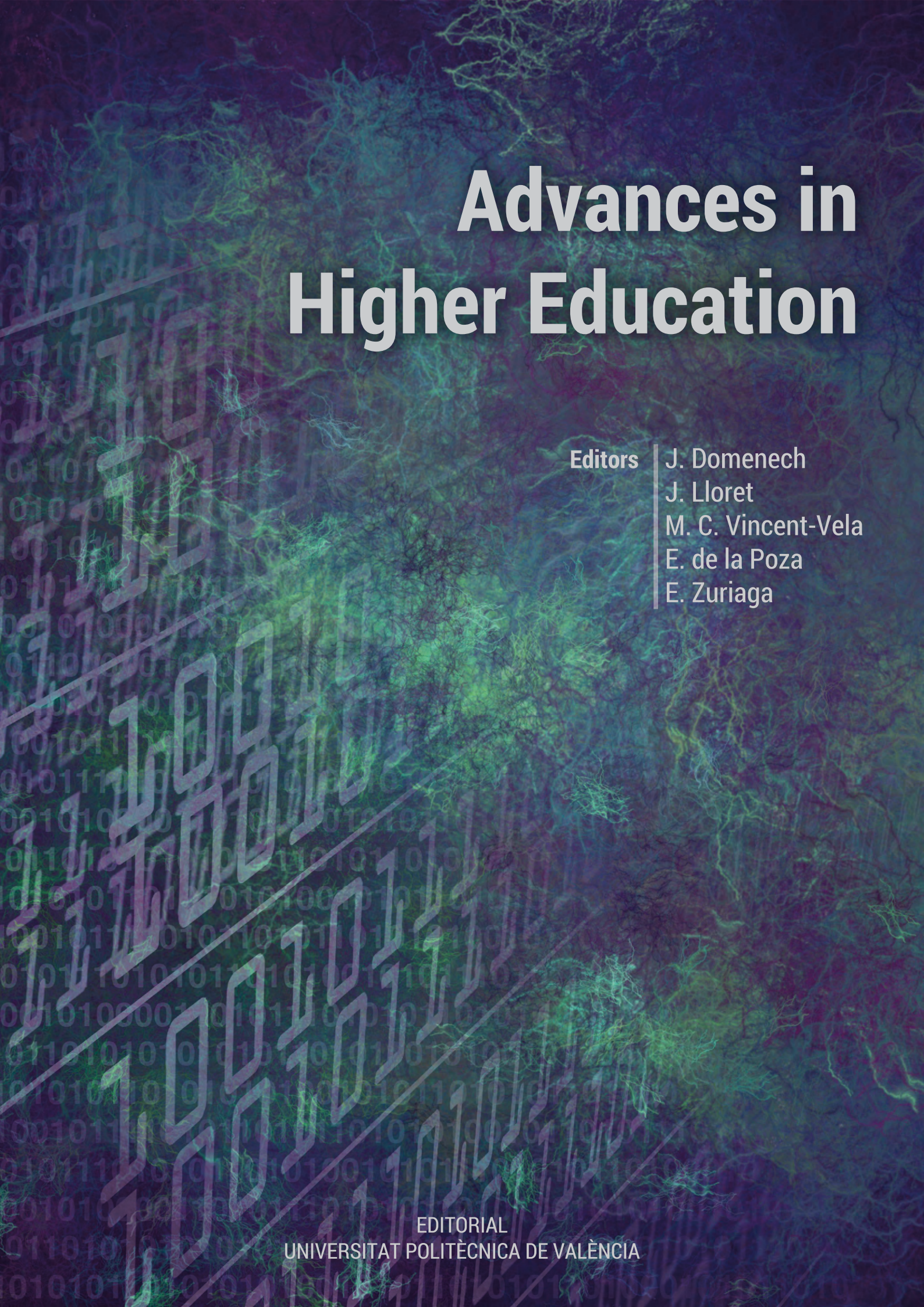

Advances in Higher Education

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E. Zuriaga

EDITORIAL
UNIVERSITAT POLITÈCNICA DE VALÈNCIA

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Abstract

Higher education institutions play an important role as leaders in knowledge creation and dissemination by setting the grounds for society to advance and to improve welfare. Despite the long-standing tradition of some higher education systems, Higher Education continuously evolves to adapt to the challenges that current societies open up to.

The objective of this book is to capture some recent advances made in Higher Education by addressing these challenges. To do so, some specific topics related to the inputs, outputs and process of education in Higher Education were selected to be analysed by a scientific research approach.

The book is arranged in five parts in accordance with these topics. Part I is related to the most important input of higher education institutions, that is, students, and particularly to address students' preparation when they access higher education studies. The next three parts of the book analyse different aspects of the learning process that take place in Higher Education. Part II assesses student learning from different points of view. Part III contains two chapters on the creation and availability of resources in higher education institutions. Part IV describes and analyses some innovative teaching and learning methods. Finally, Part V consists of three chapters that deal with the relation of Higher Education with industry, which is the main destination of graduates.

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Chapter 1
Introduction

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Universitat Politècnica de València

Higher education institutions play an important role as leaders in knowledge creation and dissemination by setting the grounds for society to advance and to improve welfare. Despite the long-standing tradition of some higher education systems, Higher Education continuously evolves to adapt to the challenges that current societies open up to.

One of these challenges is related to the increasing use of ICTs in everyday life, which obviously includes classrooms. Technologies enable new interaction modes in the educational process, and also reduce the cost of disseminating information. All this, in turn, allows knowledge to reach more and more people, which thus democratises knowledge. However, this adoption of technology needs to be properly managed in order to improve the learning experience.

Nevertheless, technology is not the only factor that opens up challenges in Higher Education. Today's social and economic trends also force institutions to adapt to the new reality. In particular, the globalisation and internationalisation of economies also affect how higher education institutions should design their programmes. It is now when instructors should focus on skills more than on contents. Students should be prepared for learning not only during their training period, but also after they have left university.

The objective of this book is to capture some recent advances made in Higher Education by addressing these challenges. To do so, some specific topics related to the inputs, outputs and process of education in Higher Education were selected to be analysed by a scientific research approach.

The book is arranged in five parts in accordance with these topics. Part I is related to the most important input of higher education institutions, that is, students, and particularly to address students' preparation when they access higher education studies. Chapter 2 analyses whether the use of ICTs can improve student performance in maths and financial education before they access university studies. Chapter 3 reviews how a cultural background can affect most of students' skills, such as autonomous learning. The last chapter in this part, Chapter 4, is about the motivation of students for them to engage in science and research.

The next three parts of the book analyse different aspects of the learning process that take place in Higher Education. Part II assesses student learning from different points of view. Chapter 5 deals with problem-solving skills and competence assessments in engineering studies. Chapter 6 focuses on how to reflect on how the

received assessment can improve the learning process. Chapter 7 centres on the consistency of exams that combine different question types. Chapter 8 introduces a classification scheme of errors in student activities as a way to find and solve their difficulties. The last chapter in this part, Chapter 9, continues with the systematisation of the assessment and discusses rubrics as a tool to guide students and markers.

Part III contains two chapters on the creation and availability of resources in higher education institutions. Chapter 10 focuses on how to design incentives to promote the creation of open educational resources which, eventually, are economically efficient. Chapter 11 focuses on the educational resources that can be created when the academia approaches professional and scientific associations.

Part IV describes and analyses some innovative teaching and learning methods. Across emerging learning methods, project-based learning is attracting more attention. In this vein, Chapters 12 and 13 describe and analyse two different experiments with this methodology for preparing future engineers. Chapter 14 also deals with teaching methods for engineers, but focuses on using simulations to help students understand complex models. The last chapter of this part, Chapter 15, describes an experiment as to how to motivate engineering students when covering topics that differ from core technical contents, such as legal issues, which are essential in their professional life.

Finally, Part V consists of three chapters that deal with the relation of Higher Education with industry, which is the main destination of graduates. Chapter 16 explores the potential of MOOCs to connect Higher Education and professional practice. Chapter 17 focuses on checking whether curricular designs follow industry trends. Finally, Chapter 18 re-analyses the links between industry and universities in the engineering professional practice context.

PART I

Access to Higher Education

Chapter 2

How financial education affects Mathematics performance? Evidence from Spain in the context of the Program School 2.0

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Abstract: In this paper we evaluate the effect of participation in the Program School 2.0 on both Financial Education and Mathematics performance using data from PISA 2012. The School 2.0 Program was implemented in 2009 in some Spanish Autonomous Communities. This program promoted the use of computers, both in school and at home, among elementary and high school students. We detect that a greater benefit is obtained when the contents of Financial Education are taught in conjunction with the contents of the subject of Mathematics. Moreover, the inclusion of financial contents in Mathematics subject could help to alleviate the gender gap (school-boys vs. school-girls) and the nationality gap (native vs. immigrant students) observed in Mathematics performance. Regarding the influence of ICT on the skills for both subjects, the benefit of having a computer for personal use by students is observed, both for school and home use. However, it only has a positive effect on performance when it is used occasionally. However, we must interpret the results with certain caution, as not much time has passed since the implementation of these new teaching methodologies, so we should expect to see a "learning effect" over time.

