn, experienced less loan-related stress. More recently, [Brady et al. \(2021\)](#) examined factors associated with financial self-efficacy among student loan borrowers in the United States; their results showed that perceived student loan literacy prior to accruing higher education debt was significantly associated with financial self-efficacy. In truth, the literature on self-efficacy is abundant in psychology and related fields (e.g., [Maddux and Gosselin 2012](#)), but it has not been until recently that researchers have begun to study the concept of self-efficacy within the finance domain.

In addition to the publications focused on university students that we have just cited, we summarize other key general contributions to the literature. First, we highlight the work of [Farrell et al. \(2016\)](#) who, using a 2013 survey of Australian women, showed that financial self-efficacy arises as one of the strongest predictors of the type and number of financial products that a woman holds. Specifically, their analysis revealed that women with higher financial self-efficacy, i.e., with greater self-assuredness in their financial management capacities, are more likely to hold investment and savings products, and less likely to hold debt-related products.<sup>3</sup> Second, [Rothwell et al. \(2016\)](#), using a national sample of low-income Canadians, showed that the association between objective financial knowledge and retirement saving and emergency saving passed through financial self-efficacy. Thus, these authors advocated that improving objective financial knowledge is necessary but not sufficient to build financial capability. Third, the results of [Mindra et al. \(2017\)](#) showed a strong positive and significant relationship between financial self-efficacy and financial inclusion among individual financial consumers in Uganda. Their results suggested that, when an individual possesses high levels of confidence to manage tasks specifically related to financial services, it indicates higher financial inclusion (access to and use of financial products and services). Finally, the structural equation model results by [Asebedo et al. \(2019\)](#) revealed that financial self-efficacy directly explains saving behavior and is central to

understanding the link between other psychological characteristics and the saving behavior of older U.S. adults.

However, the literature reviewed above has been based on correlational studies, and confusing correlation with causality is a critical flaw (Hathaway and Khatiwada 2008). The causal effects of financial education programs (i.e., their impact on financial outcomes) can only be evaluated experimentally. That is, we must separate “impact studies” (e.g., experiments) from “observational studies” (e.g., econometric analysis) (Miller et al. 2015). The novelty of the scientific approach of our study is that it uses a randomized controlled trial that allows us to evaluate the effectiveness of a financial education program aimed at college seniors in making the decision to finance a master’s degree with a graduate loan. In particular, the main objective of the article was to evaluate the impact of the educational intervention on financial knowledge and financial self-efficacy, variables that precede the intention to apply for a graduate student loan. Furthermore, we wanted to investigate to what extent objective financial knowledge plays a mediating role in the effect of the financial education treatment on the perceived financial self-efficacy. To this end, we propose causal mediation analysis, which has recently been used in medical research and psychology, but its use is practically non-existent in behavioral finance.

The remainder of this paper is organized as follows. In Section 2, the study undertaken is justified and the main research questions to be answered are raised. Section 3 summarizes the experimental design. Next, measures of financial knowledge and financial self-efficacy are introduced in Section 4. In Section 5, we evaluate the impact of the financial education intervention. In Section 6, we undertake causal mediation analysis to study the mediating role of financial literacy in the relationship between financial education and financial self-efficacy. The main conclusions are presented in Section 7.

## 2. Research Purpose and Rationale

Financial education initiatives aim to improve people’s ability to process economic information to make informed financial decisions (financial knowledge), as well as their self-assessment of their own financial capability (financial self-efficacy) (Rothwell and Wu 2017). At higher education level, the extent to which financial education programs improve financial knowledge, financial self-efficacy, and financial behaviors is of primary interest to policymakers and higher education institutions alike. In the context of substantially higher tuition fees and the consequent increase in financing higher education with educational loans, better financial knowledge and self-efficacy could help improve financial decision-making among university students in relation to the possibility of taking out a student loan, avoiding situations of overborrowing or, at the other end of the spectrum, stopping studying if doing so implies financing the studies with debt but the individual lacks the knowledge and ability to successfully make the decision. However, limited research has been carried out into how financial education impacts outcomes such as financial knowledge and self-efficacy (Rothwell and Wu 2017). The causal mechanisms through which financial education operates are not well understood because it is difficult to separate correlation from causation (Carpena and Zia 2020). True experiments with random assignment of individuals to treatment and control groups are considered the gold standard for evaluating program effects and avoiding self-selection bias (Rossi et al. 2004). “Experiments are commonly designed to find out whether a certain kind of treatment has an effect or not” (Urbach 1985, p. 256). In financial education programs, the null hypothesis assumes that the intervention does not affect the financial knowledge and other financial outcomes such as attitudes, self-efficacy, and the behavior of the people subjected to the treatment (Miller et al. 2015). For example, Kaiser and Menkhoff (2019), in an updated meta-analysis of experimental studies of school financial education programs, found that financial education treatments have, on average, sizeable impacts on financial knowledge among students, although smaller effects on financial behaviors. Kaiser and Menkhoff (2019) only found 18 interventions using randomized control trials (RCTs) and focused on financial education in schools. Indeed, we must recognize that there is still little empirical evidence of the

