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ICT and Learning: Results from PISA 2009

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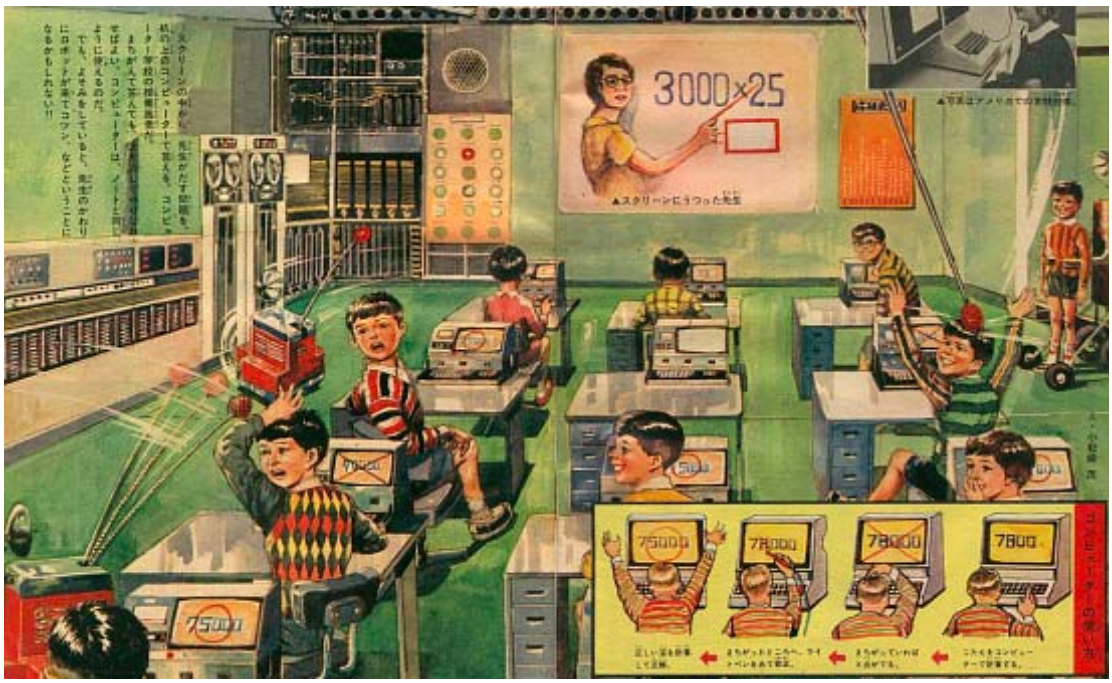

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1. Introduction

Economic and social development have urged governments to emphasize the contribution to education from a wide range of newly required skills and competencies. The recommendations of the European Parliament and the Council on key competences for lifelong learning identify a framework of eight competences necessary in a knowledge society (European Commission, 2006). Digital competences, defined as the confident and critical use of Information and Communication Technologies (ICT) for work, leisure and communication, are highlighted as one of these eight key competences. The central role of new technologies and digital competences for active citizenship, social cohesion, employability and economic development is further reaffirmed in the recently adopted initiatives "New Skills and Jobs" (European Commission, 2010a) and "Digital Agenda for Europe" (European Commission, 2010b). Education has a unique role to play in providing young people with the skills needed in a society in which ICT-related skills and competences are increasingly indispensable.

It is, therefore, relevant to assess and compare how education systems are dealing with the integration of technology in education, particularly in terms of securing and improving access, enhancing a wide range of educational and managerial uses, and monitoring the development of critical technology-related skills and competencies.

Based on these considerations, the current study focuses on the relationship between students' computer use and their achievement in reading (language of instruction), mathematics and science, controlling for students and school characteristics, with a particular attention to the actual use of ICT by students (see Witter & Senkbeil, 2008). The following questions are addressed:

QS1: Does the type of use of ICT by students affect their school performance?
QS2: Does this effect depend on students' social and economic background?

Measuring the impact of information technology on students' learning is not an easy task. Experimental and quasi-experimental studies aim to compare the performance of students using ICT (at home, at school or both) – the treatment group – with the performance of students who do not have access to (or do not use) ICT – the control group. In these studies "learning" is often reduced to student performance on a test, so that their conclusions are valid only for those aspects of the learning process that are measured by that specific test. While experimental studies are difficult to realize because of ethical issues, quasi-experimental studies – at least in developed countries – deal with the difficulty of defining a control group and an experimental group that are mutually exclusive (i.e. it is difficult to identify groups of students "with" and "without" access to ICT). Other challenges concern the nature of the data that is available: depending on the detail of the data, more or less information can be extracted from the empirical analysis.

This report contributes to the literature on the impact of ICT on educational outcomes in various respects. First, by exploiting the PISA 2009 ICT familiarity questionnaire, we are able to gather detailed information on the typology and intensity of use of ICT among 15 year-old students. This focus was not possible with earlier waves of the PISA survey (see Spiezia 2010). Thanks to the ICT familiarity questionnaire of PISA 2009, we are able to characterize different types of user profiles. For instance, we expect intense PC and software for school related tasks to have an effect on the PISA test scores different from that observed for intense playing of videogames. Second, we test whether the type of use of ICT (at school and, especially, at home) tends to reinforce differences originating from the social environment in which students are brought up. In other words, we want to understand

whether ICTs utilization amplifies or reduces the effects of the other learning skills that are transmitted by students' socio-economic backgrounds.

Our results show that it is difficult to detect a clear positive relationship between the use of new technologies and students' performance as measured by the PISA test. Moreover, we do not find strong evidence supporting the hypothesis that the use of ICT reinforces pre-existing social and economic differences.

These results, which – prima facie – could be read as evidence that investment in ICT has been ill-placed, should in fact be interpreted with great care. On the one hand, we have the issue of the type of skills that the PISA test is measuring: to the extent that this test tends to focus on abilities typically related with traditional teaching techniques, one should not expect to see any positive effect of intensive ICT utilization. On the other hand, the PISA dataset does not give us detailed information on the type of utilization of ICT at the school level. In particular, we do not know whether ICT are just added into a traditional curriculum or whether they actually shape – at least partially – the curriculum. This is important since we do not expect any particular benefit to come from the utilization of ICT in a fully traditional curriculum.

2. Data and conceptual framework

The primary source of data for our analysis is the fourth wave of the Programme for International Student Assessment (PISA) administered in 2009. PISA is a cross national survey that, every three years since 2000, has assessed 15 year-old students' performance in mathematics, reading and science, as well as cross-curricular problem-solving skills. PISA considers students' knowledge in these areas not in isolation, but in relation to their ability to reflect on their knowledge and experience and apply them to real-world issues. The emphasis is on mastering processes, understanding concepts and functioning in various contexts within each assessment area. The three domains assessed in PISA 2009 can be synthesized as follows:

> "*Reading literacy is understanding, using, and reflecting on written texts, in order to achieve one's goals, to develop one's knowledge and potential, and to participate in society*";
>
> "*Mathematical literacy is an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgments and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen*";
>
> "*Scientific literacy is the capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity*" (OECD, 2011).

In each PISA cycle, only one domain is tested in detail, taking up nearly two-thirds of the total testing time (about 390 minutes). The major domain in 2000 was reading, in 2003 it was mathematics and in 2006 it was science. In 2009 it was reading again, building on a modified reading framework which incorporates the reading of electronic texts and elaborates the constructs of reading engagement and meta-cognition (OECD, 2011).