Keywords: Program evaluation; PISA; Financial Education; Mathematics

Introduction

Adopting information conscious habits for savings and investment are the basis for enjoying economic prosperity. In contrast, fallout after borrowing money and the accumulation of debt not only poses a threat to family's economic stability, but it can also endanger economic progress at national level (Mandell, 2008). The recent economic and financial crisis has demonstrated that economic recovery requires the participation of all economic stakeholders (Lester and Williams, 2010). In this sense, during the Third National Meeting on Economic and Financial Education, Frederic Mishkin (2008), member of the Board of Governors of the Federal Reserve of the United States, declared that it would be difficult to find itself in a more propitious moment than the present, in order to demonstrate that a better understanding by citizens of the economy and finance could have reverted the situation through more

wise decision-making. But, how is it possible that citizens become aware of the consequences of their financial decisions, if they lack financial education?

Financial Education enables the individual to acquire a series of very useful skills for adulthood and this should be a component of student learning. Studies have indicated that people who have received Financial Education show a greater tendency to manage their savings before retirement (Cole *et al.*, 2010), participate more in the stock markets, depict better optimizing behaviors for their stock portfolios (Van Rooij *et al.*, 2011), and take greater care when choosing mortgages or loans with lower interests and fees (Lusardi and Tufano, 2009).

Nowadays, students face a greater number of financial decisions than we could have ever imaged. For example: (i) the use of mobile phones means having to decide between either pre-paid plan or a contract and the responsibility to monitor their own consumption, (ii) the preference of receiving money instead of a gift on their birthday or some other important date, (iii) the management of money periodically, whether or not it is given to them by their parents, for expenses such as going out with friends, clothes, trinkets, etc. Moreover, ICTs (Information and Communication Technologies) play an important role in the lives of students and it is also required that they are prepared to make financial decisions involving the use of new technologies: (i) decide whether to buy a CD or purchase some of their favorite songs on-line, (ii) buy concert tickets online etc.

The OECD (2005) report had already indicated that the skills and abilities developed from Financial Education are so important that should be included within the curriculum of all schools. PISA (2012) provides the opportunity to analyze the importance of Financial Education as a tool to solve real life problems.

We have empirical evidence, as indicated by Varcoe *et al.* (2005), Hinojosa *et al.* (2009) and Lusardi and Mitchell (2009), which demonstrates that the incorporation of Financial Education into the academic curriculum has a positive impact on young people and facilitates the development of skills in the areas of savings, loans, investments, critical thinking and problem solving. In fact, New Zealand has not only introduced Financial Education into the school curriculum of Secondary Education, but there exist also elective subjects for learning Accounting (Samkin *et al.*, 2012). Moreover, Pinto *et al.* (2005) analyzed four elements (family, friends, schools and communication media) in order to determine which of these exerted the greatest influence on the adoption of financial culture by students. They found that parents and schools were the two most important forces, since students spend much of their day at school and it is there where the core of financial learning should be found.

This article jointly analyzes the relationship between performances in Mathematics and Financial Education, subject to their participation in School Program 2.0. Nowadays, computers are an essential instrument in the workplace and a certain mathematical literacies are required for effective practice in modern life (Hoyles *et al.*, 2002). Given that mathematical literacy is so completely intertwined with computer literacy, we will try to asses if the implementation of the Program School 2.0 in Spain has improved Mathematics achievement.

We analyze the interplay of the performance in both subjects using a bivariate probit model. The decision to consider simultaneous performances between the two subjects has a dual motive. First, PISA (2012) evaluates performance in Mathematics and some studies, such as Suiter and McCorkle (2008), have found that the melding of Mathematics and Financial Education favors the development of responsible financial

behaviors. Second, the majority of problems that students need to solve on the PISA-Financial questionnaire (responding to real-life situations) require the completion of numerical calculations. Table 1 shows three examples of PISA-Financial problems.

Table 1. PISA-Financial Sample Questions (2012)

Exercise 1. The Market

John can buy individual or boxes of tomatoes. A kilogram of tomatoes costs 2.75 zeds and a 10 kilogram box of tomatoes costs 22 zeds. John says: "It is better to buy a box of tomatoes than to buy handpicked tomatoes." Provide an argument to support this claim.

Possible answers that could obtain a maximum score:

- It costs 2.75 zeds per kilogram for handpicked tomatoes, but only 2.2 zeds per kilogram for tomatoes in cases.
- It costs only 2.20 per kilogram for a case.
- Because 10 kilograms of handpicked tomatoes would cost 27.50 zeds.
- You get more kilos for each zed that you spend.
- Handpicked tomatoes cost 2.75 per kilo, but the tomatoes in cases cost 2.2 per kilo.
- It's cheaper per kilo. [This generalization is acceptable.]
- It's cheaper per tomato. [The assumption that tomatoes are of the same size is acceptable.]
- You get more tomatoes per zed. [This generalization is acceptable.]

Exercise 2. Travel Money

Natalie works in a restaurant 3 afternoons a week. Every afternoon, she works 4 hours and earns 10 zeds per hour. Every week, Natalie also gains 80 zeds in tips. Natalie saves exactly half the total amount of money that she makes every week. Natalie wants to save 600 zeds to go on vacation.

How many weeks it will take Natalie to save 600 zeds?

Answer with maximum score: 6 (written answer)

Exercise 3. New Offer

Ms. Janeiro has a loan for 8,000 zeds from Primazed Bank. The annual interest rate for the loan is 15%. Monthly payments are 150 zeds. After a year, Ms. Janeiro still owes 7,400 zeds. Another financial company called Zedsuper, offers Ms. Janeiro a loan for 10,000 zeds with an annual interest of 13%. Monthly payments would also be 150 zeds.

What possible financial disadvantage may Ms. Janeiro have if she accepts a loan from Zedsuper?

Possible answers that could obtain a maximum score:

- She would owe more money.
- You will not be able to manage her expenses.
- She is getting into even more debt.
- 13% on 10,000 is more than 15% on 8,000.
- It may take longer to pay it off, because the loan is larger and monthly payments are the same.
- She may have to pay Primazed a penalty for paying back the loan sooner.

Source: The questions refer to a fictitious country Zedland, where the zed is the currency. Students receive this information at the beginning of the test.

Material and Methods

Program School 2.0

In July 2009, the Spanish Education Sector Conference approved a budget of €98,182,419 for the implementation of the Program School 2.0 (Resolution of 3rd August, 2009, of the Technical Secretariat General, with respect to the Agreement of the Council of Ministers of 31st July, 2009).

The allocation of these funds was to co-finance 50% of the following activities, within the Autonomous Communities: (1) The transformation of all 5th and 6th Primary Education and all 1st and 2nd Compulsory Secondary Education classrooms into digital classrooms at public schools; (2) The provision of computers for personal use, (3) The development of digital contents that may could be used by teachers. However, the Autonomous Communities' participation in School Program 2.0 was not homogeneous and three levels of participation were discernible:

(i) Total Participant Communities (TP): Andalusia, Aragon, Cantabria, Castile-Leon, Castile-La Mancha, Catalonia, Extremadura, Galicia, Navarra, Basque Country, La Rioja, Ceuta and Melilla

(ii) Partial Participant Communities (PP): Asturias, Balearic and Canary Islands. These one will not be considered in the following analysis.

(iii) Non-participat Communities (NP): Madrid, Murcia and the Valencian Community.

With the data of total expenditure by Autonomous Region and the number of students who have received a computer, the ratio of "investment per student" can be calculated (Table 2). This ratio must be understood in a broader sense, since it not only reflects the value of computer equipment received by the student has received, but also the appropriate allocation of expenditure on the digitization of classrooms and teacher training. On average, School Program 2.0 represents an investment of €476.1 per student (not only including the student's computer, but also the digitization of classrooms and teacher training), with a maximum of €1,840.8 for Navarre and €1,201.7 for Galicia, and a minimum of €142.3 for the Basque Country.

To appreciate the magnitude of this data, it has been compared with expenditure per ESO student in public schools in 2010. On average, students of School Program 2.0 have received an investment of 5,3% with respect that of an ESO student at a public school, with a maximum of 20% in Navarra and a minimum of 1.6%in the Basque Country.