positive causal effects of financial education programs at the personal level (Hastings et al. 2012). Lusardi and Mitchell (2014) already reported that few empirical studies can be considered serious evaluations of the effectiveness of financial education programs. Additionally, randomized experiments studying the impact of financial education on the financial decision-making of university students are practically non-existent. The present study attempts to fill that existing gap in the literature and its main contribution is to assess the effects of financial education intervention focused on debt-financed graduate education decision-making. The evidence comes from a randomized controlled experiment in which college seniors were given online training on the convenience of pursuing a master's degree, using cost-benefit analysis, and the suitability of taking out a student loan to fund the graduate degree program. To our knowledge, this is the first randomized experiment targeting undergraduates in their decision making about graduate studies.

This study conducts hypothesis testing and analyzes the causal relationship between related variables in order to answer three key research questions: (i) What is the association between financial education intervention and financial knowledge; (ii) What is the association between financial education intervention and financial self-efficacy; (iii) Is there an indirect effect of financial education intervention on financial self-efficacy via financial knowledge. Specifically, relying on a control group in the estimation of intervention impacts, this article aimed to evaluate: (i) Treatment effects on financial knowledge (i.e., performance on a standardized financial knowledge test); (ii) Treatment effects on subjective financial knowledge and self-confidence (i.e., perceived financial self-efficacy). Regression analysis was used to examine the impact of financial education on outcome variables, allowing for pre-treatment covariates. The study also contributes to a better understanding of financial knowledge-financial self-efficacy relationships (i.e., whether financial literacy is an antecedent of financial self-efficacy, as established in the literature). In this regard, we wanted to test whether an increase in perceived financial self-efficacy can be explained by the effect of the treatment alone or also by a greater objective financial knowledge that was in turn increased by the intervention. To formalize causal effects that can answer such a research question, we propose the use of causal mediation analysis (CMA), a formal statistical framework by which a researcher can assess the relative magnitude of these direct and indirect effects, which is rapidly growing in popularity in economics and finance, especially in experimental work (Celli 2022). In program evaluation, CMA has primarily focused on the question of whether or not a program, or package of policies, has an impact on the targeted outcome of interest (Keele et al. 2015).

### 3. Experimental Design

In order to answer our research questions, we used data from the so-called FUNCAS research project.<sup>4</sup> Data were collected experimentally at the beginning of the 2019/2020 academic year at the business school of a southern Spanish university. Around 70% of the total number of college seniors enrolled at the business school participated in the experiment.<sup>5</sup> As part of the experiment, participants were randomly assigned to treatment and control groups. Specifically, two-thirds were assigned to what we named experimental group 1 and experimental group 2, while the other third formed the control group (Table 1).

**Table 1.** Sample summary: Distribution of experiment participants.

	Frequency	Percentage
Experimental group 1	183	34.86
Experimental group 2	180	34.29
Control group	162	30.86
Total experiment participants	525	100.00
Source: author's elaboration		

During the experiment session, students had to complete two activities. The first one was structured in three parts. In Part I, experimental subjects were exposed to several stimuli. Experimental group 1 received a short online course about: (a) How to calculate the viability from an economic point of view of the investment in a master's degree; (b) How to finance the master's degree by requesting a student loan. In addition to the same economic and financial training, experimental group 2 received a stimulus consisting of information on the so-called availability bias (or availability heuristic).<sup>6</sup> It was briefly explained to them that it is a bias that may affect the decision of requesting a loan for a master's degree, and they were recommended to base their decision on reliable and verified sources of information as well as expert advice. After the intervention (Part II), experiment participants were given a case study and they had to answer six objective questions about financial knowledge related to the case study. Additionally, they had to rate on a seven-point Likert scale several statements related to variables that precede the decision to request a student loan to pursue a master's degree. In Part III, some sociodemographic questions and academic performance indicators were included. The control group was composed of participants who did not receive the experimental treatment and they started from the beginning of the experiment with Part II and then Part III.<sup>7</sup>

The second activity was carried out in an online behavioral economics lab in the last 15 min of the experiment. All subjects, including the control group, completed a series of experimental tasks aimed to determine their personality traits such as risk preferences, loss aversion, or cognitive reflection. Finally, we would like to highlight that participation in the experiment was voluntary and encouraged through economic rewards assigned by lottery, and the amount of money depended on the number of correct answers the winning participant had to certain questions raised in the second part of the first activity and the second activity of the experiment.