Table 1: Dataset structure: students and schools distribution by country

	Students		Schools	
	number	%	number	%
Belgium (BE)	8,501	5.16	278	4.4
Bulgaria (BG)	4,507	2.74	178	2.8
Czech Rep. (CZ)	6,064	3.68	261	4.2
Germany (DE)	4,979	3.02	226	3.6
Denmark (DK)	5,924	3.60	285	4.6
Spain (ES)	25,887	15.72	889	14.2
Estonia (EE)	4,727	2.87	175	2.8
Finland (FI)	5,81	3.53	203	3.2
Greece (EL)	4,969	3.02	184	2.9
Croatia (HR)	4,994	3.03	158	2.5
Hungary (HU)	4,605	2.80	187	3.0
Ireland (IE)	3,937	2.39	144	2.3
Iceland (IS)	3,646	2.21	131	2.1
Italy (IT)	30,905	18.77	1097	17.5
Lithuania (LT)	4,528	2.75	196	3.1
Latvia (LV)	4,502	2.73	184	2.9
Norway (NO)	4,66	2.83	197	3.1
Poland (PO)	4,917	2.99	185	3.0
Portugal (PT)	6,298	3.83	214	3.4
Slovak Rep. (SK)	4,555	2.77	189	3.0
Slovenia (SI)	6,155	3.74	341	5.4
Sweden (SE)	4,567	2.77	189	3.0
Turkey (TU)	4,996	3.03	170	2.7
Pooled sample	164,633		6,271	

Note: unweighted data; country abbreviation in brackets
Source: OECD - PISA 2009

In addition to evaluating student performance, PISA collects contextual data on the characteristics of students, families and schools. Furthermore, PISA gives each country the option to administer a 10-minute questionnaire on students' familiarity with ICTs (the PISA-ICT 2009). Through this questionnaire, students are asked which kinds of new technologies are at their disposal at home and at school, if they use them, how often and for what purposes. Students are also asked to self-assess their level of proficiency in performing certain tasks using a computer and to express their attitude toward computers.

The PISA survey uses a two-stage stratified sampling procedure to collect the data. First, schools in which 15 year-old students are enrolled are selected systematically with probabilities proportional to their size. Second, eligible students within the sampled schools are selected with equal probability (OECD, 2009). Given this complex sampling design, the student sample is characterized by a hierarchical structure in which students are nested within classes and schools which, in turn, are nested in countries or geographic regions.

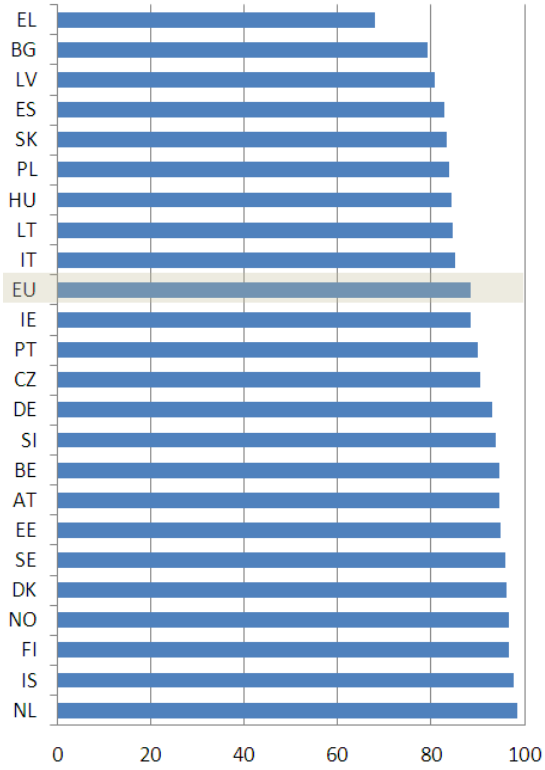
The analyses contained in this work consider only the European countries that completed the optional questionnaire on students' familiarity with ICT (plus Iceland, Norway and Turkey) and only the student-level observations with no missing values on any variable of

interest (list-wise deletion). The full sample is composed of 23 countries and most students within this sample have some experience in using ICT.[1] France, Luxembourg, the United Kingdom and Romania are not in the dataset because they did not complete the PISA-ICT questionnaire, while the Netherlands has been excluded from the econometric estimates because of missing data issues.[2] Similarly, Austria was not considered in the econometric analysis of the study because of data reliability issues. Table 1 presents the structure of the sample retained for the econometric analyses.

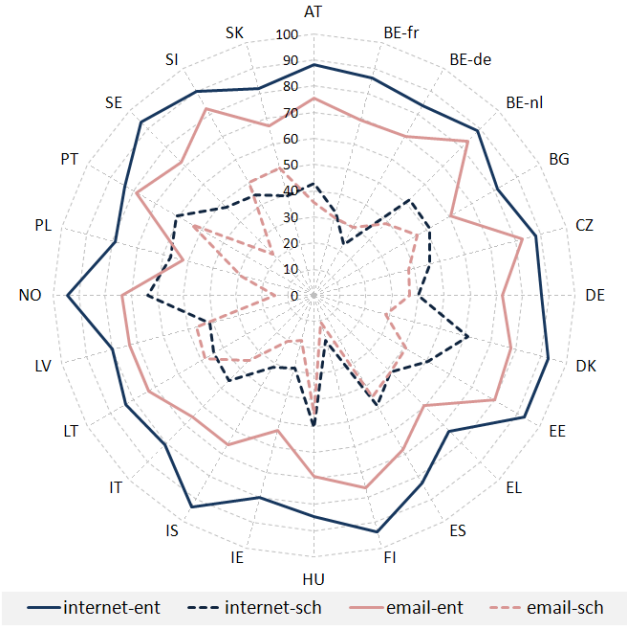
The analyses have been realized using normalized weights, calculated following the procedure suggested by the PISA 2009 data analysis manual (OECD, 2009, p. 219).

We start with the inspection of questions Q1 and Q2 of the PISA-ICT 2009 questionnaire (see Appendix A) aiming at collecting information on the availability of ICT at home and school.

1a. Percentage of 15 years old students using internet at home



1b. Percentage of 15 years old students using the internet or the email for entertainment or schoolwork at least once a week



Note: the EU average is a weighted average where the contribution of each country is proportional to the size of the country's 15 years old population
Source: authors' estimates from PISA ICT 2009

Figure1: Percentage of students using internet at home by country and by type of activity

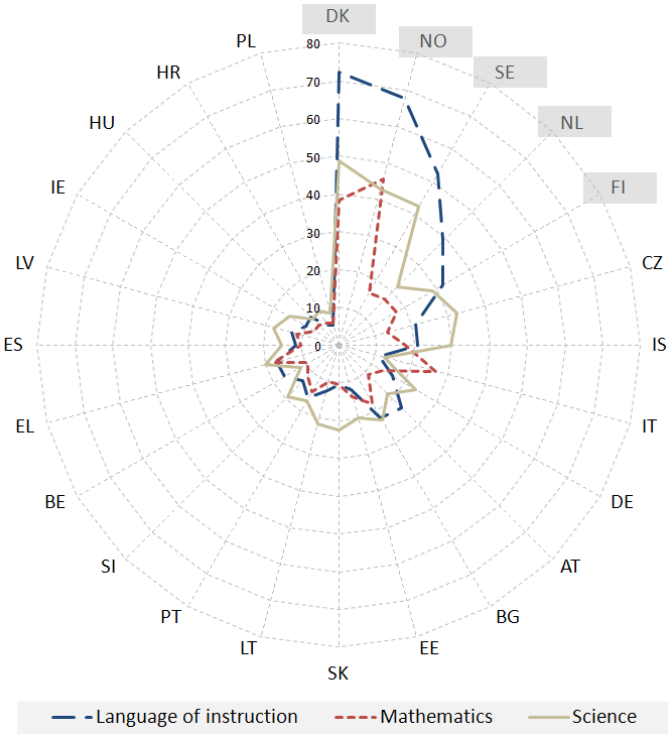
The data tell us that there are large cross-country differences in ICT availability (and use). On average, 88.3% of European students have access to and use internet at home; this

1 About 97% of students in the selected dataset declared to have used a computer before the survey.

2 The Netherlands, although completed the ICT familiarity questionnaire, is completely missing for the information concerning the use of ICT at home for entertainment purposes (variables from IC04Q01 to IC04Q09 of the OECD-PISA dataset).

percentage is above 95% in all the Nordic countries (it is highest in the Netherlands with 98.6%) and it is below 80% only in Bulgaria (79.1%) and Greece (68.1%) (Figure 1a). In all countries but Poland, the share of students using internet or e-mail at least once a week for entertainment is well above the share of students using these media for school-related purposes. Only in Portugal and Slovakia do students report using e-mail for schoolwork in more than half of the cases (54.2% and 50.3%, respectively); in 9 countries[3] the majority of students report browsing the internet for school work, while in 7 countries[4] nine tenths of students report browsing for fun (Figure 1b).