Table 2. Estimated expenditure per Student within School Program 2.0 Compared to the Average Expenditure per Student in Compulsory Secondary Education and Public Schools

	Total Expenditure School Program 2.0. (1)	**Computers for Students (2)**	**Investment per student (3)=(1)/(2)**	**Investment per Student within School Program 2.0 with respect to Public Expenditure per Public Student**
Andalusia	70,081,420	282,082	248.4	0.027
Aragon	9,832,459	17,006	578.2	0.064
Asturias	6,383,629	14,568	438.2	0.048
Balearic Islands	7,718,435	27,050	285.3	0.032
Canary Islands	16,983,532	26,139	649.7	0.072
Cantabria	3,987,342	4,390	908.3	0.100
Castile and Leon	18148363	19,275	941.5	0.104
Castilla-La Mancha	18,928,362	43,250	437.6	0.048
Catalonia	53,191,112	100,209	530.8	0.059
Valencian Community	22,919,873	-	-	-
Extremadura	10,202,075	22,047	462.7	0.051
Galicia	18,026,168	15,000	1201.7	0.133
Madrid	23,022,965	-	-	-
Murcia	8,273,915	12,307	672.3	0.074
Navarra	5,065,906	2,752	1840.8	0.203
The Basque Country	5,665,355 (*)	39,826	142.3	0.016
La Rioja	2,315,613	4,103	564.4	0.062
Ceuta and Melilla	1,383,066 (**)	4,545	304.3	0.034
Total	302,129,589	634,549	476.1	0.053

The number of computers per student is considered as a representation of the number of students who have benefited from School Program 2.0. The ratio between column (1) and (2) represents the average investment per student, including not only a computer but also the digitization of classrooms and teacher training.

Annual public expenditure per student in public secondary education (2010). (Facts and Figures. School Year 2013/2014. Ministry of Education, Culture and Sports; pg. 11).

Econometric model

We consider two latent variables FE_i^* and MAT_i^* that denote "knowledge in Financial Education" and "knowledge in Mathematics", respectively. Both variables are influenced by observable characteristics (family group, resources available at home and at the school) and unobservable characteristics (innate aptitudes of students or their level of motivation). Additionally, the relationship between them can flow in both directions. On the one hand, Financial Education can provide a more applied perspective for certain mathematical concepts, so it can be useful to reduce the degree of abstraction that is so often argued as a difficulty by students when dealing with exact sciences. Moreover, students with a greater ability for numerical reasoning may find it easy and attractive to choose the field of Financial Education. In general, the score obtained in both areas may be expressed using the following system:

$$FE_i^* = X_{1i}^{'}\beta_1 + \varepsilon_{1i} \quad (1)$$

$$MAT_i^* = \alpha EF_i^* + X_{2i}^{'}\beta_2 + \varepsilon_{2i} \quad (2)$$

where $X_{1i}^{'}$ and $X_{2i}^{'}$ are vectors of observable characteristics, β_1 and β_2 are vectors of parameters, ε_{1i} and ε_{2i} are both error terms, which we assume follow a bivariate normal distribution with zero mean, unit variance and correlation coefficient ρ:

$$\begin{pmatrix}\varepsilon_{1i}\\ \varepsilon_{2i}\end{pmatrix} \sim N\left(\begin{pmatrix}0\\0\end{pmatrix}, \begin{pmatrix}1 & \rho\\ \rho & 1\end{pmatrix}\right) \quad (3)$$

and such that $E[X'_{1i}, \varepsilon_{1i}] = 0$ and $E[X'_{2i}, \varepsilon_{2i}] = 0$. Thus, if ρ is equal to zero, FE_i^* is not endogenously determined and both equations may be solved separately.

The following explanatory variables were introduced in both equations: characteristics of the students and the family (gender, nationality, repetition of grade level, availability of a computer at home, educational level of parents), and characteristics of the school (average class size, ratio of schoolgirls at the school, size of municipality). In the equation for MAT, we considered the following explanatory variables: if there is a school-policy on the use of computers in the classroom and on the quality assessment of Mathematics, the percentage of teachers with ISCED5A qualifications, if the student has a computer in the classroom and the frequency of ICT use to do homework.

In the equation for FE, the following explanatory variables have been considered: if the contents of Financial Education are compulsory, if it is delivered within a specific subject (Mathematics, Economics, Social Sciences and Humanities), the length Finance Education has been delivered, if teaching staff of Financial Education belong to the school's faculty and if teachers have received specific training.

Regarding student environment, two instrumental variables were introduced taking as reference evidence from the literature on Financial Education (Pinto *et al.*, 2005; Williams, 2010): (i) a binary variable that takes value 1 if the student indicates talking to his/her parents almost every day or 1-2 times a week about financial issues (savings, household spending, banks, etc.) and (ii) a binary variable that takes value 1 if the student indicates earning money from working (tutoring, babysitting) or helping out in a family business.

However, we did not observe the level of knowledge in Mathematics and in Financial Education (FE_i^* or MAT_i^*), but rather the results of PISA (FE_i and MAT_i). PISA (2012) scores are based on calculations on a metric scale, with a 500 point average for all OECD countries and a standard deviation of 100 points. For a better understanding, they are usually divided into proficiency levels. This classification, recommended by PISA Technical Report is useful because it allows us to communicate about the proficiency of students in terms other than numbers.

The variable FE_i is an ordered variable that classifies the PISA-Financial results into 5 levels: (1) "lowest performers": less than 400.33 points, (2) "low performers": between 400.33 and 475.10 points, (3) "moderate performers": between 475.10 and 549.86 points, (4) "strong performers": between 549.86 and 624.63 points, and (5) "top performers": over 624.63 points.

The variable MAT_i is another ordered variable that classifies PISA-Mathematics results into 6 Levels: (1) "lowest performers": less than 357.7 points, (2) "low performers": between 357.5 and 420.1 points, (3) "low moderate performers": between 420.1 and 482.4 points, (4) "high moderate performers": between 482.4 and 544.7 points, (5) "strong performers" between 544.7 and 607 points and (6) "top performers": over 607 points. Observed variables are linked to the latent variables according to the following expressions:

$$FE_i = \begin{cases} 1 \; if \; FE_i^* < \omega_1 \\ 2 \; if \; \omega_1 < FE_i^* < \omega_2 \\ 3 \; if \; \omega_2 < FE_i^* < \omega_3 \\ 4 \; if \; \omega_3 < FE_i^* < \omega_4 \\ 5 \; if \; \omega_4 < FE_i^* \end{cases} \quad (4)$$

$$MAT_i = \begin{cases} 1 \; if \; MAT_i^* < \tau_1 \\ 2 \; if \; \tau_1 < MAT_i^* < \tau_2 \\ 3 \; if \; \tau_2 < MAT_i^* < \tau_3 \\ 4 \; if \; \tau_3 < MAT_i^* < \tau_4 \\ 5 \; if \; \tau_4 < MAT_i^* < \tau_5 \\ 6 \; if \; \tau_5 < MAT_i^* \end{cases} \quad (5)$$

Where $\omega_1 < \omega_2 < \omega_3 < \omega_4$ and $\tau_1 < \tau_2 < \tau_3 < \tau_4 < \tau_5$ are the cut-off points.

We proceeded to calculate two bivariate probit models. In the first one, the effect of EF on MAT is considered as a constant, and therefore, a standard ordered bivariate probit model was calculated. The second alternative is a bivariate probit with mixed effects assuming that the parameter α follows a normal distribution with mean μ_α and standard deviationσ_α. The denomination "mixed effects" makes reference to the existence of heterogeneity regarding the impact of FE over MAT across students. Considering that α follows a statistical distribution allow us to distinguish between those who are able to transform the skills gained in FE into better results in MAT, and also, those students with higher difficulty in cross-curriculum learning in MAT from skills learned in FE. With regard to computational aspects, the calculation for the standard model was done using the command proposed by Sajaia (2008), while for the model with mixed effects we have adapted the routine proposed by Buscha and Conte (2010).

Data

PISA is a cross-sectional study, conducted every three years that started in 2000 for 15 year old students, with the purpose of evaluating their performance in the areas of mathematics, reading and science, as well as cross-curriculum problem solving skills. PISA does not consider students' knowledge in these areas in isolation, rather in relation to their ability to apply them to real world situations. In addition to the general module and the CBA module (computer based assessment), a third type of test was conducted to measure Financial Education performance.

PISA(2012) defines Financial Education as "the knowledge and understanding of financial concepts and risks, and the skills, motivation and confidence to apply such knowledge and understanding in order to make effective decisions across a range of financial contexts, to improve the financial well-being of individuals and society, and to enable participation in economic life." (OECD, 2014).

The sample for Spain contains 1,108 observations, but if we restrict the sample to public schools it becomes reduced to 765 observations. Regarding participation in School Program 2.0, there are 167 observations for non-participating communities (NP), 532 for totally participating Communities (TP) and 66 for partially participating Communities (PP). Due to the small number of observations for PP, the subsequent analysis shall focus only on NP and TP.

Descriptive statistics

Table 3 shows the descriptive statistics of the variables that are subsequently used in the econometric analysis, differentiating by type of participation in the School Program 2.0.

In relation to students' characteristics, the percentage of non-repeating students is greater in TP Communities (66.23%) compared to 54% for NP Communities. The percentage of immigrant students in NP Communities is substantially higher as compared to the TP Communities (12.08%). Around 90% of students of both types of Communities have a computer at home. However, the percentage indicating the use of a computer for doing homework "every day" or "almost every day" is higher in TP Communities (12.76%) as compared to NP Communities (8.5%).

