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The role of ICT for supporting relationships between students. Evidence for Spain

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Abstract

At present, the use of ICT (Information Communication Technology) is integrated in everyday teaching. Apart from developing new knowledge, it is convenient to test if computer enhances communication and solidarity among students. The implementation of the Program School 2.0 in Spain in conjunction with PISA survey for 2012 provides a unique opportunity for analyzing this issue. We estimate a bivariate ordered probit model for the frequency of support provided to other students and Mathematics performance. We posit the potential endogeneity of the variable Mathematics performance given that support received from others could have a significant effect over the resulting Mathematics achievement. We highlight two main results. First, the probability of helping other classmates with Mathematics increases notoriously in participant Communities in School 2.0 for "strong performers" and "top performers". Second, for repeater and immigrant students (and specifically those with different mother tongue), the probability of providing support "always/almost always" or "often" increases significantly in participant Communities with respect to non-participant Communities for all Mathematics performance levels. ICT provide an incentive for exchanging mathematical problems and discussing different solutions. And what is even more valuable, ICT may foster togetherness and ease the integration of different profiles of students.

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Keywords: Mathematics; ICT; interaction, integration

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1. Introduction

Spanish Universities have adapted their degrees and masters according to Bologna Process, establishing a list of general and specific competences that students should have acquired before graduating. One of these competences is "*being able to project the knowledge and skills to promote a society based on the values of freedom, justice, equality and pluralism*" (UMU, 2010). This competence remind us that the main goal of school is not to do well at university but to succeed in life (Eisner, 2004). It also raises the following question: beyond looking for comparable academic results among students of different cultural/economic stratum or different gender, would it be possible to enhance support among students, so that they learn from conviviality at schools?

The educational system should set up citizens who treat each other with respect, who value others' contributions (irrespective of race, social class or gender) and who act in a sense of justice. The first step towards this objective is to configure environments (classrooms) in which students learn to act in such a way, because students learn a lot more than specific knowledge associated to the different subjects in their classrooms. There is a growing group of scholars who recognize the need for students to learn to work collaboratively with others, especially those from different cultures and backgrounds. The implications of globalization should be taken into account in the pedagogical context with the purpose of melding the intellectual capacities (i.e, critical thinking, problem solving) with social abilities (i.e, respectful social relations) (Gardner, 2004).

Anderson (1999) has stated that "*democratic equality is identified by an individual standing as an equal over the course of an entire life*". If students (potential adults) are going to live in a pluralistic society, it is important that such ways of interaction should be included in the academic curriculum. Although this paper is related to Mathematics subject, the main focus is not on academic performance per se, but on the ways in which students learn from others.

In this sense, Gordon (2001) supported a move away from Mathematics subject being conceived as an individual practice towards a group activity in which the main purpose is less on finding the right answer than on providing a suitable explanation for a particular strategy, and where part of the responsibility for determining the solution shifts from the teacher (or the textbook) to the students (community of learners). Additionally, it may allow students with different native language to express their opinions and learn suitable language patterns by exposing them to models of collaborative talk and thinking. Shweder (2003) recognizes the importance of considering different perspectives and states that "*not only alternate solutions, but multidimensional ones, addressing several orders of reality or orders of experience may be more practical for solving complex human problems*".

Boaler (2008) performed a 4-year study of different Mathematics teaching approaches. In one of the high-schools, students learned to value the act of helping and to care about the learning of others. He found that interactions among students were extremely successful for reducing Mathematics' achievement differences between groups of students belonging to different ethnic groups. At the beginning of the year, Asian students and White students were outperforming Hispanic and Black students. At the end of the first year, there were no significant differences between White and Hispanic students. At the end of subsequent years, Asian students continued to significantly outperform Black and Hispanic students, but differences among Hispanic, White and Black students had disappeared.

At the same time, another competence which has been profusely incorporated to most academic programs is "*being able to information and communication technologies (ICT) in its disciplinary field*" (UMU, 2010), and in fact, the use of ICT has been integrated in everyday teaching. Apart from developing new knowledge, and given that the letter "C" stands for Communication, it is convenient to test if computer enhances communication and solidarity among students.

However, it seems difficult to test this hypothesis given the omnipresence of ICT in university classrooms. It seems quite implausible to compare students' habits and performance with and without ICT. The key point of this paper is that the availability of PISA survey and the different implementation of the Program School 2.0 in Spain provides a unique opportunity to analyze the effect of ICT over collaborative behavior among classmates. Nowadays, computers are an essential instrument in the workplace and 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.