For the first time, the latest wave of the OECD-PISA study asks students if, and how intensively, they use computers for classes in language-of-instruction, mathematics or science during a typical school week. The information provided by this question is synthesized in Figure 2.



EU average by PISA domain		
Language of instruction	Mathematics	Science
17.1	14.3	18.8

Note: the EU average is a weighted average where the contribution of each country is proportional to the size of the country's 15 years old population
Source: authors' estimates from PISA ICT 2009

Figure 2: Percentages of ICT use at school, by country

On average, across European countries, the percentage of students using computers during mathematics lessons (14.3%) is smaller than that of students using computers during

[3] In alphabetic order: BE-NL (51.9%), BG (51.1%), DK (61.1%), EE (50.5%), HU (50.5%), NL (53.2%), PL (56.7%), PT (60.7%), and NO (63.7%).

[4] In alphabetic order: DK (92.8%), EE (93.2%), SI (90.2%), FI (93.7%), SE (93.9%), IS (93.3%), and NO (94.5%).

language-of-instruction or science classes (17.1% and 18.8%, respectively). There are substantial variations between countries and between subjects. Denmark and Norway show the highest proportion of students using computers in all the three subjects covered by the OECD-PISA survey, whereas in Hungary and Poland students are less likely to use computers during these classes. In the Netherlands and Sweden, a substantial share (40% or more) of 15 year-old students declare they use computers during language-of-instruction lessons. In Sweden, the same percentage also uses computers during science classes.

A proxy measure for the general use of computers at school for educational purposes can be obtained by computing the percentage of students who declare they use computers during classroom lectures in at least one of the three PISA domains. This measure shows that, despite the fact that 91% of European students attend schools with computers available for instruction that are connected to the internet (OECD-PISA 2009), ICT are widely used only by schools in Denmark (85.3%), Norway (81.3%), Sweden (67.5%), the Netherlands (54.5%) and Finland (50.1%).

Furthermore, Figure 2 reveals that in these five Northern countries the likelihood of using a computer during language-of-instruction classes is higher than the likelihood of using a computer during science lessons, which in turn is superior to the likelihood of using a computer during mathematics lessons. In all the remaining countries (with the exception of Austria, Belgium and Italy), the share of students who declare they use computers during science lessons is higher than the share of students using them in the two other domains.

Our econometric analysis is mostly based on Q4, Q5 and Q6 of the ICT familiarity questionnaire, which are meant to capture the use of ICT, both at home and at school (these questions are reported in Appendix B). Q4 refers mainly to entertainment uses of ICT at home, while Q5 and Q6 capture school-related activities (respectively at home and at school). There are various ways to read the information provided by Q4, Q5 and Q6. On the one hand, these questions distinguish between the location of ICT use: home vs. school. On the other hand, they also distinguish between the purpose of the activity: some of them are school related (even if performed at home) while others are mostly entertainment related. Finally, these activities involve different skills: some are more related to information gathering, while others support collaboration or communication and sharing (to name just a few), irrespective of the location at which they are performed.

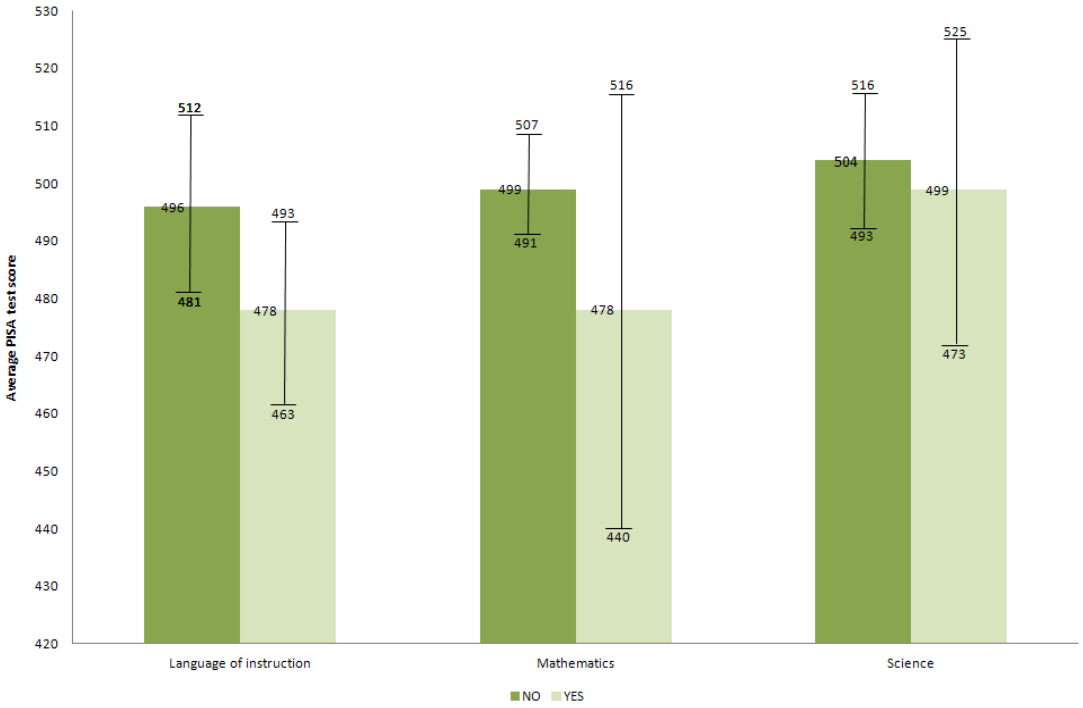
Table 2 shows how students use computers at school. It contains the share of students, computed on the whole dataset (column 1) and by PISA domain (columns 3 to 4), performing one of the following nine activities at least once a week: *chat online*; *use e-mail*; *browse the internet for school work*; *download, upload or browse material from the school's website*; *post work on the school's website*; *play simulations at school*; *practice and drilling, such as for learning a foreign language and mathematics*; *do individual work on a school computer*; *and use school computers for group work and to communicate with other students* (Q6 of the PISA-ICT questionnaire). Students who reported engaging in the listed activities at least once a week are considered frequent users. Overall, 45% of the students declared that they frequently browsed the internet for school work and more than 26% reported frequent use of school computers for group work and communicating with other students. At least 15% of students declared they frequently download, upload or browse material from the school website, use a school-computer to practice and drill (17%), do individual homework on a school computer (18%), chat online at school (18%), and use e-mail at school (21%). Finally, less than 15% of the students declared they use a school-computer at least once a week to play simulations (11%) or to post homework on the school's website (10%).

Table 2: Percentage of student doing one of the following activities at school at least once a week

	Pooled sample (1)	**only LANG-OF-INSTRUCTION (2)**	**only MATH (3)**	**only SCIE (4)**
Browse the Internet for schoolwork from the school's website (e.g. <intranet>)	45.01	53.56	36.86	41.04
Use school computers for group work and communication with other students	26.38	30.2	23.41	24.3
Use e-mail at school	21.24	23.31	16.54	21.49
<Chat online> at school	18.39	21.71	15.48	17.75
Doing individual homework on a school computer	18.29	24.43	15.49	14.09
Practice and drilling, such as for foreign language learning or mathematics	17.42	16.44	26.22	14.4
Download, upload or browse material	15.82	17.97	14.9	14.33
Play simulations at school	10.57	11.02	13.02	9.08
Post homework on the school's website	9.82	12.83	9.56	7.27

Source: authors' estimates from PISA 2009

Table 2, columns 2 to 4, shows how these activities are distributed across students who declare they use computers at school in only one of the three PISA domains. Generally speaking, the likelihood of performing one of the listed activities at least once a week is higher for students who use computers exclusively during language-of-instruction classes than for students who use computers only during science classes, which in turn is higher than the likelihood of students using computers exclusively during mathematics classes. *Practice and drilling* and *play simulations at school* are the main exceptions. These two activities, most of which aim to develop students' problem-solving skills, are performed more often during mathematics classes (in comparison to the two other domains). Minor exceptions concern the likelihood *of doing homework on a school computer* or *of posting homework on the school website* at least once a week, which is lower during science lectures.