As instrumental variables in the equation for Financial Education, we will use the habit of talking to parents about financial issues (on a frequent basis) and if the student is working (tutoring, babysitting, helping out with the family business). 26.80% of students in NP Communities indicated talking to their parents about financial issues (family situation, news, etc.) compared to 20% in TP Communities. Moreover, 18%-19% of students in TP and NP Communities do some kind of work.

The vast majority of schools of schools stated that they have a program that specifies Mathematics contents on a monthly basis. By contrast the existence of a policy for quality control of Mathematics was much less widespread (37% of NP and 45% of TP), as well as the use of computers in Mathematics classes (35% of NP and 37% of TP). Most schools do not deliver Financial Education contents in 4thESO (80.17% of NP, 65.38% of TP). Furthermore, only 12.13% of schools in NP Communities and 16.87% of TP Communities have a separate subject for Financial Education, while 22%-26% of schools teach the contents of Financial Education in a cross-curricular manner (i.e., within the curriculum of another subject or subjects).

Focusing on schools in which Financial Education is included within other subjects, a higher concentration was observed in Mathematics or Social Sciences/Humanities (40% of NP, 50% of TP), but the inclusion of Financial Education within Economics subject shows more disparity (18.22% in NP, 43.71% in TP).

The level of teacher qualification in Mathematics show significant differences between the Communities. 100% of Mathematics teaching staff has ISCED5A qualifications in NP Communities compared to 72.56% in TP Communities. Differences in classrooms' technical equipment are smaller: 70.30% of students in TP Communities have a computer in the classroom compared to 65.95% for NP.

Teaching staff who deliver the contents of Financial Education in TP Communities tends to belong to school's own faculty. Around 12% of teachers come from the private or public institutions or from NGOs. The percentage of teachers that have received specific training to deliver Financial Education during the last year is quite reduced (30% for TP and NP), and the same happens for the average number of training hours (38 hours/year in TP, 30 hours/year in NP).

Table 3. Descriptive Statistics

	Autonomous Communities Not Participating	**Total Participation by Autonomous Communities**
Student Characteristics		
School Boys	50.19	52.97
School Girls	49.81	47.03
Repeated grade level		
Has not repeated grade level	54.56	66.23
Has repeated a grade level	44.07	32.80
Has repeated two grade levels	1.37	0.97
Lives with only one parent	10.87	10.36
Lives with both parents	82.51	82.15
Immigrant	21.17	12.08
Foreign father	23.23	13.73
Foreign mother	26.39	15.66
Speak another language at home	21.42	19.30
Age upon arrival to Spain	14.49	8.07
Father's education		
Has not completed ISCED1	2.55	4.13
ISCED1	14.65	12.08
ISCED2	21.61	24.27
ISCED3	4.37	0.81
ISCED4	18.38	23.05
ISCED5	15.05	11.02
ISCED6	16.68	18.97
Mother's Education		
Has not completed ISCED1	3.00	3.27
ISCED1	14.82	13.83
ISCED2	26.57	19.97
ISCED3	3.24	1.81
ISCED4	23.24	24.40
ISCED5	9.81	11.81
ISCED6	16.33	21.71
Relationship between parental economic activity		
Father, employed	83.33	76.84
Father, unemployed	9.90	9.42
Father, other circumstance	3.67	7.11
Mother, employed	62.83	60.33
Mother, unemployed	8.37	10.94
Mother, other circumstance	25.28	25.50
During the past two weeks		
Missed a day of school	52.49	40.79
Late to school	38.93	33.31
Uses ICT to complete homework		
Never	36.76	36.24
1-2 times/month	30.41	20.52
1-2 times/week	17.79	22.38
Almost every day	5.52	8.92
Everyday	2.98	3.84
Availability of computer/tablet	90.00	92.40
More than 100 books at home	35.30	41.99
Talk to parents about financial issues	26.80	20.75
Student works or helps with family business	18.76	19.00
School Characteristics		
Educational policy for school		
Quality control for Mathematics	37.89	45.52
Use of computers	35.12	37.10
Same textbook for all students	81.55	62.24
Specification of monthly content	93.53	91.10
Class Size	25.20	26.66
Availability of computer/tablet	65.95	70.30
Proportion of schoolgirls in class	42.84	48.21
Teachers with ISCED5A qualifications	100.00	72.56
Location of school		
City (over 1,000,000 pop.)	12.54	12.92
City (100,000-1,000,000 pop.)	21.20	30.26
City (15,000-100,000 pop.)	44.99	31.90
Town (3,000-15,000 pop.)	21.27	21.26
Rural areas (less than 3,000 pop.)	0.00	3.67

Financial Education		
Availability of Financial Education		
Not available	80.17	63.58
Available less than 2 years ago	8.28	9.47
Available 2 or more years ago	11.55	25.83
Compulsory subject	0.00	17.17
Teaching Financial Education (Multiple answers possible)		
Independent subject	12.13	16.87
Cross-curricular subject	22.02	26.70
Within Economics subject	18.22	36.98
Within Mathematics subject	41.55	49.75
Within other subjects (Humanities or Social Sciences)	42.87	52.09
Extra-curricular activity	3.10	2.07
Within personal tutor classes	15.44	8.62
Who delivers Financial Education		
School teaching staff	68.98	78.68
Professionals in the public and private sectors or NGO	12.98	12.43
Teaching staff have participated in professional development activities (Finance area)	30.46	32.10
Average number of hours	30.81	38.02
N	167	532

Tables 4 to 7 show the cross tabulation of the scores in Mathematics and Financial Education in Communities with total participation in School Program 2.0 and non-participating Communities, and for repeating and non-repeating students. Scores in Mathematics and Financial Education have been tabulated according to the levels proposed by the OECD (2014).

For non-repeating students, we appreciate that the percentage of students with Levels 4 or 5 in both subjects is lower in TP Communities (26.54%) compared to 31.95% in NP. We also find a similar concentration of students with low scores in both Communities, since the percentage of students who have Level 1 or 2 in Financial Education, and at the same time, lower than 1, Level 1 or Level 2 in Mathematics is 9.23% for TP Communities compared to 10.30% for NP.

Finally, there are some atypical cases in TP Communities: high performance in Financial Education but, very low in Mathematics (0.56% of Students with Level 3 in Financial Education, but only Level 1 in Mathematics; 0.56% of students with Level 4 in Financial Education and only Level 2 in Mathematics), or vice versa, a high performance in Mathematics, but very low in Financial Education (0.28% with Level 1 in Financial Education and Level 4 in Mathematics).

Table 4. Ranking of Mathematics and Financial[1] Education Levels. Communities with Total Participation in School Program 2.0. Non-repeating students (%)

	Mathematics						
Financial	Below Level 1 Less than 357.7	Level 1 Between 357.7 and 420.1	Level 2 Between 420.1 and 482.4	Level 3 Between 482.4 and 544.7	Level 4 Between 544.7 and 607	Level 5 Over 607	**Total**
Level 1 Less than 400.33	1.12	4.47	1.12	0.00	0.28	0.00	6.98
Level 2 Between 400.33 and 475.10	1.68	1.96	6.15	2.79	1.40	0.00	13.97
Level 3 Between 475.10 and 549.86	0.56	2.51	12.29	13.69	4.47	0.00	33.52
Level 4 Between 549.86 and 624.63	0.00	0.56	3.91	10.61	9.50	0.84	25.42
Level 5 Over 624.63	0.00	0.00	0.00	3.91	7.82	8.38	20.11
Total	3.35	9.50	23.46	31.01	23.46	9.22	100.00

Table 5. Ranking of Mathematics and Financial Education Levels. Non-participating Communities in School Program 2.0. Non-repeating students (%)

	Mathematics						
Financial	Below Level 1 Less than 357.7	Level 1 Between 357.7 and 420.1	Level 2 Between 420.1 and 482.4	Level 3 Between 482.4 and 544.7	Level 4 Between 544.7 and 607	Level 5 Over 607	**Total**
Level 1 Less than 400.33	3.09	1.03	2.06	1.03	0.00	0.00	7.22
Level 2 Between 400.33 and 475.10	1.03	5.15	9.28	2.06	1.03	0.00	18.56
Level 3 Between 475.10 and 549.86	0.00	2.06	8.25	12.37	4.12	1.03	27.84
Level 4 Between 549.86 and 624.63	0.00	0.00	3.09	8.25	16.49	1.03	28.87
Level 5 Over 624.63	0.00	0.00	0.00	3.09	10.31	4.12	17.53
Total	4.12	8.25	22.68	26.80	31.96	6.19	100.00

A combined tabulation was conducted for students repeating 1 or 2 academic years in Tables 6 and 7. The percentage of students found within Levels 3, 4 or 5 in Mathematics and Levels 4 or 5 in Financial Education is similar for both communities: 14.37% in TP and 14.49% in NP.