#### 4. Measures of Financial Knowledge and Financial Self-Efficacy

As part of the experiment, objective assessments of financial knowledge along with self-assessed financial knowledge and self-confidence (i.e., perceived financial self-efficacy) were carried out in the treatment and control groups. After the intervention, in Part II of the first activity (Part I for the control group), all participants were presented with a case study related to the possibility of pursuing a master's program aimed at recent college graduates. They were provided with information on the direct costs of a master's degree and cost of living for the year of completion of the program, data on the labor market in the two options of pursuing a master's degree or not (earnings and employability rates associated with different levels of degree completion), and information on financial aid in the form of a graduate student loan offered by a financial institution.

Typically, financial knowledge is objectively measured with a series of exam-style questions that are then scored as correct or incorrect. The more items correct, the higher the financial knowledge. In the FUNCAS experiment, all subjects were asked to respond to six objective multiple-choice questions related to the case study (Figure 1). The participants had economic incentives to make a concerted effort in their calculations, since if they got the answer correct they would enter a draw and could win up to 25 euros for each correct answer. The researchers of the FUNCAS project developed an ad hoc test to assess the level of financial knowledge of the participants because the "Big Three" financial literacy questions of Lusardi and Mitchell (2011), the most widely used test globally to assess the level of financial literacy of a country, was not suitable in the context of making investment and financing decisions in graduate studies.<sup>8</sup> It was pilot tested in several undergraduate classes in the academic year prior to the implementation of the experiment.

1. Calculation of direct and opportunity costs of pursuing the master’s degree.	4. The total amount of interest on a student loan according to the repayment term.
2. Calculation of the expected income differential as a graduate.	5. Student loan installment based on borrowing capacity.
3. Calculation of the net present value (NPV) of the investment in the master’s degree.	6. Calculation of cash surplus.

**Figure 1.** Objective financial knowledge measurement in the experiment. Source: author’s elaboration.

Table 2 provides the results. As can be seen in Table 2, the average number of correct answers was 2.72 (S.D. = 1.35). Only 2.9% of the participants ( $n = 525$ ) answered the six questions correctly, approximately 16% answered only one of them correctly and nearly 4% answered none of them correctly.

**Table 2.** Number of correct answers in the objective financial knowledge test.

Number of Correct Answers	Freq.	Percentage
0	20	3.8
1	83	15.8
2	126	24.0
3	150	28.6
4	101	19.2
5	30	5.7
6	15	2.9
Total	525	100.0
Mean	2.72	
Std. Dev.	1.35	

Source: author’s elaboration

After testing their financial knowledge, all participants were next instructed to assume that a master’s degree was viable from an economic point of view and they had funds available for an amount equivalent to 50% of its total cost,<sup>9</sup> but they were able to obtain financial aid in the form of a graduate student loan, according to the bank’s financing conditions shown in the experiment. Participants then had to respond to various subjective items on a seven-point Likert scale about their perceived control over applying for a student loan to pursue a master’s degree. In particular, the FUNCAS project research team developed a 3-item financial self-efficacy scale specific to debt-financed graduate education decision-making. As can be seen in Table 3, the perceived financial self-efficacy scale was intended to measure students’ beliefs about their abilities to achieve and succeed in making a decision about applying for a graduate student loan. Bandura’s concept of self-efficacy provided the theoretical framework: “Perceived self-efficacy is a judgment of one’s ability to organize and execute given types of performances” (Bandura 1997, p. 21). Financial self-efficacy is thus the extension of efficacy to the area of financial management and involves understanding patterns of attitudes, beliefs, and confidence in relation to financial decisions and behaviors (Rothwell and Wu 2019). As can be seen in Table 3, the mean score of the participants is below the central point of the scale, which reflects a relatively low perceived self-efficacy of the individuals to make the decision of indebtedness (request a loan for graduate studies).<sup>10</sup>

**Table 3.** The decision to apply for a graduate loan: Perceived financial self-efficacy.

	Obs.	Mean	S.D.	Range
	<b>525</b>	<b>3.903</b>	<b>1.146</b>	<b>1–7</b>
1. My level of financial knowledge regarding the decision to apply for a student loan to pursue a master’s degree is: <i>Very low 1–2–3–4–5–6–7 Very high</i>	525	3.823	1.324	1–7
2. For me, making the decision about requesting a student loan to pursue a master’s degree is: <i>Extremely difficult 1–2–3–4–5–6–7 Extremely easy</i>	525	3.438	1.419	1–7
3. Rate from 1 (totally disagree) to 7 (totally agree) the following statement: <i>I am confident that I can make the best decision about whether to apply for a student loan to pursue a master’s degree</i>	525	4.450	1.587	1–7
Cronbach’s alpha = 0.7021				
Cronbach’s alpha assesses the internal consistency of the scale items. The scale has an adequate internal consistency because of a Cronbach’s alpha coefficient equal to or greater than 0.70 is considered “acceptable” in most social science research situations (Hair et al. 2013). In bold: the mean value of the scale.				
Source: author’s elaboration				