Source: authors' estimates using PISA ICT 2009

Figure 3: Students' achievement and use of computers at school during lectures by PISA domain (with 95% confidence intervals).

Figure 3 illustrates the relationship between students' PISA scores and the use of computers at school during classes by domain. The dark-tone bars represent the average score of students who do not use computers during lessons, while the light-tone bars represent the average score of students who do use computers at school.

This figure tells us two things. First, regardless of the domain, students who do not use computers during classes outperform students who declare they use computers at least some time per week during classroom lectures. Second, the gap in performance is particularly marked within the language-of-instruction and the mathematics domains. However, adjusted Wald F-tests reveal that the PISA scores do not differ significantly across these two groups of students; hence, they reinforce the "*no significant difference phenomenon*" hypothesis proposed by Russel (2001).[5]

[5] Sample surveys like PISA have complex sampling design with multistage sampling and stratification. To take into account these characteristics, the mean scores of the students belonging to each of the groups considered in this analysis (users and non-users of computers during classroom lectures) have been computed estimating the corresponding variance through balanced repeated replication (BRR) methods. In these circumstances, the adjusted Wald F-tests is generally used as a substitute for the more classical t-test. The results of the tests are the following: Language-of-instruction: $F(1, 79) = 1.02$, Prob > F = 0.3155; mathematics: $F(1, 79) = 1.47$, Prob > F = 0.2282; science: $F(1, 79) = 0.98$, Prob > F = 0.3250. These statistics highlight that, regardless of the domain, the PISA test scores of students who use ICT during lectures do not differ significantly from the PISA test scores of students who do not use ICT at school. The fact that the confidence intervals in Figure 5 overlap for a substantial part in all domains confirms this conclusion.

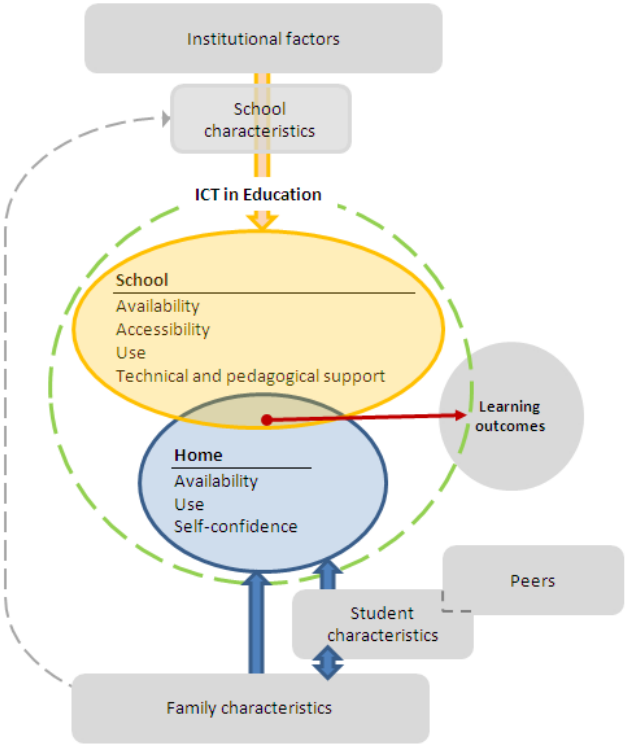


Figure 4: Conceptual framework

This bivariate analysis is not conclusive, as it does not control for other factors that might affect the impact of ICT use on students' achievement such as the characteristics of students, families and schools (Figure 4).

Student characteristics (i.e. gender, migration background and grade of enrolment) as well as family characteristics (i.e. socio-economic status and family structure) are very likely to influence adolescents' use of new technologies. Notten, Peter, Kraaykamp, & Valkenburg (2009) show that students from high socio-economic and two-parent family households are more likely to have internet access at home than children from lower-status families, and use the web more frequently to gain information and to extend their social networks. Concerning the relationship between student gender and use of new technologies, previous research demonstrates that female students use internet less often than male students (Notten et al., 2009; Livingstone, & Helpser, 2007) and that males tend to use computers and internet more for entertainment than for school-related tasks (i.e. Tømte & Hatlevik, 2011; Ainley, Enger, & Searle, 2008). Moreover, individual and family characteristics affect students' attitudes to computers, generally defined as students' self-assessed capability in performing various ICT tasks (i.e. Zhong, 2011; Ainley et al., 2008; Broos, 2005). For instance, Zhong (2011) finds a positive relationship between adolescents' socio-economic status, home ICT access and self-reported digital skills. On this point, Ainley et al. (2008) show not only that, on average, males tend to report higher levels of confidence in their ability to use ICT than females, but also that this gap is particularly pronounced for high-level tasks, with the largest differences observed for creating a web page or creating a multimedia presentation. Finally, it is reasonable to suppose that the way students use ICT and their self-confidence in using them are influenced by interaction with peers (i.e. classmates, out-of-school friends, brother(s)/sister(s)). The relationship between family/student characteristics and availability/use of ICT at home is synthesized by the lower half of Figure 4.

Findings of two recent international studies conducted by the International Association for Evaluation of Academic Achievement (namely the Second International Technology in Education Study – SISTES 2006 – and the Trends in International Mathematics and Science Study – TIMSS 2007) highlight the role of school-level factors in exploiting the potential of ICT in education. The literature identifies two main sets of barriers that make it difficult to achieve the effective integration of ICT in education. The first concerns school principals and teachers' behaviour and knowledge (see Pelgrum, 2008; Law & Chow, 2008; Brummelhuis & Kuiper, 2008), while the second refers to schools' technological equipment including software, internet connectivity and technical and pedagogical support (Eurydice, 2009 and 2011).

Figure 4 takes into account the fact that school characteristics may not be independent from family characteristics (dashed arrow linking family and school characteristics), e.g. families with higher socio-economic backgrounds have the possibility to enroll their children in schools that are better equipped.

Institutional-level factors play a role in moderating or accentuating the barriers at school level. Many countries suggest or recommend the use of ICT for teaching, offering support (practical advice and help for lesson planning, effective teaching, classroom management, use of various resources, etc.) for the effective integration of these tools in education (see Condie & Munro, 2007). Moreover, countries play a central role in promoting (national and local) policies that aim to provide teachers with knowledge and skills to integrate ICT into their teaching activities. In this regard it is noteworthy that, across Europe, most of the countries do include ICT in initial teacher training, provide ICT-related continuing professional development opportunities and evaluate periodically teachers' ICT skills (Eurydice, 2011).

The relationship between institutional/school factors and availability/use of ICT at school is synthesized by the upper half of Figure 4.

Finally, in our view, the effect of ICT on students' learning outcomes (the horizontal arrow in Figure 4) results from the interaction between the availability and use of the new technologies at home and at school (the intersection between the upper and the lower ovals in Figure 4).

Having presented our conceptual framework in broad terms, we now need to relate it to the information actually available in PISA 2009.

3. Empirical specification

Given the research questions addressed by this paper, our empirical approach is to use the information provided by a specific set of items – from Q4 to Q6 – contained in the PISA 2009 ICT familiarity questionnaire (see Appendix B). In doing so, we encountered two main problems. The first concerns how to summarize in an informative and concise way the main information provided by Q3 to Q6 (**the conceptualization issue**). The second relates to the choice of appropriate covariates which explain the relationship between ICT use and students' school performance (**the functional form issue**).

On the first point, following the approach adopted in a recent study by the JRC-IPTS Information Society Unit on Digital Competences (Ferrari, 2012), we categorized ICT activities on the basis of the skills involved in each of them (and hence not so much of the sole location – home vs. school – of the activity). Based on this categorization, the activities listed in Q4, Q5 and Q6 have been assigned to the four groups presented in Table 3.