There is a higher concentration of students with poor results in both subjects for TP Communities: 68.40% of TP Communities compared to 50.87% of NP Communities are found within Levels 1 or 2 of Financial Education and lower than Level 1, Level 1 or Level 2 in Mathematics.

[1] The classification conducted by OECD (2014) defines "Level 5" as scores ranging between 606.9 and 669.3 and "Level 6" for scores above 669.3, but given the small number of observations reaching Level 6, they have been included within Level 5.

Table 6. Ranking of Mathematics and Financial Education Levels. Communities with Total Participation in School Program 2.0. Repeating Students (%)

Financial	Mathematics						Total
	Below Level 1 Less than 357.7	Level 1 Between 357.7 and 420.1	Level 2 Between 420.1 and 482.4	Level 3 Between 482.4 and 544.7	Level 4 Between 544.7 and 607	Level 5 Over 607	
Level 1 Less than 400.33	17.82	14.37	8.05	0.00	0.00	0.00	40.23
Level 2 Between 400.33 and 475.10	3.45	10.34	14.37	2.30	0.00	0.00	30.46
Level 3 Between 475.10 and 549.86	0.00	3.45	8.05	8.05	1.15	0.00	20.69
Level 4 Between 549.86 and 624.63	0.00	0.00	2.30	4.60	0.00	0.00	6.90
Level 5 Over 624.63	0.00	0.00	1.15	0.00	0.00	0.57	1.72
Total	21.26	28.16	33.91	14.94	1.15	0.57	100.00

Table 7. Ranking of Mathematics and Financial Education Levels. Non-participating Communities in School Program 2.0. Repeating students (%)

Financial	Mathematics						Total
	Below Level 1 Less than 357.7	Level 1 Between 357.7 and 420.1	Level 2 Between 420.1 and 482.4	Level 3 Between 482.4 and 544.7	Level 4 Between 544.7 and 607	Level 5 Over 607	
Level 1 Less than 369.9	21.74	11.59	2.90	0.00	0.00	0.00	36.23
Level 2 Between 369.9 and 457.5	1.45	14.49	8.70	7.25	0.00	0.00	31.88
Level 3 Between 457.7 and 518.6	0.00	1.45	11.59	11.59	1.45	0.00	26.09
Level 4 Between 518.6 and 579.4	0.00	0.00	4.35	0.00	1.45	0.00	5.80
Level 5 Over 579.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	23.19	27.54	27.54	18.84	2.90	0.00	100.00

Results and Discussion

The results obtained from the analysis (with and without mixed effects) are shown in Table 8 for TP Communities and in Table 9 for NP Communities. In all models (with and without mixed effects), the correlation coefficient is significant and positive. Regarding the validation of the model with mixed effects, it is observed that the likelihood function is higher compared to the value of the function in the standard bivariate probit model. Furthermore, when calculating the impact of Financial Education on Mathematics as a function with mean (μ) and standard deviation (σ), both parameters are significantly different from zero for TP Communities and NP Communities. This result confirms the existence of substantial heterogeneity in the effect of Financial Education on the results of Mathematics among the students.

In both types of Communities, it is observed that non-repeating students (boys) and those who have a computer at home tend to obtain higher scores in Mathematics. However, having a computer/tablet for personal use in the classroom has a negative effect on Mathematics scores. In relation to this intriguing evidence, the analysis of the implementation of ICT in schools and high schools has sparked debate during the last decade. Some studies have appreciated a substantial improvement of students' achievement as a result of the introduction of ICT (Barro *et al.*, (2009) in United States and Carrillo *et al.* (2010) in Canada). However, other analyses have found an insignificant or even negative relationship between both variables. Golsbee and

Guryan (2002) concluded that a program implemented in United States aimed at increasing the computer-to-student ratio, had not had any significant effect over students' achievement. For Israel, Angrist and Lavy (2002) observed a negative effect of ICT over Mathematics scores for 4th grade students. Similarly, Leuven *et al.* (2004) concluded that the increase of computer-to-student ratio in Dutch schools had led to worse Language and Mathematics results.

When comparing mixed effect models, it is observed that the increase in Mathematics scores for non-repeating students and the reduction for immigrant students are considerably higher in NP Communities. Although female students and immigrants show poorer performance in Mathematics and Financial Education, the difference with respect to male students or non-immigrant students is lower in the area of Financial Education (as others authors have also noted, Martin *et al.*, 2007).

For the model with mixed effects in TP Communities, schools that have a policy concerning the use of computers in the classroom and quality assessment in Mathematics tend to score higher in this subject.

In relation to Financial Education score, the positive effect for male students is lower than the Mathematics one, while the negative effect experienced by immigrant students is lower for Mathematics. With regards to the placement of Financial Education in the teaching project, a positive effect is observed when there is an obligation to teach this subject and when it has been delivered for more than two years at the school. This last result may be related to the existence of learning outcomes within the teaching plans, since with an increased number of years of "running", teachers know better how to teach students.

Talking with parents about issues related to Financial Education or having a job are significant and positive variables, with the first one having great influence on the score of Financial Education. These results confirm the evidence obtained by previous literature.

The fact that teaching faculty corresponds to school teachers instead of professionals from public and private institutions or NGOs is not significant for TP Communities, but it has a positive influence for NP Communities. The percentage of teachers who have received specific training in Financial Education during the past year is not significant for TP Communities, however, it is for NP Communities.

Table 8. Estimation of Bivariate Ordered Probit Model for Mathematics and Financial Education Scores. Communities with Total Participation

	Without Mixed Effects			With Mixed Effects		
Mathematics	**Coef**	**Std.D**		**Coef**	**Std.D**	
Financial Education Score	1.215	0.069	***			
Student (boy)	0.457	0.103	***	0.433	0.193	***
Immigrant	-0.149	0.077	**	-0.339	0.090	***
Non-repeating	0.175	0.041	**	0.334	0.045	***
Use of Computers Policy	0.224	0.100	**	0.180	0.032	***
Mathematics Quality Policy	0.011	0.163		0.050	0.028	*
Average Class Size	0.005	0.007		-0.006	0.008	
Ratio of Schoolgirls	-0.928	0.360	**	-0.599	0.413	
Ratio of ISCED5A Teachers	0.142	0.110		0.181	0.143	**
Computer/tablet at home	0.349	0.117	***	0.431	0.218	**
Computer/tablet at school	-0.136	0.010	***	-0.146	0.035	***
ICT for homework						***
1-2 times/week	0.230	0.113	**	0.141	0.148	
Almost every day	-0.068	0.011	***	-0.245	0.105	**
Everyday	-0.440	0.241	**	-0.695	0.288	***
Financial Education						
Non-repeating	1.198	0.121	***	1.250	0.236	***
Student (boy)	0.363	0.091	***	0.315	0.102	***
Immigrant	-0.305	0.162	*	-0.238	0.108	*
Student talks to parents	0.092	0.011	***	0.172	0.011	***
Student works	0.041	0.071	**	0.102	0.026	***
Computer/tablet at home	0.454	0.205	***	0.239	0.146	***
Subject, less than 2 years ago	0.304	0.154	**	0.572	0.192	**
Subject, more that 2 years ago	0.407	0.202	**	0.635	0.188	**
Compulsory subject	0.276	0.155	*	0.664	0.207	*
Explanation						
Cross-curricular subject	-0.342	0.126	***	-0.403	0.177	***
Within Economics Subject	-0.331	0.013	**	-0.420	0.137	**
Within Mathematics Subject	0.270	0.065	***	0.221	0.103	***
Within Science or Humanities Subjects	-0.128	0.050	**	-0.093	0.177	**
Teacher Training Courses	0.042	0.139		0.086	0.135	
Teacher: Teacher from School	0.175	0.147		0.260	0.156	
Average Class Size	-0.016	0.006	**	-0.023	0.175	**
Ratio of Schoolgirls	-0.066	0.281		-0.017	0.007	
Interaction: Computer/tablet at school and Financial Education within Mathematics	-0.485	0.056	***	-0.602	0.289	***
Interaction: ICT for homework and Financial Education within Mathematics						
1-2 times/week	0.207	0.062	**	0.326	0.173	**
Almost every day	-0.192	0.082	**	-0.047	0.200	**
Everyday	-0.804	0.323	**	-0.147	0.278	**
Constant	-0.736	0.245	***	-0.935	0.445	***
μ(mixed effect)				1.222	0.254	***
σ(mixed effect)				0.653	0.287	***
ρ	0.627	0.149	***	0.351	0.178	***
Log likelihood		-1,174.959			-1,147.912	
N		532			532	

All cut-off points are significant at 5%. In both equations, the size of the municipality and the highest educational level of the father/mother have been included as an explanatory variable. Omitted variables: schoolgirls, repeating students, national, use computer for homework 1-2 times/month or less frequently, non-compulsory Financial Education, Financial Education subject not available. (***: Significant at 1%; **: significant at 5%; *: significant at 10%).