For the first time, PISA survey has recorded information regarding supporting behavior among students, although this information is limited to Mathematics subject. Nevertheless, some authors have claimed that Mathematics are not just a way of thinking (internal to individual mind). Instead, it is a kind of language and offers a different form of communication between people. The combination of ICT and Mathematics contribute to improve students' abilities to articulate their mathematical thinking (Svensson, 2001; Wegerif and Daves, 2004). One additional advantage of introducing ICT in Mathematics' subject is that the group of students face an external opponent (the computer) rather than going head-to-head, which may lessen personal tensions within the group (Monaghan, 2005).

The aim of this paper is to answer the following questions: (i) does the methodology implemented in TP Communities play a significant role in the explanation of the differences in Mathematics scores?; (ii) do ICT strength collaborative behavior among students?, and (iii) do ICT allow students with specific profiles (repeater, immigrants) to feel that they can make a contribution by helping to other students?

2. The Program School 2.0

In July 2009, the Spanish Education Conference approved the implementation of the Program School 2.0 in conjunction with the Autonomous Communities (which are the Spanish denomination for regions). This Program pursued three main objectives: (1) the transformation of 5th and 6th Primary Education and 1st and 2nd Compulsory Secondary Education classrooms into digital classrooms at public schools, (2) the provision of computers for personal use and (3) the development of digital contents that could be used by teachers. However, Communities' participation in School Program 2.0 was not homogeneous and three levels of participation were discernible:

- Total Participant Communities (TP): Andalusia, Aragon, Cantabria, Castile-Leon, Castilla-La Mancha, Catalonia, Extremadura, Galicia, Navarra, Basque Country, La Rioja, Ceuta and Melilla
- Partial Participant Communities (PP): Asturias, Balearic and Canary Islands.
- Non-participant Communities (NP): Madrid, Murcia and Valencian Community.

With the data of total expenditure by Autonomous Region and the number of students who have received a computer, the ratio of "expenditure per pupil" has been computed (Table 1). This ratio must be understood in a broader sense, since not only reflects the value of computer equipment that 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 expenditure 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 5.3% that of ESO students at a public school, with a maximum of 20% in Navarra and a minimum of 1.6%in the Basque Country.

Table 1. 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 Program School 2.0 (1)	Computers for Students (2)	Expenditure per student (3)=(1)/(2)	Expenditure per student in Program School 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 Com.	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	-	-	-
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.
Madrid, Murcia and Valencian Community received funds, but finally they did not implemented the program.
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)

3. Methodology

We consider two latent variables H_i^* and MAT_i^* that denote "*propensity to help friends or classmates with Mathematics*" and "*knowledge in Mathematics*", respectively. Both variables are influenced by observable characteristics (family, resources available at home and at school) and unobservable characteristics (innate aptitudes of students, level of motivation). The relationship between them can flow in both directions. Students who perform better in Mathematics may receive more requests from other friends/classmates to help them with this subject, and devoting time to help others may also provide benefits for oneself. In general, the following system of equations can be used:

$$MAT_i^* = X_{1i}'\beta_1 + \varepsilon_{1i} \tag{1}$$

$$H_i^* = \alpha MAT_i^* + X_{2i}'\beta_2 + \varepsilon_{2i} \tag{2}$$

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

We do not observe neither the level of knowledge in Mathematics nor the intrinsic propensity to help others (H_i^* or MAT_i^*), but rather the results of PISA. Helping others is analyzed through the following question: "*How often do you help your friends/classmates with Mathematics?*": (1) never/almost never; (2) sometimes; (3) often; (4) always/almost always. We define an ordered variable H_i according to previous categories.

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 easier interpretation, they are usually divided into proficiency levels. The variable MAT_i is an 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, (6) "*top performers*": over 607 points. (OECD, 2014).

The following explanatory variables are introduced in both equations: characteristics of students (gender, nationality, immigrant with different mother tongue, repeater student) and characteristics of the school (average class size, ratio of schoolgirls at the school, size of municipality, having school policy regarding computer use and participant Community in the Program School 2.0).

Given that Mathematics proficiency scores are introduced as a potential endogenous variable, we have in fact 5 potential endogenous variables (one is the omitted category) in the equation for H_i. As identification restrictions in the equation for MAT_i, we have included parent's level of education and having 100 or more books at home. The choice of the instrumental variables is based on the assumption that they are correlated with the potential endogenous variable (MAT_i), but they are uncorrelated with the error term of the equation for helping behavior (ε_{2i}). With regard to computational aspects, the calculation for the standard model was done using the command proposed by Sajaia (2008).