Table 3: Groups of ICT activities

Group	Short description	Basic activities (from Q4, Q5, Q6)
Gaming activities	Its content is defined as: play individual or collective games, both online and off-line	- Play one-player games - Play collaborative online game
Collaboration and communication activities	Its content is defined as: link with others, participate in online networks and communities, interact constructively and responsibly; communicating through online tools, taking into account privacy, safety and etiquette	- Use e-mail - Chat online - Publish and maintain a personal website, weblog or blog - Participate in online forums, virtual communities - Use e-mail for communication with other students about schoolwork - Use e-mail for communication with teachers and submission of homework or other schoolwork - Chat online at school - Use e-mail at school - Use school computers for group work and communication with other students
Information Management and Technical Operations	Its content is defined as: identify, locate, access, retrieve, store and organize information; use technology and media, perform tasks through digital tools	- Browse the Internet for fun - Download music, films, games or software from the internet - Browse the Internet for schoolwork - Download, upload or browse material from your school's website - Check the school's website for announcements - Browse the Internet for schoolwork - Download, upload or browse material from your school's website - Post your work on the school's website
Creation of Content and Knowledge and Problem Solving activities	Its content is defined as: integrate and re-elaborate previous knowledge and content, construct new knowledge; define problems to be solved or tasks to be achieved and resources and means for achievement	- Play simulations at school - Practice and drilling, i.e. for foreign language learning or mathematics - Doing individual homework on a school computer

For each of these groups we created an *index of intensity of use* combining the information on the number of *basic activities* performed and the related frequency of use. Thus, we first attributed a score ranging from 1 to 4 to the frequency a student performs one of the basic activities listed in Q4, Q5 and Q6 (1 corresponds to the lower frequency of use – *never or hardly ever* – and 4 to the highest intensity of use – *every day or almost every day*).

Then, for each student and each group of activities we computed two indicators. First, we generated the *maximum intensity* multiplying by 4 (the highest intensity of use) the number of basic activities performed by the student and contained in the group. Then, for each student, we computed the *total score* associated to each of group of activities summing up the scores corresponding to the frequency with which s/he performs the basic activities within the group. Finally, we obtained the index of intensity of use computing the ratio between the student's total score and the maximum intensity.

For example, let's consider a student playing one-player games once a week and collaborative online games almost every day. These two activities form the gaming group (see Table 3), for which maximum intensity is equal to 8 (2 – the number of activities in the group – multiplied by 4 – the highest intensity of use). The total score for the student's activities in the gaming group is equal to 3 (the score attributed to "Once or twice per week" frequency of use) plus 4 (the score attributed to "Every day or almost every day" frequency of use). Thus, his/her index of intensity of use for gaming activities is equal to 7/8.

Following this approach, we created five different explanatory variables (corresponding to the different groups of activities): *games_int* (measuring the intensity in the use of ICT for gaming activities); *colcom_int* (measuring intensity in the use of ICT for communication and collaboration activities); *techinfo_int* (measuring intensity in the use of ICT for technical operations and for info retrieval activities); *contprob_int* (measuring intensity in activities related to creation of content and knowledge and problem solving.

In addition to these indexes, we computed an indicator capturing the total number of activities a student performs within each of the groups we created (*totactivities*).

These variables, in addition to other student and family socio-economic characteristics, constitute our starting model (Model 1) and were used as controls in a set of regressions, with the PISA test score in Language of instruction, Mathematics and Science (one at a time, for each student) as dependent variable. More specifically, in addition to the measures of intensity and breadth of ICT use computed as explained above, we considered the following variables: grade, gender, socio economic status of the family (which is an index created by the OECD capturing both income and education related household variables), a dummy variable for student's migration background, dummy variables capturing the family composition (single parents, nuclear and mixed families), dummy variables for the number of books available at home, peer-effects as captured by the average school score in the corresponding test (i.e. Language of Instruction, Mathematics or Science). In these regressions we also allowed for interactions between our main explanatory variables (intensity of ICT use and breadth of ICT, as defined above) and the variable capturing the household socio-economic status, in order to verify whether ICT use tends to increase pre-existing socio-economic differences (Table 4).

Table 4: Variables and models description

Model	Variable name	Short description ***It measures…***
Baseline	*ESCS*	…student's economic, social and cultural background (PISA index)
	SCSCORE	…school peer effects (Average PISA test score computed at the school level)
	female	…student's gender (dummy equal to 1 if female student)
	grade7-grade above 10	…student's grade of enrolment (dummy equal to 1 in correspondence of student's grade of enrolment)
	graderep	…grade repetition (dummy equal to 1 for students that repeated one or more grades)
	native	…student's migration background (dummy equal to 1 if native student)
	singleParent	…family structure (dummy equal to 1 for students living with only one parent)
	nuclearFamily	…family structure (dummy equal to 1 for students living with both parents)
	mixedFamily	…family structure (dummy equal to 1 for students living with only one of the two parents and a guardian or with two guardians)
	Books_0_10 – Books_more500	…student's cultural capital at home (dummy equal to 1 in for the category selected by the student)
Model 1	*games_int*	…the intensity in the use of ICT for gaming activities
	colcom_int	…the intensity in the use of ICT for communication and collaboration activities
	techinfo_int	…the intensity in the use of ICT for technical operations and for info retrieval activities
	contprob_int	…intensity in activities related to creation of content and knowledge and problem solving
	totactivities	…total number of activities that involve the use of ICT (regardless their intensity of use)
Model 2	*Stz_games*	…the standardized value of the total score in the use of ICT for gaming activities
	Stz_colcomm	…the standardized value of the total score in the use of ICT for communication and collaboration activities
	Stz_techinfo	…the standardized value of the total score in the use of ICT for technical operations and for info retrieval activities
	Stz_contprob	…the standardized value of the total score in activities related to creation of content and knowledge and problem solving

As an alternative specification (Model 2), instead of using both the measures of intensity for the various groups and the total number of activities performed, we used as regressors the standardized values for students' total scores in reference to a given group. Such variables, by construction, have a mean equal to 0 and a standard deviation of 1; therefore standardized values for each individual should be read as changes from the mean. The new variables generated for this model specification are: *Stz_games*, *Stz_colcomm*, *Stz_techinfo*, *Stz_contprob* (Table 4).

Both models – Model 1 and Model 2 – were run separately for each country and for each PISA domain (Language of instruction, Mathematics and Science), using the methodology suggested in the OECD PISA 2009 manual, which takes into account the special nature of the sampling procedures used for PISA (we use the balanced repeated replication method).

4. Main results

Table 4 and Table 5 summarize the main results we obtained from Model 1 and Model 2, respectively; country-specific estimates are presented in Appendix C (Table C1 – C6). The numbers in the parenthesis indicate the total number of countries satisfying the sign set to the left of the parenthesis.

For instance, Model 1 highlights a positive and significant coefficient for the relationship between the mathematics PISA test-score and our measure of intensity in gaming activity (*games_int*) in 15 countries over 23. When looking at the relationship between the mathematics PISA test-score and our measure of intensity in the use of ICT for communication and collaboration activities (*colcom_int*), from this model we find a negative and significant coefficient in 14 over 23 countries (with the sole exception of the Slovak Republic, where this relationship is positive and significant).

Overall, our results indicate that there are very consistent patterns across countries and across models.