Table 9. Estimation of Bivariate Ordered Probit Model for Mathematics and Financial Education Scores. Non-participating Communities

	Without Mixed Effects			With Mixed Effects		
Mathematics	**Coef**	**Std.D**		**Coef**	**Std.D**	
Financial Education Score	1.291	0.142	***			
Student (boy)	0.688	0.199	***	0.624	0.201	***
Immigrant	-0.616	0.278	**	-1.844	0.419	***
Non-repeating	0.826	0.338	**	2.051	0.548	***
Use of Computers Policy	0.332	0.203		0.490	0.858	
Mathematics Quality Policy	0.547	0.371		1.670	2.336	
Average Class Size	-0.040	0.025		-0.142	0.199	
Ratio of Schoolgirls at class	-1.257	0.568		1.060	2.313	
Ratio of ISCED5A Teachers						
Computer/tablet at home	0.592	0.256	**	0.845	0.316	**
Computer/tablet at school	-0.064	0.021	***	-0.226	0.112	**
ICT for homework						
1-2 times/week	0.029	0.009	***	0.021	0.006	***
Almost every day	-0.049	0.024	**	-0.216	1.482	**
Everyday	-0.102	0.050	**	-0.614	0.201	***
Financial Education						
Non-repeating	1.180	0.210	***	1.240	0.189	***
Student (boy)	0.350	0.128	**	0.310	0.098	***
Immigrant	-0.503	0.272	*	-0.391	0.115	*
Student talks to parents	0.228	0.100	**	0.344	0.165	**
Student works	0.257	0.130	**	0.195	0.068	***
Computer/tablet at home	0.631	0.349	**	0.241	0.108	**
Subject, less than 2 years ago	0.121	0.016	***	0.798	0.378	**
Subject, more than 2 years ago	0.728	0.321	**	0.941	0.450	**
Compulsory subject	-	-		-	-	
Explanation						
Cross-curricular subject	-0.607	0.134	***	-0.214	0.064	***
Within Economics Subject	-0.670	0.216	***	-0.771	0.349	***
Within Mathematics Subject	0.105	0.038	***	0.297	0.084	***
Within Science or Humanities Subjects	-0.249	0.036	***	-0.242	0.015	***
Teacher Training Courses	0.786	0.279	***	0.952	0.445	***
Teacher: Teacher from School	0.789	0.382	**	0.808	0.323	**
Average Class Size	0.038	0.026		0.863	0.515	
Ratio of Schoolgirls at class	0.573	0.874		0.039	0.030	
Interaction: Computer/tablet at school and Financial Education within Mathematics	-0.434	0.132	***	-0.830	0.211	***
Interaction: ICT for homework and Financial Education within Mathematics						
1-2 times/week	0.184	0.067	***	0.180	0.063	***
Almost every day	-0.263	0.025	***	-0.350	0.075	***
Everyday	-0.337	0.067	**	-0.413	0.065	**
Constant	0.468	0.421		-0.998	0.572	**
μ(mixed effect)				1.410	0.308	***
σ(mixed effect)				0.257	0.081	***
ρ	0.751	0.178	***	0.271	0.101	***
Log likelihood		-360.159			-347.454	
N		166			166	

Same footnote than previous table.

When comparing the effect of Financial Education on Mathematics between the two types of Communities and models, we observe that Financial Education always has a significant and positive effect on the subject of Mathematics. The advantage of calculating a mixed effects model is that it is possible to differentiate the effect of Financial Education on Mathematics within the same group.

Figure 1 shows the density functions corresponding to the effect of Financial Education on Mathematics in TP and NP Communities. The mean effect of the Financial Education variable on Mathematics is more intense in NP Communities than for TP Communities (1.410 compared to 1.222) and it is also more concentrated. This implies that in TP Communities there are students who receive greater benefit from learning Financial Education in regards to Mathematics scores (30% of the distribution is above 2), but there are also students who are found in the opposite situation (10.62% are below

zero), i.e., that obtain good results in Financial Education, but poor results in Mathematics.

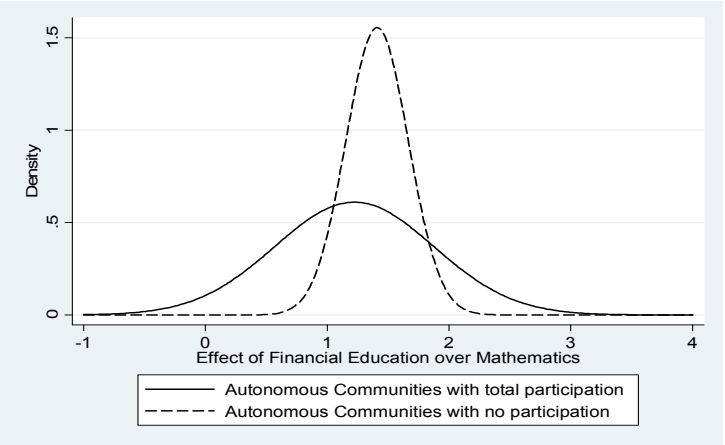

Figure 1. Density Functions of the Effect of Financial Education on Mathematics Scores According to Participation in School Program 2.0 (repeating and non-repeating students are included)

The sample size of the TP Communities allows the calculation of the bivariate probit model with mixed effects distinguishing between repeating and non-repeating students. We consider that this analysis is interesting given the relevant proportion of repeating students. The results of the estimation are not shown due to their size, but are available on request from the authors. Figure 2 shows the density functions for repeating and non-repeating students in TP Communities.

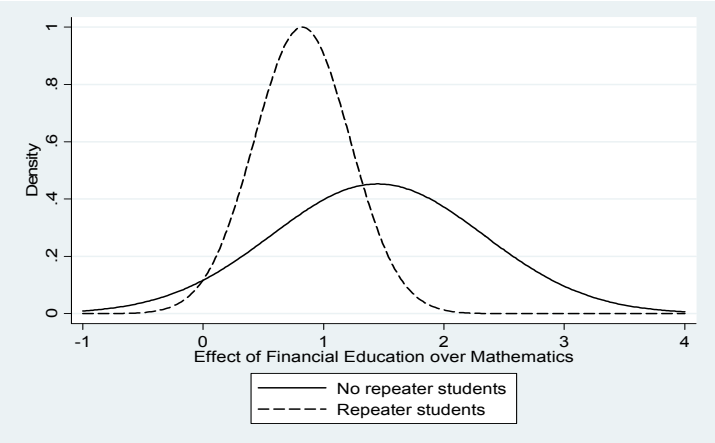

Figure 2. Density Functions of the Effect of Financial Education on Mathematics Scores According to Grade Repetition. Only Communities with Total Participation in School Program 2.0

The effect of Financial Education on Mathematics is, on average, 1.4491 for non-repeating students compared to 0.8234 for repeating ones. Consequently, in TP Communities, there is a multiplicative effect (which also might be described as a positive externality) of Financial Education over Mathematics for non-repeating students. However, for students who have repeated a school year, the transmission of knowledge or skills from Financial Education to Mathematics occurs at a lower rate (the sample size does not allow us to differentiate between students who have repeated one or two school years).

These results suggest that for some students the learning process operates like an osmosis system, in a manner that knowledge/skills from Financial Education are transferred to the field of Mathematics with a clearly positive effect. However, there are other students that seem to operate within a separate system: they "do" well in Financial Education but have less satisfactory results in Mathematics.

Predicted Probabilities for Financial Education

Table 10 shows the probability that Financial Education scores lies within Levels 1-5 depending on the teaching methodology, participation in the School Program 2.0 and repeating and non-repeating students.

Placement of Financial Education in relation to other subjects

For non-repeating students, the probability that Financial Education score lies within Levels 4 or 5 is higher when it is included within the subject of Mathematics (0.439 for TP and 0.566 for NP). In second place, when it is included within another subject of Social Sciences or Humanities (0.408 for TP and 0.493 for NP). It must be noted that if Financial Education is included within the subject of Mathematics, the probability of obtaining a score within Levels 4 or 5 is increased by 36.33% (TP) and 52.97% (NP) compared to its placement within the subject of Economics.

For non-repeating students, the probability that the Financial Education score lies within Level 1 is 0.519 (TP) and 0.426 (NP) if it is delivered within the subject of Economics, compared to 0.394 (PF) and 0.314 (NP) if it is included within the subject of Mathematics. Therefore, the probability of obtaining the lowest results is reduced by 24.08% (TP) and 26.29% (NP) when it is taught within the subject of Mathematics.

Utilization of Computers in the Classroom for Mathematics Classes

The interaction between the use of a computer in the subject of Mathematics and the placement of Financial Education within this subject reveals that the probability of obtaining Financial Education score within Level 4 or 5 decreases when the student has a computer/tablet for personal use (0.393 compared to 0.452 for TP and 0.398 compared to 0.518 for NP). In percentage terms, the use of computers in the subject of Mathematics implies a lower score in Financial Education by 15.26% for TP and 30.15% for NP. The fact that the reduction (in percentage terms) is greater in NP Communities may indicate different styles of teaching methodology applied to ICTs between Communities that have participated or not in School Program 2.0.