### 5. Impact Evaluation of Financial Education Intervention

Financial education program evaluation is the process of systematically assessing the implementation of a financial education intervention (National Endowment for Financial Education 2016). Is there a significant change in participants’ financial outcomes before and after program participation? For estimating causal effects (impact of financial education), we are interested in the difference between treatment and control conditions. One of the more common ways of estimating causal effects with experimental data in many disciplines is based on regression methods (Imbens and Rubin 2015). We can write the following regression equation for the outcome measure (dependent variable):

$$Y_i = \alpha + \theta T_i + X_i\beta + error_i \tag{1}$$

Equation (1) includes the indicator variable for the receipt of treatment ( $T_i$ ) and additional pre-treatment variables ( $X_i$  represents the vector of pre-treatment covariates). It is important to highlight that it is appropriate to only allow for pre-treatment predictors when estimating causal effects in experiments (Gelman and Hill 2006). The parameters of the regression equation are estimated by least squares, with the primary focus on the coefficient for the treatment indicator (Imbens and Rubin 2015).

Using separate regressions for outcomes  $Y_i$  (financial knowledge and financial self-efficacy), our randomized experiment allows us to estimate average treatment effects (ATE) on financial outcomes by comparing each treatment arm against the control arm. The average causal effect can be identified as the observed difference in mean outcomes between the treatment and control groups. The results of ordinary least square (OLS) regressions are shown in Table 4.<sup>11</sup> Descriptive statistics and variable description can be found in Table A1 in the Appendix A. Table 4 shows the estimated coefficients for *treatments*, controlling pre-treatment covariates of gender, academic ability, and majors. On the one hand, Model I estimates causal treatment effects of financial education on objective financial knowledge. The dependent variable of interest,  $Y_i$ , takes values from 0 to 6 depending on the number of correct responses to the questions shown in Figure 1. According to Model I, both treatments increased financial knowledge in relation to the control group (the estimated coefficients associated with treatment dummies are positive and statistically significant). Specifically, once we allow for gender, academic ability, and majors, experimental subjects in treatment group 1 answered correctly on average 0.65 more questions than those in the control group, and experimental subjects in treatment group 2 answered correctly on average 0.74 more



questions than those in the control group.<sup>12</sup> However, the difference between the two coefficients is not statistically significant (test shown at the bottom of Table 3). On the other hand, the results of the econometric estimation of Model II also reveal that financial education can be effective by increasing financial self-efficacy (greater perceived financial knowledge and self-confidence) in student loan decision-making. In the estimation, for each participant, the dependent variable of interest ( $Y_i$ ) was the mean value of the 3-item financial self-efficacy scale shown in Table 3. Once more, the difference between the two treatment coefficients is not statistically significant (test shown at the bottom of Table 4). In summary, the results of this section show that financial education aimed at university students is effective, increasing not only their objective financial knowledge but also increasing their perceived financial self-efficacy. Our main results are of high relevance for policymakers because there is a public debate questioning the effectiveness of financial education interventions (e.g., [Fernandes et al. 2014](#)).