Table 5: Summary of main results from Model 1 by PISA domain

Variable	Language of instruction	Mathematics	Science
games_int	+ (11/23) - TU	+ (15/23)	+ (13/23)
colcom_int	- (15/23) + PT	- (14/23) + SK	- (15/23)
techinfo_int	- (16/23) + NO	- (17/23) + NO	- (15/23) + NO
contprob_int	- (21/23)	- (19/23)	- (20/23)
totactivities	+ (22/23)	+ (18/23)	+ (21/23)

Source: authors' estimates from PISA 2009

Table 6: Summary of main results from Model 2 by PISA domain

Variable	Language of instruction	Mathematics	Science
Stz_games	+ (17/23)	+ (20/23)	+ (17/23)
Stz_colcom	- (10/23) + PT	- (12/23) + SK	- (13/23)
Stz_techinfo	- (12/23) + NO, SE	- (14/23) + NO	- (13/23) + NO
Stz_contprob	- (21/23)	- (19/23)	- (19/23)

Source: authors' estimates from PISA 2009

Consistently with previous studies, we find that student gender, socio-economic status, grade of enrolment, books at home, family structure and migration backgrounds are strongly correlated with PISA test-scores. More specifically, PISA test-scores are higher for students attending schools with higher than average socio-economic status, higher grades and with a higher number of books at home (we use this variable as an indicator for a family's cultural possession). Furthermore, in most of the countries, students repeating at least one grade show lower PISA-test scores than students who do not repeat a grade. Whereas these correlations hold for all three PISA domains, the effect of gender and family structure on students' PISA-test scores is domain-specific. Female students outperform male students in reading, but they tend to be less proficient in mathematics and science. Students living in mixed families exhibit lower PISA test-scores in most of the countries, regardless of the domain, than students living in nuclear families; while the effect of a single parent family on students' performance is country -and domain-specific.

Finally, from our results it is not possible to draw a clear sign of the correlation between students' migration backgrounds and PISA test-scores. In many countries migrant students perform as well as native students, while in many others native students outperform migrant students. Surprisingly, in a few countries (mainly Poland and Turkey but also Greece and the

Slovak Republic for specific domain), migrant students show higher PISA test-scores than native students.

Concerning the correlation between the use of ICT and students' proficiency, we find that gaming activities, when significant, are positively correlated with PISA-test scores. Furthermore, the use of ICT for communication and collaboration activities and for technical operations/ information retrieval activities are negatively correlated with students' PISA test-score in most of the countries with the exception of Norway, the Slovak Republic and Sweden. The use of ICT for creation of content and knowledge problem solving activities, when significant, seems to hinder students' proficiency in the large majority of the countries in the study.

The rest of the section describes in detail the results of our estimates by PISA domain and by model.

Language of instruction

Across both Model 1 and Model 2 for the main domain of PISA 2009 we consistently find the following results:

- Gender: positive and significant effect on the female dummy variable in all the countries, with size of coefficient varying (also significance levels).
- Peer effects: positive and significant in all the countries (value of coefficient is quite close among countries).
- Dummies for number of books: generally positive and increasing with the number of books. Some variation across countries.

When running Model 1 for reading, we obtain the following:

- *ESCS*: in general no evidence of significant interaction, with the exceptions of Finland and Sweden (positive) and Czech Republic (negative).
- The variable *games_int* is positively correlated with students' reading performance in 11 countries (it is not significant). For only one country (Turkey), it has a negative coefficient. However, *colcom_int*, *techinfo_int*, *contprob_int*, in the vast majority of countries are negatively associated with students' reading proficiency. Exceptions are Norway, where there is a positive and statistically significant correlation between students' reading proficiency and the use of ICT to perform technical operations and Portugal, where the coefficient on *colcom_int* is positive and significant at the 90^{th} confidence level.
- The interactions between *games_int*, *colcom_int*, *techinfo_int*, *contprob_int* and the variable capturing the socio-economic status (*ESCS*) tend to be not significant. Only in few cases we find some significant interactions. More specifically:
    - for interactions between *games_int* and *ESCS* we find a positive and significant coefficient only for Belgium and Sweden.
    - for interactions between *colcom_int* and *ESCS* we find a negative and significant coefficient for Germany, Latvia, Slovak Republic and positive and significant for Iceland.
    - for interactions between *techinfo_int* and *ESCS* we find a negative and significant coefficient for Denmark, Croatia, Ireland and Italy.
    - for interactions between *contprob_int* and *ESCS* we find a negative and significant interaction in Belgium and Spain, and a positive one in Poland.
- The coefficient on *totactivities* is correlated positively with students' reading proficiency in all the countries but Portugal.

- The interaction between *totactivities* and *ESCS* tends to be not significant (only in a few countries – Czech Republic, Italy, Latvia, Poland – is it significant with a positive coefficient, while only in two countries – Finland and Slovenia- does it have a significant negative coefficient).

As for Model 2 applied to language of instruction we get the following:

- *ESCS*: in general evidence of significant and positive effects, with the exceptions of Italy, Lithuania and Slovenia (no significant effect).
- *Stz_games*: when significant, it enters with a positive coefficient (in 17 countries).
- *Stz_colcomm*: in 10 countries in enters with a negative coefficient, while in only 1 country – Portugal- does it have a positive coefficient.
- *Stz_techinfo:* in 12 countries in enters with a negative coefficient, while in only two countries – Norway and Sweden – does it have a positive coefficient.
- *Stz_contprob*: in 21 countries it enters with a negative coefficient and in no country does it have a positive coefficient.

When we consider the interactions with *ESCS* we find:

- *Stz_games* and *ESCS*: in general no evidence of significant interaction, with the exceptions of Belgium, Iceland and Sweden (positive).
- *Stz_colcomm* and *ESCS*: in general no evidence of significant interaction, with the exceptions of and Iceland (positive) and Germany and Slovak republic (negative).
- *Stz_techinfo* and *ESCS*: in general no evidence of significant interaction, with the exceptions of Denmark, Croatia, Ireland, Iceland, Italy, Lithuania and Sweden (negative).
- *Stz_contprob* and *ESCS*: in general no evidence of significant interaction, with the exceptions of Belgium, Spain and Ireland (negative).

Mathematics

Across both Model 1 and Model 2 for mathematics, we consistently find the following results:

- Gender dummy: negative and significant coefficient on the female dummy variable in all the countries, with size of coefficient varying (also significance levels).
- Peer effects: positive and significant in all the countries (value of coefficient is quite close among countries).
- Dummies for number of books: generally positive and increasing with the number of books. Some variation across countries.

When focusing on Model 1, we also get the following:

- Household socio-economic status (*ESCS*): in general no evidence of significant coefficient, with the exceptions of Poland (negative) and Slovenia (positive).
- *colcom_int*, *techinfo_int*, and *contprob_int*, when significant, enter with a negative coefficient. The exceptions are Slovak Republic (for *colcom_int*) and Norway (for *techinfo_int*). The only ICT use variable that, when significant, enters with a positive coefficient is *games_int*. The values of the coefficients vary across countries, but the sign does not.

- The interactions between *games_int*, *colcom_int*, *techinfo_int*, *contprob_int* and the variable capturing the socio economic status (*ESCS*) tend to be not significant. More specifically:
    - for interactions between *games_int* and *ESCS* we find a negative and significant coefficient for Bulgaria and a positive and significant one for Hungary.
    - for interactions between *colcom_int* and *ESCS* we find a negative and significant coefficient for Poland, Slovak republic and positive and significant for Greece.
    - for interactions between *techinfo_int* and *ESCS* we find a negative and significant coefficient for the Czech Republic, Denmark, Estonia, Iceland, and Italy.
    - for interactions between *contprob_int* and *ESCS* in no country do we find a significant coefficient.
- In the vast majority of countries the variable capturing the total number of activities that involve the use of ICT (*totactivities*) enters with a positive (and significant) coefficient. In no country does it have a (significant) negative coefficient.
- The interaction between *totactivities* and *ESCS* tends to be not significant (only in few countries –Czech Republic, Norway, Poland and Turkey- it is significant with a positive coefficient, while in only one country – Slovenia- does it have a significant negative coefficient).

Using Model 2 for mathematics we get the following results:

- *ESCS*: in general evidence of significant and positive effects, with the exceptions of Spain, Croatia, Hungary, Italy and Slovenia (no significant effect).
- *Stz_games*: when significant it enters with a positive coefficient (20/23).
- *Stz_colcomm*: in 12 countries it enters with a (significant) negative coefficient while in only 1 country – Slovak Republic – does it have a (significant) positive coefficient.
- *Stz_techinfo*: in 14 countries it enters with a (significant) negative coefficient while in only 1 country – Norway – does it have a (significant) positive coefficient.
- *Stz_contprob*: in 19 countries it enters with a (significant) negative coefficient while in no country does it have a (significant) positive coefficient.