4. 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, but in relation to their ability to apply them to real world situations. Mathematical literacy is defined as "*an individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals to recognise the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged and reflective citizens*" (OECD, 2014).

The sample for Spain contains 25,313 observations, but if we restrict the sample to public schools it becomes reduced to 15,565 observations. Regarding participation in School Program 2.0, there are 6,553 observations for non-participating communities (NP), 6,866 for totally participating Communities (TP) and 2,146 for partially participating Communities (PP). In the following, we will focus on NP and TP Communities.

Table 2 shows average Mathematics scores according to the degree of support participation in the Program School 2.0 for different profiles of students. We appreciate that Mathematics performance tends to be slightly higher in NP Communities for students providing support "always/"almost always" or "often". It is noteworthy that for both types of Communities, students who provide support "often" tend to overperform those providing support "always/almost always". Mathematics' scores for repeater students are between 100 and 120 points below no-repeater students, and scores for immigrant students are between 50 and 70 points below native students.

Table 2. Mathematics performance according to the question: "How often do you help friends with Mathematics"

	No Participant Communities				Total Participant Communities			
	(4)	(3)	(2)	(1)	(4)	(3)	(2)	(1)
Total	514.87	525.78	507.53	474.80	486.98	514.63	503.70	470.38
	(101.62)	(87.71)	(80.35)	(81.35)	(103.56)	(93.73)	(84.90)	(85.14)
No repeater student	549.47	549.60	529.45	506.21	531.19	545.16	529.56	506.54
	(84.57)	(73.40)	(69.30)	(68.30)	(87.88)	(79.11)	(73.09)	(73.68)
Repeater student	413.33	428.66	429.45	414.52	413.15	421.45	431.18	417.86
	(76.50)	(73.22)	(67.38)	(69.59)	(84.01)	(70.57)	(72.87)	(72.38)
Student-boy	507.66	531.39	518.52	483.44	494.24	520.81	517.71	476.51
	(106.28)	(93.20)	(82.33)	(82.76)	(107.43)	(98.93)	(86.76)	(89.91)
Student-girl	522.53	520.32	497.99	464.92	477.80	507.84	491.89	463.34
	(96.19)	(81.73)	(77.36)	(78.58)	(98.07)	(87.24)	(81.47)	(78.76)
Native	524.68	534.02	514.89	481.38	496.98	522.66	508.82	474.98
	(100.51)	(83.25)	(77.27)	(79.79)	(100.82)	(90.35)	(83.57)	(83.38)
Immigrant	446.45	466.22	449.07	425.75	424.06	450.82	452.40	426.44
	(81.88)	(96.05)	(80.49)	(76.05)	(99.42)	(95.92)	(81.11)	(89.27)
Immigrant	446.41	447.14	432.98	420.80	419.74	441.54	439.98	413.23
(other language)	(82.81)	(101.36)	(83.02)	(75.75)	(95.79)	(100.16)	(75.36)	(88.69)
N	244	1,151	3,054	2,104	297	1,432	3,130	2,008
%	3.72	17.57	46.60	32.11	4.32	20.86	45.58	29.24

Standard deviation between parenthesis. (4) Always/almost always; (3) Often; (2): Sometimes; (1) Never/Almost never.
Source: Own work using PISA (2012).

Table 3 shows the frequency of help to other students distinguishing between TP and NP Communities. We appreciate that the percentage of immigrants and immigrants with different mother tongue that have reported helping others "always/almost always" is higher in TP Communities (6.30% vs. 3.80%; 8.48% vs. 5.75%). The same applies for repeaters students (4.76% vs. 3.85% for 1-year repeater; 5.81% vs. 4.17% for 2-year repeater) and immigrant students (6.30% in TP vs. 3.80% in NP).