**Table 4.** Financial education for decision making on graduate studies: Assessing the intervention effectiveness.

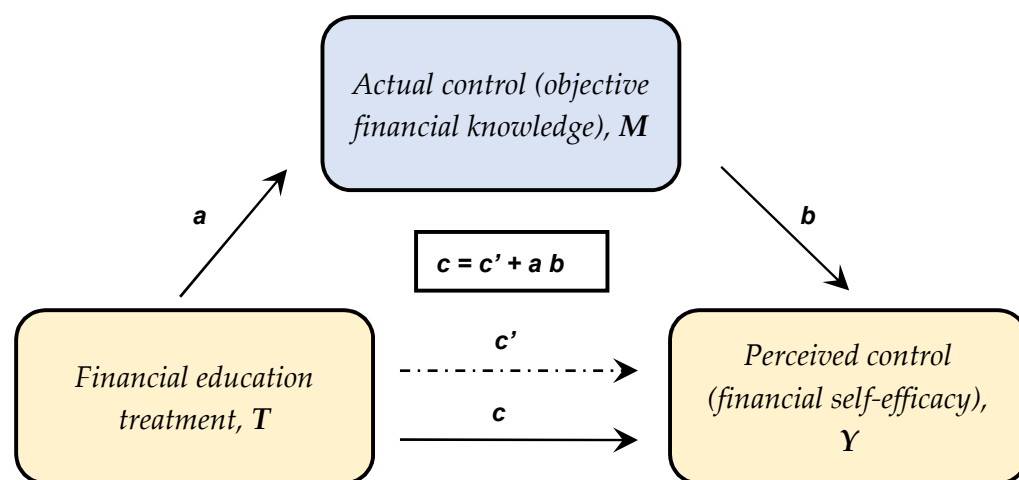
	Model I		Model II	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
Control group	Ref. cat.		Ref. cat.	
Experimental group 1	0.647 ***	0.136	0.316 **	0.121
Experimental group 2	0.739 ***	0.142	0.354 **	0.123
Gender (=1 female)	−0.421 ***	0.111	−0.478 ***	0.097
Academic ability	0.362 ***	0.082	−0.024	0.068
Majors (=1 Finance and Accounting)	0.612 **	0.186	0.820 ***	0.134
Constant	−0.053	0.560	3.997 ***	0.455
Number of obs.	525		525	
F (5, 519)	14.83 ***		14.01 ***	
R-squared	0.128		0.105	
Dependent variable	Correct answers in the objective financial knowledge test		Average scores on the perceived financial self-efficacy scale	
Testing the equality of two coefficients				
H <sub>0</sub> : $\beta_1$ and $\beta_2$ are not statistically different				
F(1, 519)	0.49		0.12	
Prob. > F	0.483		0.730	
	0.647 and 0.739 are not statistically different		0.316 and 0.354 are not statistically different	
*** $p < 0.001$				
** $p < 0.01$				
Source: author’s elaboration				

Although our results show that online financial education can be effective in increasing financial knowledge, we cannot directly compare them with other published studies. The main reason is that financial education experiments targeting undergraduate students on taking out graduate loans are practically non-existent. We have only found a couple of academic works that experimentally demonstrate the effectiveness of online resources in increasing the financial knowledge of the subjects. In an important experiment by [Heinberg et al. \(2014\)](#), a representative sample of the U.S. population was exposed to videos explaining basic financial concepts such as compound interest, risk diversification, and inflation. Compared to a control group that received no such training, the subjects exposed to the informational videos were more knowledgeable and better able to answer

hypothetical questions about saving decisions. Kuntze et al. (2019) also showed that web-based financial education can be an effective tool to improve financial literacy. Those students exposed to short videos on financial topics had significantly higher financial literacy scores than those who did not receive the treatment.

### 6. Financial Education and Financial Self-Efficacy: The Mediating Role of Financial Literacy

We have just shown that financial education intervention had an impact on both college seniors’ objective financial knowledge and perceived financial self-efficacy. However, this article also seeks to go beyond the ATE and quantify the effect of treatment that operates through a particular channel. That is, we focus on the causal mechanism by which treatment  $T$  causally affects outcome  $Y$  through mediator  $M$ . As shown in Figure 2, a mediating variable transmits (partially) the effect of an independent variable on a dependent variable (MacKinnon et al. 2007). Despite lacking a conceptual framework linking financial education to financial knowledge and financial self-efficacy (Rothwell and Wu 2019), the independent variable or experimental factor in the mediation model in Figure 2 is hypothesized to change a mediator (financial literacy), which in turn changes the outcome or dependent variable (financial self-efficacy). In relation to the latter, as the scale shown in Table 3 demonstrates, perceived self-efficacy can be identified with Ajzen’s concept of “perceived control,” which is focused on the ability to perform a particular behavior (Ajzen 2002). Thus, our goal is to test whether perceived control (financial self-efficacy) is improved by the treatment effect alone or also by better “actual control” (objective financial knowledge) that was in turn boosted by the intervention.



Path diagrams for the **total causal effect** ( $c$ ) of the independent variable  $T$  on the dependent variable  $Y$  (solid line), the **indirect effect** ( $a \times b$ ) of the variable  $T$  on the variable  $Y$  through the *mediator* variable  $M$ , and the effect of  $T$  on  $Y$  adjusting for  $M$  (**direct effect**,  $c'$ ) (dashed line).