When we consider the interactions with *ESCS* we find:

- *Stz_games* and *ESCS*: in general no evidence of significant interaction, with the exceptions of Bulgaria and Portugal (negative) and Hungary (positive).
- *Stz_colcomm* and *ESCS*: in general no evidence of significant interaction, with the exceptions of Greece (positive) and Slovak republic (negative).
- *Stz_techinfo* and *ESCS*: in general no evidence of significant interaction, with the exceptions of Denmark, Greece and Italy (negative).
- *Stz_contprob* and *ESCS*: in general no evidence of significant interaction, with the exceptions of Bulgaria and Spain (negative).

Science

Finally, when we run Model 1 and Model 2 on science PISA test-scores, we obtain the following results:

- Gender: male students outperform females students in all the countries with the only exceptions being Greece and Lithuania; the magnitude and the level of significance of the correlation between this variable and students' achievements differ markedly across countries.
- Peer effects: positive and significant in all the countries (value of the coefficient is quite close among countries).
- Dummies for number of books: as for the other domains, students' achievements increase with the number of books that are available at home.

When running Model 1 for science, we obtain the following:

- *ESCS*: overall no significant correlation with students' science PISA test-scores, with the exceptions of Finland and Sweden (positive) and of the Czech Republic, Poland and Turkey (negative).
- The variable *games_int* is positively correlated with students' scientific literacy in 13 countries out of 23 (for the others, the relationship is statistically not significant). The variables *colcom_int*, *techinfo_int* and *contprob_int* are significantly and negatively correlated with students' science PISA test-scores in the majority of the countries; again, Norway, which has positive and statistically significant student achievement and use of ICT technical operations, is the only exception.
- The interactions between *games_int*, *colcom_int*, *techinfo_int*, *countprob_int* and the variable capturing students' socio-economic status (*ESCS*) in most of the cases is not significant. The only exceptions are:
    - for interactions between *games_int* and *ESCS* we find a positive and statistically significant coefficient for Belgium;
    - for interactions between *colcom_int* and *ESCS* we find a negative and statistically significant coefficient for the Slovak Republic;
    - for interactions between *techinfo_int* and *ESCS* we find a negative and statistically significant coefficient for Denmark, Estonia, Croatia, Hungary, Iceland and Italy.
- The coefficient on *totactivities* is correlated positively with students' scientific literacy in all the countries but Germany and Hungary.
- The interaction between *totactivities* and ESCS is not significant in most of the countries with the exception of the Czech Republic, Ireland, Latvia, Poland and Turkey (positive) and of Finland and Slovenia (negative).

And from Model 2 applied to science we get the following:

- *ESCS:* there is evidence of a positive and statistically significant correlation between students' socio-economic status and their scientific literacy in the majority of the countries; exceptions are Slovenia (significantly negative correlation) and Germany, Spain, Croatia, Hungary and Italy (no statistically significant correlation).
- *Stz_games:* when significant it enters with a positive sign (in 17 countries).
- *Stz_colcomm:* it enters only with a negative sign and it is significant in 13 countries out of 23.
- *Stz_techinfo:* when significant it enters with a negative sign with the only exception being Norway (positive).

- *Stz_contprob:* in 19 countries it significantly hinders students' scientific literacy; in none of the countries considered in this study does it have a positive coefficient.

When we consider the interaction with *ESCS* we find:

- *Stz_games* and *ESCS*: no significant interaction in any of the countries in our dataset.
- *Stz_colcomm* and *ESCS*: in general there is no evidence of significant interaction, with the only exception being Slovakia (negative).
- *Stz_techinfo* and *ESCS*: in general there is no evidence of significant interaction, with the only exceptions being Denmark, Croatia and Italy (negative).
- *Stz_colcomm* and *ESCS*: no significant interaction in any of the countries in our dataset.

5. Discussion and concluding remarks

Overall, the results of the estimates presented in this report point to a generalized negative correlation between the use of ICT (in terms of either intensity or deviations from the mean) and PISA test scores. However, ours is not a proper impact assessment based on counterfactual evaluation. In order to do that, we would have had to compare the PISA test scores obtained by students using ICT more intensively with the PISA test scores of an appropriate control group. Figure 1(a and b) and Figure 2 highlight how difficult it is to find such a control group, especially in Nordic countries where the large majority of students declare they have access to and use computers both at home and at school. Furthermore PISA test scores are probably not the best measure to assess the link between ICT and students' school performance. To the extent that such tests tend to focus on abilities typically related to traditional teaching techniques, one should not expect to see any positive effect of intensive ICT utilization on PISA test scores.

What we capture here, however, are correlations, and some of these correlations are quite interesting, since they are the opposite to what we would have expected ex ante. Surprisingly we find that gaming, when significant, is positively correlated with students' PISA test score. For the remaining activities, our measures of intensity tend to be negatively correlated with students' PISA test score (exceptions are Norway, the Slovak Republic, Portugal and Sweden). Moreover, this negative effect is particularly strong for creation of content and knowledge and problem solving activities, which appear to be highly related to the use of ICT in the school curriculum.

These are:

- Play simulations at school
- Practice and drilling, such as for foreign language learning or mathematics
- Doing individual homework on a school computer

These results, though surprising, tell us that the type of ICT use matters and somehow empirically confirms the conclusions of the OECD report "Are new millennium learners making the grade?"

"… *computer use can make the difference in educational performance if the student has the appropriate set of competences, skills and attitudes. Without these, no matter how intense the student's use of a computer, the expected benefits will not be realized.*" (OECD, 2010, p.172)

Furthermore, the results of our estimates show that the number of activities (and hence the diversification of activities), irrespective of the intensity of ICT use, is positively correlated with students' PISA scores in the three domains in the vast majority of countries. Thus, ICT breadth of use, as opposed to intensity of use in a given activity, tends to be positively associated with students' performance. This result is consistent with a framework in which the different activities complement each other in building competences that turn out to be relevant for the PISA tests. However, this conclusion may be challenged by the fact that the variable capturing the "breadth of ICT use" (i.e. the number of activities) may simply be a proxy for households' socio-economic status, an interpretation consistent with the fact that in Model 1 *ESCS* is almost never significant but is almost always significant in Model 2 (i.e. when we do not control for the diversity effect). In other words, to validate our interpretation we need to exclude the fact that the sign and the magnitude of the correlation between the number of activities performed using computers and students' achievement is driven mainly

by their socio-economic background. We hence checked the correlation between the variable indicating the breadth of ICT activities – *totactivities* – and the variable indicating students' socio-economic status – *ESCS*. Appendix D reports the results of this check. Given that these correlations are quite low – they range between 0.01 (Iceland) and 0.18 (Belgium) – we think that it is quite safe to conclude that students using ICT for many activities tend to have higher PISA scores than students using ICT only for a few activities, irrespective of their economic and social status (still, there might be unobservable factors that induce the most brilliant students to engage in multiple uses of ICT).

Concluding, we would like to stress the fact that our results tackle only part of the problem of evaluating the effect of ICT in education. The use of new technologies in schools may not only affect students' learning and capability to use digital tools, it is also a sure driver for innovating schools and educational systems as well as teachers' skills and teaching methods (Eurydice, 2010).

Future research should try to assess, possibly using counterfactual impact evaluation techniques, what the causal effects of ICT on learning are. This requires a proper design of the social experiment, and, more important, requires the development of an ICT-based learning process which includes: providing ICT skills to teachers and students, designing the curriculum in order to obtain the largest benefit from ICT use (i.e. embed ICT in the curriculum), designing a test that is able to properly capture both general and specific skills that may be affected by ICT adoption and use.