Table 3. Students' characteristics according to helping behavior and participation School 2.0

	Total Participant Communities				No Participant Communities			
	(4)	(3)	(2)	(1)	(4)	(3)	(2)	(1)
Total	4.32	16.54	45.58	33.56	3.72	17.57	46.60	32.12
Student-boy	5.05	16.81	41.73	36.41	4.00	18.21	43.42	34.37
Student-girl	3.62	16.27	49.34	30.78	3.45	16.95	49.66	29.95
No repeater student	3.92	18.13	49.35	28.60	3.57	18.65	49.79	27.99
Repeater student								
1 year	4.76	13.12	41.02	41.10	3.85	16.47	39.94	39.74
2 years	5.81	15.74	33.90	44.55	4.17	11.31	40.18	44.35
Native	4.08	16.15	46.11	33.67	3.71	17.28	46.88	32.13
Immigrant	6.30	19.72	41.26	32.72	3.80	19.31	44.88	32.01
Immigrant (other language)	8.48	18.75	41.96	30.80	5.75	22.41	41.95	29.89
N	4.32	16.54	45.58	33.56	3.72	17.57	46.6	32.12
%	297	1,136	3,130	2,304	244	1,151	3,054	2,105

(4) Always/almost always; (3) Often; (2): Sometimes; (1) Never/Almost never

5. Results

Table 4 shows the results of the bivariate ordered model. First of all, we validate our bivariate model with endogenous variable. The correlation coefficient is significant and positive, indicating that unobservable variables positively linked to Mathematics performance also increase helping behavior. Additionally, the cut-off points estimated for both ordinal dependent variables are significant, thus validating the ordered nature of the model.

It is interesting to remark the coefficients for the variables "immigrant" and "repeater student". On one hand, both variables have a positive impact over helping behavior, but negative over Mathematics performance. On the other side, the interaction of these variables with participation in the Program School 2.0 reveals a positive and significant effect in both equations. This implies that although repeater and immigrant students tend to underperform in Mathematics, this negative effect is partially mitigated in TP Communities.

Regarding the exclusion restrictions, they are significant and have the expected sign. Parents with a higher level of education play a positive influence over Mathematics performance, being the effect for father as compared to mother.

Categorical variables for Mathematics performance are significant with positive sign, and the magnitude of the coefficient increases with academic achievement. This result ascertains the positive relationship between supporting behavior and Mathematics performance. However, the highest effect of Mathematics' performance over supporting behavior is not observed fort "top performers", but for "strong performers".

As for the exclusion restrictions, they are significant and have the expected sign. Having parents with higher level of education plays a positive influence over Mathematics performance, being the effect for father higher as compared to mother.

Table 4. Bivariate ordered model

	Equation: Helps other students			Equation: Mathematics performance		
	Coef.	Std.D.		Coef.	Std.D.	
Student boy	-0.066	(0.02)	***	0.348	(0.02)	***
Repeater student	0.104	(0.04)	**	-1.264	(0.02)	***
Immigrant	0.169	(0.03)	***	-0.315	(0.03)	***
Immigrant (other language)	0.140	(0.03)	***	-0.166	(0.02)	***
Total participant Community	0.034	(0.01)	**	0.037	(0.01)	**
Policy: Mathematics computer use						
Interaction with TP Community						

Repeater student	0.051	(0.01)	**	0.089	(0.02)	***
Immigrant	0.073	(0.01)	**	0.038	(0.01)	**
Policy: Mathematics computer use	0.005	(0.05)		0.025	(0.01)	**
Mathematics performance						
"Top performers":	0.624	(0.14)	***			
"Strong performers"	0.718	(0.11)	***			
"High moderate performers"	0.200	(0.10)	**			
"Low moderate performers"	0.072	(0.03)	**			
"Low performers"	0.017	(0.01)	*			
Books at home >=100				0.443	(0.02)	***
Father's level of education						
ISCED2				0.125	(0.02)	***
ISDED3				0.139	(0.04)	***
ISCED4				0.158	(0.05)	***
ISCED5				0.240	(0.04)	***
ISCED6				0.256	(0.04)	***
Mother's level of education						
ISCED2				0.016	(0.03)	
ISDED3				0.076	(0.04)	
ISCED4				0.074	(0.04)	*
ISCED5				0.109	(0.04)	**
ISCED6				0.129	(0.03)	***
Size of municipality						
Village	0.038	(0.09)	*	-0.289	(0.09)	**
Small town	0.045	(0.10)	*	0.315	(0.09)	***
Town	0.020	(0.09)	**	0.410	(0.09)	***
Ratio of girls at classroom	-0.045	(0.07)		0.067	(0.06)	
Average class size	0.066	(0.01)	**	-0.003	(0.01)	
Log likelihood	-43209.646		ρ	0.139	(0.03)	***
Wald chi2 (p-value)	273.52	(0.00)	N	13.419		

Omitted category: student-girl, no repeater student, native, father/mother's education (ISCED1). father/mother's economic activity: different from employed or unemployed, living in city/big city. Cut-off points not shown due to space constraints.