**Figure 2.** Schematic diagram of the hypothesized mediation model. Source: author’s elaboration.

#### Conducting Causal Mediation Analysis

As we have anticipated, our purpose is to investigate the extent to which the mediator (actual control) transmits the effect of the treatment (financial education) to the outcome (perceived control). In the FUNCAS experiment, randomization of participants to levels of  $T$  removes confounder bias in the  $T$  to  $M$  and  $T$  to  $Y$  relation. So, randomization enables causal interpretation of the  $a$  coefficient (the relation between  $T$  and  $M$ ) and  $c$  coefficient (the total relation between  $T$  and  $Y$ ). Nonetheless, the relation between  $M$  and  $Y$  (the  $b$  effect) fails to provide a clear interpretation as a causal effect (MacKinnon and Pirlott 2015).<sup>13</sup>

“Causal mediation analysis” (CMA) is most frequently applied to such experiments where the treatment is randomized but the mediator is not (Imai et al. 2010a, 2010b). In CMA, under certain assumptions, the causal mediation effect represents the indirect effect of the treatment *T* on the outcome *Y* through the mediating variable *M* (Imai et al. 2010a, 2010b).<sup>14</sup> The mediation package of Stata<sup>®</sup> 15 statistical software was used for carrying out the causal mediation analysis (See Hicks and Tingley 2011; Nguyen et al. 2021); *medeff* is the Stata command for implementing the Imai et al. approach, the mediation package also includes a *medsens* command that allows for conducting sensitivity analysis.<sup>15</sup> The *medeff* command requires two fitted models: one is for the mediator variable and the other is for the outcome variable. In our case, since we have continuous (mediator and outcome) variables, linear models are used for the mediator and outcome variables. Specifically, the mediator model is a linear model that regresses the number of correct answers in the objective financial knowledge test on a binary treatment variable,<sup>16</sup> and observed pre-treatment covariates of gender, academic ability, and majors. On the other hand, the outcome model regresses average scores on the perceived financial self-efficacy scale on the binary treatment variable, the number of correct answers in the objective financial knowledge test (i.e., the mediating variable), and the vector of observed pre-treatment covariates of gender, academic ability, and majors.

Table 5 shows the results from the two regression models, along with average causal mediation effect (ACME), average direct effect, and average total effect. In particular, the average effect of the treatment variable on the outcome that operates through the mediator is 0.070, while the estimate of the direct effect is equal to 0.26 and that of the total effect is equal to 0.33 (bottom of Table 5).<sup>17</sup> The average total effect is equivalent to the usual average treatment effect. Thus, the intervention increased the self-assessment of students’ own financial ability by just over 0.3 points. Here, we find that a substantial portion of the average total effect is due to changes in financial knowledge; there is mediation and it is an important fraction of the total effect. Specifically, treatment-induced changes in student loan financial literacy account for about 21% of the total effect.<sup>18</sup> The direct effect represents all other possible mechanisms or explanations for why the treatment worked. However, “a [causal] mediation analysis is not complete without a sensitivity analysis” (Imai et al. 2010a, p. 315). The sensitivity analyses for the sequential ignorability assumption indicated that the ACME estimate was robust (see lower rows in Table 5 and more details in the Appendix A).

**Table 5.** Causal mediation analysis in the context of financial education intervention.

	Model I. Model for the Mediator Variable			Model II. Model for the Outcome Variable		
	Coef.		Robust Std. Err.	Coef.		Robust Std. Err.
Treatment (=1 treated subjects)	0.693	***	0.122	0.265	*	0.111
Objective financial knowledge				0.101	*	0.041
Gender (=1 female)	−0.420	***	0.111	−0.435	***	0.099
Academic ability	0.365	***	0.082	−0.059		0.069
Majors (=1 Finance and Accounting)	0.623	**	0.186	0.762	***	0.134
Constant	−0.075		0.556	3.995	***	0.451
Number of obs.	525			525		
F-statistic	18.32	***		15.35	***	
R-squared	0.127			0.117		
Dependent variable	Correct answers in the objective financial knowledge test			Average scores on the perceived financial self-efficacy scale		

**Table 5.** *Cont.*

	Model I. Model for the Mediator Variable		Model II. Model for the Outcome Variable	
	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
	Mean	[95% Conf. Interval]		
Indirect effect (average causal mediation effect)	0.070	0.018 0.133		
Direct effect	0.258	0.056 0.469		
Total effect	0.327	0.088 0.569		
Sensitivity results (95% confidence interval)				
Rho at which ACME = 0	0.117			
$R_M^2 * R_Y^2$ at which ACME = 0	0.014			
$\tilde{R}_M^2 \tilde{R}_Y^2$ at which ACME = 0	0.011			
Using 0 and 1 as treatment values				
*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$				
Source: author’s elaboration				

**7. Conclusions**

Much political attention on student-loan debt has been focused on improving the financial literacy of college and university students, largely through financial education programs; however, their effectiveness can only be evaluated experimentally. Our study is based on a randomized controlled experiment among final-year undergraduate students and it provides an assessment of treatment effects of financial education intervention focused on debt-financed graduate education decision-making. Our results show that there are positive treatment effects on both college seniors’ objective financial knowledge (financial literacy) and subjective financial knowledge and self-confidence (i.e., perceived financial self-efficacy). This study also contributes to financial literacy literature by demonstrating that financial knowledge partially mediates the relationship between financial training and financial self-efficacy.