For repeating students of TP Communities, there are no significant differences in the distribution by Financial Education levels based on the use of computers in the classroom. In contrast, for NP Communities, the probability that the score for Financial Education lies in the lowest Levels (1 or 2) is 0.289 when using a computer compared to 0.204 when not used, which represents a reduction of 29.41%. As already mentioned, these differences according to Communities hint the existence of differences in the use that is given to ICT as a learning tool.

Utilization of a Computer to do Mathematics Homework

The relationship between the use of a computer for Mathematics homework and the inclusion of Financial Education within this subject reveals different patterns of behaviour in terms of the participation in School Program 2.0 and grade repetition.

For non-repeating students, the highest probability of obtaining a score within Level 4 or 5 for Financial Education corresponds to the use of a computer 1-2 times/week for TP Communities compared to 1-2 times/month or less for NP Communities. For TP Communities, the probability drops to a minimum (0.130) for the use of a computer every day, increases to 0.374 when it is used almost every day, peaks (0.497) at 1-2 times/week and decreases again to 0.430 when rarely used. For NP Communities, the probability of obtaining better results in Financial Education shows an inverse relationship with respect to its the frequency of use: 0.222 for daily use, 0.451 for almost everyday, 0.600 for 1-2 times/week and 0.677 for 1-2 times/month or less.

For repeating students, the greatest probability to achieve a score within Level 1 in Financial Education corresponds to computer daily use in TP Communities or almost everyday in NP. The lowest probability of obtaining a score within Level 1 is for using a computer for homework 1-2 times/week (0.251 for TP and 0.242 for NP).

Table 10. Predicted Probability for Financial Education Levels

	Total participation		**No participation**	
	No rep.	**Repeating**	**No rep.**	**Repeating**
Financial Education: Within Economics Subject				
Financial Compt. Score: Level 1	0.117	0.519	0.110	0.426
Financial Compt. Score: Level 2	0.209	0.260	0.223	0.306
Financial Compt. Score: Level 3	0.351	0.173	0.297	0.186
Financial Compt. Score: Level 4	0.201	0.039	0.233	0.066
Financial Compt. Score: Level 5	0.121	0.009	0.137	0.015
Financial Education: Within Mathematics Subject				
Financial Compt. Score: Level 1	0.068	0.394	0.040	0.314
Financial Compt. Score: Level 2	0.158	0.280	0.133	0.323
Financial Compt. Score: Level 3	0.334	0.236	0.261	0.238
Financial Compt. Score: Level 4	0.241	0.069	0.301	0.100
Financial Compt. Score: Level 5	0.198	0.021	0.265	0.026
Financial Education: Within Humanities or Social Sciences Subject				
Financial Compt. Score: Level 1	0.080	0.421	0.056	0.361
Financial Compt. Score: Level 2	0.171	0.278	0.166	0.314
Financial Compt. Score: Level 3	0.341	0.221	0.285	0.217
Financial Compt. Score: Level 4	0.232	0.061	0.283	0.086
Financial Compt. Score: Level 5	0.176	0.018	0.210	0.021
Financial Education: Extra-Curricular Activity				
Financial Compt. Score: Level 1	0.083	0.442	0.070	0.426
Financial Compt. Score: Level 2	0.177	0.282	0.190	0.317
Financial Compt. Score: Level 3	0.348	0.210	0.300	0.185
Financial Compt. Score: Level 4	0.229	0.053	0.271	0.061
Financial Compt. Score: Level 5	0.163	0.014	0.168	0.012
Availability of a computer/tablet in the classroom for the subject of Mathematics and Financial Education within the subject of Mathematics				
Financial Compt. Score: Level 1	0.083	0.413	0.084	0.392
Financial Compt. Score: Level 2	0.178	0.282	0.205	0.314
Financial Compt. Score: Level 3	0.346	0.226	0.313	0.203
Financial Compt. Score: Level 4	0.228	0.062	0.262	0.075
Financial Compt. Score: Level 5	0.165	0.018	0.136	0.016
Do not have a computer/tablet in the classroom for the subject of Mathematics and Financial Education is taught within the subject of Mathematics				
Financial Compt. Score: Level 1	0.064	0.405	0.049	0.279
Financial Compt. Score: Level 2	0.151	0.282	0.155	0.327
Financial Compt. Score: Level 3	0.332	0.230	0.278	0.255
Financial Compt. Score: Level 4	0.248	0.064	0.288	0.110
Financial Compt. Score: Level 5	0.205	0.018	0.230	0.029
Use of ICT for homework in Mathematics (1-2 times/week) and Financial Education within the subject of Mathematics				
Financial Compt. Score: Level 1	0.046	0.251	0.032	0.242
Financial Compt. Score: Level 2	0.132	0.283	0.121	0.290
Financial Compt. Score: Level 3	0.325	0.310	0.247	0.265
Financial Compt. Score: Level 4	0.262	0.114	0.297	0.148
Financial Compt. Score: Level 5	0.235	0.042	0.303	0.054
Use of ICT for homework in Mathematics (almost every day) and Financial Education within the subject of Mathematics				
Financial Compt. Score: Level 1	0.077	0.483	0.069	0.448
Financial Compt. Score: Level 2	0.186	0.280	0.186	0.280
Financial Compt. Score: Level 3	0.363	0.187	0.294	0.177
Financial Compt. Score: Level 4	0.228	0.040	0.274	0.074
Financial Compt. Score: Level 5	0.146	0.009	0.177	0.020
Use of ICT for homework in Mathematics (every day) and Financial Education within the subject of Mathematics				
Financial Compt. Score: Level 1	0.260	0.714	0.201	0.366
Financial Compt. Score: Level 2	0.302	0.194	0.312	0.321
Financial Compt. Score: Level 3	0.308	0.080	0.265	0.215
Financial Compt. Score: Level 4	0.099	0.010	0.142	0.081
Financial Compt. Score: Level 5	0.031	0.001	0.080	0.017
Use of ICT for homework in Mathematics (1-2 times a month or less) and Financial Education within the subject of Mathematics				
Financial Compt. Score: Level 1	0.070	0.402	0.011	0.383
Financial Compt. Score: Level 2	0.161	0.286	0.076	0.295
Financial Compt. Score: Level 3	0.339	0.231	0.236	0.215
Financial Compt. Score: Level 4	0.241	0.063	0.346	0.088
Financial Compt. Score: Level 5	0.189	0.018	0.331	0.019

Simulation of the Effects of an Increased Score in Financial Education

Tables 11 and 12 show the effects on Mathematics scores resulting from improved scores by 5, 10, 15 and 20 points in Financial Education. For non-repeating students, an increase in Financial Education scores by 5 points increases the probability that Mathematics scores would lie in the highest level (level 5) by 5.74% for TP Communities and 8.17% for NP Communities. If Financial Education scores increase by 10 points, the probability that Mathematics scores lies within Level 5 is increased by 11.82% and 15.22%, respectively.

For repeating students, the effects of an increase in Financial Education scores on Mathematics are higher for NP Communities. For example, an increase by 10 points raises the probability that Mathematics scores are found within Level 5 by 12.99% compared to 19.76 in NP Communities.

The differences between repeating and non-repeating students are particularly evident to encourage an increase by 20 points in Financial Education. The probability that Mathematics score lies within Level 5 increases by 21% for non-repeating students (for both types of Communities). However, for repeating students, the probability increases by 28.65% for TP Communities and by 65.49% for NP Communities.

Table 11. Simulation of the Effect on Mathematics Score as a result of an increase in the performance of Financial Education. Communities with Total Participation in School Program 2.0

	No rep.	Rep	Variation from Base Case (%)	
Base Case				
Mathematics Score: Level 1	0.087	0.305	-	-
Mathematics Score: Level 2	0.106	0.212	-	-
Mathematics Score: Level 3	0.206	0.233	-	-
Mathematics Score: Level 4	0.208	0.136	-	-
Mathematics Score: Level 5	0.393	0.114	-	-
Financial Education: +5				
Mathematics Score: Level 1	0.081	0.295	-6.96	-3.43
Mathematics Score: Level 2	0.101	0.208	-4.52	-2.01
Mathematics Score: Level 3	0.198	0.234	-3.68	0.60
Mathematics Score: Level 4	0.204	0.142	-1.95	4.38
Mathematics Score: Level 5	0.415	0.122	5.74	6.48
Financial Education: +10				
Mathematics Score: Level 1	0.075	0.277	-14.62	-9.19
Mathematics Score: Level 2	0.092	0.204	-13.05	-3.81
Mathematics Score: Level 3	0.188	0.239	-9.00	2.64
Mathematics Score: Level 4	0.207	0.151	-0.60	11.17
Mathematics Score: Level 5	0.439	0.129	11.82	12.99
Financial Education: +15				
Mathematics Score: Level 1	0.070	0.258	-20.07	-15.45
Mathematics Score: Level 2	0.085	0.203	-20.07	-4.29
Mathematics Score: Level 3	0.179	0.249	-13.27	6.66
Mathematics Score: Level 4	0.208	0.158	-0.07	16.41
Mathematics Score: Level 5	0.459	0.133	16.89	16.19
Financial Education: +20				
Mathematics Score: Level 1	0.065	0.247	-25.80	-19.06
Mathematics Score: Level 2	0.080	0.195	-24.30	-8.03
Mathematics Score: Level 3	0.173	0.247	-15.90	6.03
Mathematics Score: Level 4	0.207	0.164	-0.54	20.95
Mathematics Score: Level 5	0.475	0.147	20.94	28.65