After estimating the model we have computed the predicted probabilities of providing help to friends/classmates "always/almost always" or "often". Results are shown on Table 5. We appreciate that the probability of helping other friends/classmates "always/almost always" or "often" increases with Mathematics performance. For all levels of Mathematics performance, predicted probabilities are higher in TP Communities as compared to NP: 12%-13% for non-repeater students; 14%-18% for repeaters; 12%-13% for native students; 16%-21% for immigrant students. For natives and immigrant students, predicted probabilities are higher for "strong performers" as compared to "top performers". The estimated probability for immigrant students is higher as compared to native students for all categories of Mathematics performance: 26%-32% higher in TP Communities; 19%-23% higher in NP Communities. Moreover, the probability for immigrant students with different mother tongue is always higher (11%-14%) as compared to native students for all levels of Mathematics performance and both types of Communities.

Table 5. Predicted probability of helping others "always/almost always" or "often"

	Lowest perf.	Low perf.	Low moderate perf.	High moderate perf.	Strong perf.	Top perf.
No repeater student						
TP Community	0.167	0.191	0.223	0.259	0.297	0.337
NP Community	0.144	0.170	0.198	0.228	0.262	0.299
Repeater student						
TP Community	0.139	0.166	0.196	0.230	0.261	0.309

NP Community	0.119	0.141	0.165	0.194	0.224	0.271
Native student						
TP Community	0.129	0.164	0.204	0.249	0.334	0.291
NP Community	0.110	0.142	0.180	0.219	0.297	0.258
Immigrant student						
TP Community	0.190	0.228	0.271	0.320	0.423	0.374
NP Community	0.151	0.182	0.223	0.267	0.364	0.307
Immigrant student (other mother language)						
TP Community	0.174	0.200	0.243	0.285	0.326	0.373
NP Community	0.168	0.201	0.242	0.280	0.319	0.365

6. Conclusions

Our results corroborate that ICT provide an incentive for exchanging mathematical problems, which could also improve certain abilities such as critical thinking and communication skills (presenting informed judgements). And what is even more valuable, in an unintended manner, ICT may foster togetherness and ease the integration of different profiles of students. Students participating in these exchange of opinions benefit from employing new vocabulary expressing their own thinking to their partners, and developing decision making.

Nevertheless, this is not a closed issue and our results give cause for thought regarding the following questions: is that moving to another country make immigrant students more responsive to others students' needs?, why the best performing students tend to provide less support?, and why support provided by repeater students do not revert in their own interest? It seems that the relationship among ICT, Mathematics and supporting behavior is not exempt of psychological connotations that should be carefully analyzed.

Regarding the role of teachers, they should act as "facilitators", that is, helping students to build their own knowledge. It is crucial than students' ideas and opinions be treated with note-worthy degrees of respect. The way students learn to treat each other will impact the opportunities they extend to others in their lives beyond school (high-school/university). Teachers should also value students seeing problems in different ways, offering different methods or different interpretations.

References

Anderson, E. (1999). What is the point of equality? *Ethics*, 109, 287-337.

Boaler. J. (2008). Promoting relational equity and high mathematics achievement through an innovative mixed ability approach. *British Educational Research Journal,* 34(2), 167-194.

Eisner, E. (2004). Preparing for today and tomorrow. *Educational Leadership,* January, 7-10.

Gardner, H. (2004). How education changes: considerations of history, science and values. In M. Suárez-Orozco & D. Quin-Hilliard (Eds.), *Globalization: culture and education in the new millennium*. Berkeley, California, University of California Press.

Gordon, L. (2001). *Mathematical conversations within the practice of Mathematics*. New York: Peter Lang.

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. Available at: http://eprints.ioe.ac.uk/1565/

Monaghan, F. (2005). Don't think in your head, think aloud: ICT and exploratory talk in the primary school mathematics classroom. *Research in Mathematics Education*, 7(1), 83-100.

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

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

Shweder, R. (2003). Classroom structure and the organization of ability. *Sociology of Education*, 54, 120-132.

Svensson, I. (2001). Children's interaction in front of the computer. In I.M. Chaib (Ed.), *Perspectives on human-computer interactions*. Lund: Sudentlitterateur.

UMU (2010). Memoria del Título de Grado en Administración y Dirección de Empresas. Universidad de Murcia. (pp. 15). Available at: http://www.um.es/web/economiayempresa/contenido/estudios/grados/ade/documentacion

Wegerif, R., Dawes, L. (2004). *Thinking and learning with ICT: raising achievement in primary classrooms*. London: Routledge.