Master’s degrees are likely to offer higher lifetime earning potential and other non-monetary benefits associated with achieving the degree. However, the fact of having to finance a graduate degree with a student loan can stop investments in human capital for fear of indebtedness and/or not having the financial knowledge and the self-confidence to make the decision. This underinvestment in human capital has negative implications for individuals, but also for society, as advanced degrees are strongly correlated with productivity and economic growth and provide a greater tax base for government funding. The results of our study show that financial education programs work, and improve both the objective financial knowledge of the participants and their self-assessment of their own financial ability (financial self-efficacy). Nonetheless, policies that aim to improve financial capabilities among higher education students through financial education programs should also be aware that financial literacy is a significant antecedent of (a prerequisite for) financial self-efficacy.

Despite the fact that this study has offered novel results from experimental research, we are conscious of its limitations, particularly in terms of external validity, given that the experiment was done with a group of college seniors at a school of business. Extending the study to university students from different academic fields ensures external validity. The project researchers are already engaged in this assignment.

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### Appendix A

**Table A1.** Descriptive statistics of the independent variable and covariates.

	Mean	Std. Dev.
Control group	0.31	
Experimental group 1	0.35	
Experimental group 2	0.34	
Gender (=1 female)	0.53	
Academic ability (grade point average)	6.78	0.73
Majors (=1 Finance and Accounting)	0.11	
Observations	525	

1. Academic ability is the average mark of the academic transcript up to the time of the experiment. This information was self-reported by the participants. In the Spanish system, grades fluctuate from 0 to 10, requiring a 5 to pass.
2. In relation to undergraduate majors, in the category = 0 were included: Business, Business & Law, Economics, Marketing, and Tourism.
3. For binary or dichotomous variables such as gender and undergraduate majors, and also for a set of dummy variables such as treatment-control groups, the mean represents the percentage of experiment participants in each category.

Source: author’s elaboration

**Table A2.** Statistical tests for treated and control groups (when experiment participants are grouped into two groups).

	Group 0 Control obs. = 162	Group 1 Treatment obs. = 363	Two-sample test of proportions		
			diff. = prop.(0) – prop.(1)	Ho: diff. = 0 §	p-value
Proportion of women	0.48	0.55	–0.07	We fail to reject the null hypothesis at the 95% confidence level.	0.126
The proportion of college students that are majoring in Finance and Accounting	0.12	0.10	0.02	We fail to reject the null hypothesis at the 95% confidence level.	0.464
			Two-sample t-test with equal variances <sup>(a)</sup>		
			diff. = mean(0) – mean(1)	Ho: diff. = 0 §	p-value
Grade point average	6.71	6.81	–0.10	We fail to reject the null hypothesis at the 95% confidence level.	0.130

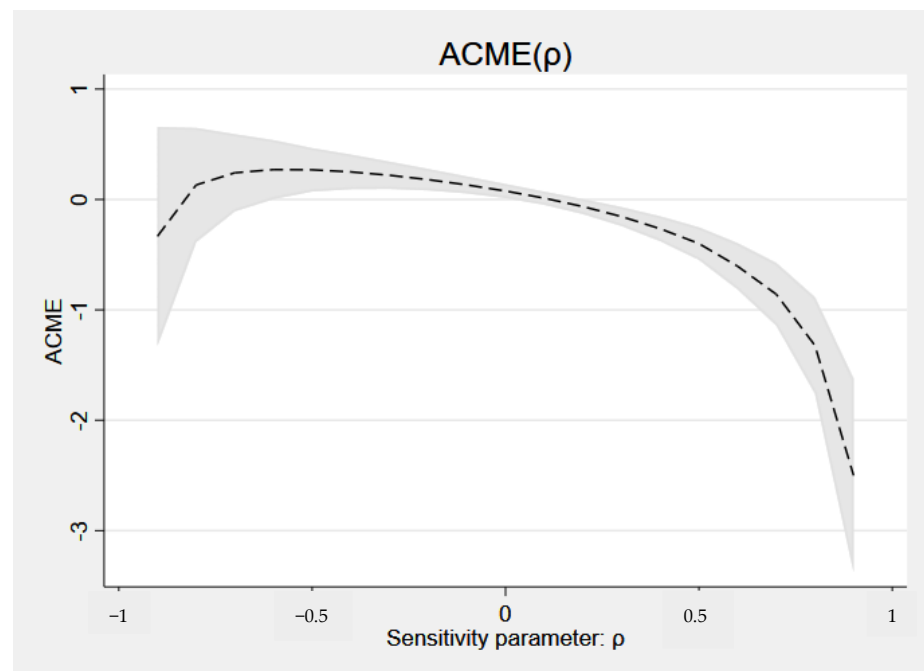
§ If the difference is zero, then they are not different (i.e., they are equal).