Table 12. Simulation of the Effect on Mathematics Score as a result of an increase in the performance of Financial Education. Communities Not Participating in School Program 2.0

	Non-repeating	Rep	Change from base case (%)	
Base Case				
Mathematics Score: Level 1	0.070	0.247	-	-
Mathematics Score: Level 2	0.110	0.239	-	-
Mathematics Score: Level 3	0.192	0.271	-	-
Mathematics Score: Level 4	0.220	0.161	-	-
Mathematics Score: Level 5	0.407	0.083	-	-
Financial Education: +5				
Mathematics Score: Level 1	0.067	0.244	-4.54	-1.29
Mathematics Score: Level 2	0.102	0.229	-7.25	-4.00
Mathematics Score: Level 3	0.176	0.262	-8.26	-3.24
Mathematics Score: Level 4	0.214	0.170	-2.82	5.70
Mathematics Score: Level 5	0.441	0.095	8.17	14.90
Financial Education: +10				
Mathematics Score: Level 1	0.058	0.239	-16.82	-3.10
Mathematics Score: Level 2	0.091	0.221	-17.14	-7.53
Mathematics Score: Level 3	0.172	0.262	-10.53	-3.27
Mathematics Score: Level 4	0.210	0.179	-4.65	11.26
Mathematics Score: Level 5	0.469	0.099	15.02	19.76
Financial Education: +15				
Mathematics Score: Level 1	0.057	0.222	-18.55	-10.15
Mathematics Score: Level 2	0.089	0.206	-19.66	-13.68
Mathematics Score: Level 3	0.170	0.264	-11.42	-2.58
Mathematics Score: Level 4	0.208	0.191	-5.47	18.62
Mathematics Score: Level 5	0.476	0.117	16.86	42.00
Financial Education: +20				
Mathematics Score: Level 1	0.053	0.201	-24.53	-18.51
Mathematics Score: Level 2	0.085	0.193	-23.02	-19.20
Mathematics Score: Level 3	0.165	0.264	-14.41	-2.55
Mathematics Score: Level 4	0.202	0.205	-8.04	27.53
Mathematics Score: Level 5	0.495	0.137	21.60	65.49

Conclusions

This work has confirmed the importance that young people understand Financial Education concepts, not only because it involves a significant improvement for scores in this area, but also because it holds, to a great extent, a beneficial effect on the skills acquired within the subject of Mathematics. It has been shown that a greater benefit is obtained when the contents of Financial Education are taught in conjunction with the contents of the subject of Mathematics. Moreover, the inclusion of financial contents in Mathematics subject could help to alleviate the gender gap (school-boys vs. school-girls) and the nationality gap (native vs. immigrant students) observed in Mathematics performance. From the point of view of Higher Education, the main recommendation of this paper is that faculties preparing teachers for primary and secondary schools should include the standards of financial literacy and the relationship with mathematical concepts in their academic programs.

Regarding the influence of ICT on the skills for both subjects, the benefit of having a computer for personal use by students is observed, both for school and home use. This positive effect is associated with a moderate use of computers (1-2 times/week), but is not observed for the case of daily use. However, we must interpret the results with certain caution, as not much time has passed since the implementation of these new teaching methodologies, so we should expect to see a "learning effect" over time. In this case, future waves of PISA could be used to test this hypothesis.

Three relevant aspects are highlighted as areas for short-term improvements. First, the importance of school policy regarding the use of computers in the classroom, given that as PISA (2012) data reveal that less than half of schools have one. Second, the encouragement of teacher training, as only a small percentage of teachers have

received specific instruction for teaching Financial Education. Thirdly, it has been verified that 100% of students in Communities that have not participated in School Program 2.0 have experienced a positive effect of Financial Education over Mathematics; meanwhile Communities with total participation had approximately 10% of students with mixed results in both areas.

Given that the analysis included variables related to the student, his/her family, the use of ICT as a teaching methodology, and the inclusion of Financial Education contents within subjects, we must consider which other variables (motivational, linguistic, procedural) are hindering student learning, since these deficiencies in their education could imply a major detriment to his/her subsequent development as an adult.

References

Angrist, J., Lavy, V. (2002). New evidence on classroom computers and pupil learning. Economic Journal, 112, 735-765.

Barrow, L., Nmarkman, L., Rouse, C. (2009). Technology's edge: the educational benefits of computer-aided instruction. American Economic Journal: Economic Policy, 1(1), 52-74.

Buscha, F., Conte, A. (2010). The impact of truancy on educational attainment: a bivariate ordered probit estimator with mixed effects. JENA Economic Research Papers N0. 062. Volpe.

Carrillo, P., Onofa, M., & Ponce, J. (2010). Information technology and student achievement: evidence from a randomized experiment in Ecuador. Inter-American Development Bank Working Paper Series No. 223.

Cole, S., Sampson, T., Zia, B. (2011). Prices or knowledge? What drives demand for financial services in emerging markets? The Journal of Finance, 66, 1933-1967.

Golsbee, A., & Guryan, J. (2002). The impact of internet subsidies on public schools. NBER Working Paper No. 9090.

Hinojosa, T., Miller, S., Swanlund, A., Hallberg, K., Brown, M., O'Brien, B. (2009). The Stock Market Game study: a brief report. Washington, DC: FINRA Investor Education Foundation.

Hoyles, C., Wolf, C., Molyneux-Hodgson, S., Kent, P. (2002). Mathematical skills in the workplace. Final Report to the Science, Technology and Mathematics Council. London: University of London and Science, Technology and Mathematics Council.

Lester, W.F., Williams, V.J. (2010). Interactive investor education: an exploratory impact study in non-traditional learning environments. Business Education Innovation Journal, 2, 44-52.

Leuven E., Lindahl, M., Oosterbeek, H., Webbink, D. (2004). The effect of extra funding for disadvantaged pupils on achievement. IZA Discussion Paper No. 1122.

Lusardi, A., Mitchell, O.S. (2009). How ordinary consumers make complex economic decisions: financial literacy and retirement readiness. Working Paper 15350. National Bureau of Economic Research.

Lusardi, A., Tuffano, P. (2009). Debt literacy, financial experiences and overindebtedness. NBER Working Paper No. 14808.

Mandell, L. (2008). In overcoming the saving slump: how to increase the effectiveness of financial education and saving programs. Financial Literacy in High School, 20, 257-279.

Martin, F.S., (2007). A literature review on the effectiveness of financial education. Working Paper 07-03. Federal Reserve Bank of Richmond.

Mishkin, F.S. (2008). The importance of economic education and financial literacy. Speech before the Federal Reserve Board at the Third National Summit on Economic and Financial Literacy. Washington, DC.

OECD (2005). Recommendation on principles and good practices for financial education and awareness. OECD. Directorate for Financial and Entreprise Affairs.

OECD, (2014). PISA 2012. Technical Report. Available at: http://www.oecd.org/pisa/pisaproducts/PISA-2012-technical-report-final.pdf

Pinto, M.B, Mansfield, P.M., Parente, D.H. (2005). Information learned from socialization agents: its relationship to credit card use. Family and Consumer Sciences Research Journal, 33, 357-367.

Sajaia, X. (2008). Maximum likelihood estimation of a bivariate ordered probit model: implementation and Monte Carlo simulations. The Stata Journal 3(2), 311-328.

Samkin, G., Low, M., Taylor, J. (2012). Incorporating financial literacy into the secondary high school accounting curriculum: a New Zealand perspective. Australasian Accounting Business and Financial Journal, 6, 5-30.

Suiter, M. & McCorkle, S. (2008). Money math: Lessons for life. Center for Entrepreneurship and Economic Education. University of Missouri. Available at: https://www.treasurydirect.gov/indiv/tools/tools_moneymathintro.pdf.

Van Rooij, M.A., Lusardi, A., Alessie, R. (2011). Financial literacy and stock market participation. Journal of Financial Economics, 110, 449-472.

Varcoe, K., Martin, A., Devitto, Z., Go, C. (2005). Using a financial education curriculum for teens. Financial Counseling and Planning, 16, 63-71.

Williams, S. (2010). Parental influence on the financial literacy of their school-aged children: an exploratory study. Exceptional Children, Journal of Special Education, I, 23-33

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