<sup>(a)</sup> Levene’s robust test statistic (W0) for the equality of variances between the groups:  
W0 = 1.816 Pr > F = 0.178 (we cannot reject the null hypothesis that the variances are equal)

Source: author’s elaboration

### Sensitivity Analysis

The CMA depicted in Section 6 was performed under the “sequential ignorability” (SI) assumption. Violation of the assumption indicates that an unmeasured confounder exists that is related to both the mediator and the outcome. One approach is to perform sensitivity analysis to examine whether the results are robust to the violation of the assumption. Imai et al. (2010a) proposed a correlation parameter ( $\rho$ ), which is the correlation between the error terms of the mediation and outcome models. The *medsens* command in Stata 15 was used to estimate  $\rho$  and examine how varying levels of  $\rho$ , between the extremes of  $-1$  and  $+1$ , influence the ACME (Figure A1). The shaded region in the plot marks the 95% confidence intervals for each value of  $\rho$ . When  $\rho$  is zero, sequential ignorability holds and the true ACME coincides with the estimate reported in Table 5. The important question we ask in the sensitivity analysis is how large  $\rho$  must be for the mediation effect to be zero. We find that the estimated ACME equals zero when  $\rho$  equals 0.117. Although the true value of  $\rho$  is unknown, more extreme values of  $\rho$  represent larger departures from the sequential ignorability assumption. As seen in the lower rows of Table 5, our value of  $\rho$  is small and our ACME estimate is statistically significant.



**Figure A1.** The average causal mediation effect (ACME): Sensitivity analysis. Source: author’s elaboration.

### Notes

- <sup>1</sup> Narrowly defined, financial literacy refers to financial knowledge and is the ability to process economic information towards making informed decisions about financial management (Lusardi and Mitchell 2014).
- <sup>2</sup> The idea of financial self-efficacy draws on the theory of self-efficacy developed by Bandura (1997). Financial self-efficacy would be one’s self-beliefs about the ability to manage one’s finances (Lown 2011).
- <sup>3</sup> See Furrebøe and Nyhus (2022) for a recent semi-systematic review regarding the role of self-efficacy in relation to financial literacy and gender.
- <sup>4</sup> The project was framed within the training needs contemplated in the Financial Education Plan (2018–2021) of the Bank of Spain. For more details about this project, see González-López et al. (2021).
- <sup>5</sup> By gender, about half were men and the other half were women.
- <sup>6</sup> In their seminal paper, Tversky and Kahneman (1974) proposed several heuristics or rules of thumb that are prevalent and persistent in human judgment and decision-making. The availability heuristic is a mental shortcut people use to make decisions about the likelihood of an event based on how immediately an example or case comes to mind.
- <sup>7</sup> The experiment participants provided their responses through Qualtrics® software.

- 8 The “Big Three” questions measure only basic knowledge about interest rates, inflation, and asset diversification.
- 9 The total cost was €30,000 (tuition and cost of living for the year of completion of the master’s degree).
- 10 Scale items were mainly adapted from Ajzen (1991, 2019); Koropp et al. (2014); Lown (2011); Sotiropoulos and d’Astous (2013) with some minor modifications in the wording to tailor them to the context of graduate studies decision-making. As part of the validation process, factor analysis was used, which incorporated principal components analysis with varimax rotation (González-López et al. 2021). Internal consistency reliability was measured using Cronbach’s alpha (Table 3).
- 11 The analysis was performed using Stata<sup>®</sup> 15 statistical software.
- 12 The number of correct answers among participants in the control group was 2.25 out of 6.
- 13 As the mediator is not randomized, there are likely to be unobserved covariates that confound the relationship between the mediator  $M$  and the outcome  $Y$ .
- 14 The analysis rests on the strong assumption that there is not a common unobserved confounder that affects both  $M$  and  $Y$ , an assumption known as “sequential ignorability” (SI).
- 15 Using the *medsens* function, we can test for violations of the sequential ignorability assumption that there are no unmeasured confounders of the mediator-outcome pathway.
- 16 Since no statistically significant differences were observed between the two experimental groups, for analysis purposes we consider a *treatment* dichotomous variable to take values equal to 1 for treated individuals and a value of 0 for control group participants. In the Appendix we showed a balance table (Table A2) for pre-treatment covariates, where participants are grouped into two groups to verify that the means are the same among treatment and control units.
- 17 Because zero is not in the 95% confidence interval, we can conclude that the effects are indeed significantly different from zero at  $p < 0.05$  (two-tailed).
- 18 The mediation proportion, the proportion of treatment effect on outcome explained by an intermediate variable, is calculated as the ratio between the indirect effect and the total effect.

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