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Appendix A – Country list code

AT	Austria	IS	Iceland
BE	Belgium	IT	Italy
BG	Bulgaria	LT	Lithuania
CY	Cyprus	LU	Luxembourg
CZ	Czech Republic	LV	Latvia
DE	Germany	MT	Malta
DK	Denmark	NL	Netherlands
EE	Estonia	NO	Norway
EL	Greece	PL	Poland
ES	Spain	PT	Portugal
EU	European Union	RO	Romania
FI	Finland	SE	Sweden
FR	France	SI	Slovenia
HR	Croatia	SK	Slovakia
HU	Hungary	UK	United Kingdom
IE	Ireland	TK	Turkey

Appendix B – PISA 2009 ICT familiarity questionnaire: questions used for the paper

Q1 Is any of these devices available for you to use <u>at home</u>?
(Please tick one box on each row)

	Yes, and I use it	Yes, but I don't use it	No
a) Desktop computer	☐	☐	☐
b) Portable laptop computer	☐	☐	☐
c) Internet connection	☐	☐	☐
d) <Video games console>, e.g. <Sony PlayStation™>	☐	☐	☐
e) Cell phone	☐	☐	☐
f) Mp3/Mp4 player, iPod or similar	☐	☐	☐
g) Printer	☐	☐	☐
h) Usb (memory) stick	☐	☐	☐

Q2 Is any of these devices available for you to use <u>at school</u>?
(Please tick one box on each row)

	Yes, and I use it	Yes, but I don't use it	No
a) Desktop computer	☐	☐	☐
b) Portable laptop computer	☐	☐	☐
c) Internet connection	☐	☐	☐
d) Printer	☐	☐	☐
e) Usb (memory) stick	☐	☐	☐

Q4 How often do you use a computer for the following activities <u>at home</u>?
(Please tick one box on each row)

	Never or hardly ever	Once or twice a month	Once or twice a week	Every day or almost every day
a) Play one-player games	☐	☐	☐	☐
b) Play collaborative online games	☐	☐	☐	☐
c) Doing homework on the computer	☐	☐	☐	☐
d) Use e-mail	☐	☐	☐	☐
e) <Chat online> (e.g. MSN®)	☐	☐	☐	☐
f) Browse the internet for fun (such as watching videos, e.g. <YouTube™>)	☐	☐	☐	☐
g) Download music, films, games or software from the internet	☐	☐	☐	☐
h) Publish and maintain a personal website, weblog or blog	☐	☐	☐	☐
i) Participate in online forums, virtual communities or spaces (e.g. <Second Life® or MySpace™>)	☐	☐	☐	☐

Q5 How <u>often</u> do you do the following <u>at home</u>?
(Please tick one box on each row)

	Never or hardly ever	Once or twice a month	Once or twice a week	Every day or almost every day
a) Browse the internet for schoolwork (e.g. preparing and essay or a presentation)	☐	☐	☐	☐

b) Use e-mail for communication with other students about schoolwork	☐	☐	☐	☐
c) Use e-mail for communication with teachers and submission of homework or other schoolwork	☐	☐	☐	☐
d) Download, upload or browse material from your school's website (e.g. time table or course materials)	☐	☐	☐	☐
e) Check school's website for announcements, e.g. absence of teachers	☐	☐	☐	☐

Q6 How often do you use a computer for the following activities <u>at school</u>?
(Please tick one box on each row)

	Never or hardly ever	Once or twice a month	Once or twice a week	Every day or almost every day
a) <Chat online > at school	☐	☐	☐	☐
b) Use e-mail at school	☐	☐	☐	☐
c) Browse the internet for schoolwork	☐	☐	☐	☐
d) Download, upload or browse material from your school's website (e.g. <intranet>)	☐	☐	☐	☐
e) Post your work on the school's website	☐	☐	☐	☐
f) Play simulations at school	☐	☐	☐	☐
g) Practice and drilling, such as for foreign language learning or mathematics	☐	☐	☐	☐
h) Doing individual homework on a school computer	☐	☐	☐	☐
i) Use school computers for group work and communication with other students	☐	☐	☐	☐

Appendix C – Country-specific estimates

Table C1.

Language of instruction: results from Model 1 by country

Variable	BEL	BGR	CZE	DEU	DNK	ESP	EST	FIN	GRC	HRV	HUN	IRL	ISL	ITA	LTU	LVA	NOR	POL	PRT	SVK	SVN	SWE	TUR
ESCS	-14.08	8.496	-90.31***	-15.96	-2.728	10.80	-8.124	178.4*	2.094	13.14	-63.48	4.400	10.59	-8.261	-22.20	-25.99	3.265	-14.78	24.70	14.90	54.66***	4.928	-13.50
	(31.27)	(16.02)	(23.94)	(39.85)	(36.15)	(6.095)	(20.51)	(68.56)	(7.757)	(13.68)	(45.43)	(34.10)	(22.32)	(5.707)	(28.03)	(21.13)	(23.83)	(12.28)	(18.85)	(24.58)	(14.44)	(26.13)	(9.426)
Average score at school	0.653***	0.714***	0.806***	0.759***	0.660***	0.608***	0.755***	0.785***	0.776***	0.805***	0.818***	0.610***	0.816***	0.844***	0.726***	0.663***	0.721***	0.584***	0.410***	0.774***	0.847***	0.701***	0.788***
	(0.0144)	(0.0243)	(0.0115)	(0.0137)	(0.0250)	(0.0197)	(0.0203)	(0.0264)	(0.0209)	(0.0163)	(0.0133)	(0.0483)	(0.0462)	(0.00786)	(0.0236)	(0.0304)	(0.0252)	(0.0225)	(0.0289)	(0.0180)	(0.0123)	(0.0243)	(0.0177)
female	11.14***	33.25***	23.86***	25.99***	23.45***	17.30***	34.63***	45.47***	28.76***	21.59***	17.07***	18.80***	38.28***	16.66***	46.67***	33.74***	38.89***	37.27***	21.51***	30.31***	17.60***	34.05***	18.06***
	(1.829)	(2.941)	(2.448)	(1.992)	(2.482)	(1.441)	(2.552)	(2.792)	(2.517)	(2.121)	(1.612)	(2.690)	(2.710)	(1.030)	(2.556)	(2.557)	(3.179)	(2.487)	(2.395)	(2.677)	(2.175)	(2.783)	(1.720)
grade7	-65.71***	-13.21	-88.60***	-84.62***	-37.07	-67.82*	-132.1***	-123.7***	-4.610		-25.75**			8.456	-93.13***	-73.90***		-91.35***	-87.43***	-68.88***		-166.9***	-31.87
	(14.93)	(17.79)	(12.80)	(13.25)	(22.60)	(26.62)	(12.73)	(14.56)	(30.42)		(7.816)			(15.05)	(20.45)	(8.754)		(11.70)	(7.521)	(12.20)		(31.14)	(21.29)
grade8	-43.51***	-18.86*	-59.27***	-59.02***	-43.67***	-105.3***	-59.88***	-54.57***	10.18	132.6***	-0.0296	-67.86***		14.98*	-35.54***	-65.59***		-74.87***	-56.00***	-51.09***	-46.67***	-72.42***	-12.56*
	(5.097)	(9.393)	(5.472)	(3.293)	(8.406)	(3.016)	(7.436)	(11.14)	(17.15)	(6.986)	(4.854)	(12.98)		(7.299)	(4.778)	(5.665)		(8.328)	(4.959)	(8.701)	(6.776)	(9.144)	(5.421)
grade9	-27.23***	-15.95	0.461	-30.63***	-11.97	-57.57***	-26.08***	-19.62	26.99**	-30.24***	-20.49***	-10.98	-47.92***	-22.26***	-17.64***	-27.03***	-31.26	0.124	-17.41***	4.536	-1.719	5.191	-25.94***
	(2.735)	(8.078)	(1.582)	(2.027)	(7.936)	(1.585)	(7.513)	(10.47)	(8.782)	(1.806)	(1.911)	(7.993)	(11.97)	(2.042)	(3.427)	(4.940)	(19.50)	(5.709)	(4.218)	(2.656)	(2.670)	(4.828)	(2.394)
grade_above10	41.67***			37.65***		66.89**	121.5***				21.30	-8.072	5.504	13.41***	72.45***	37.20	16.28		57.31***	14.05**	24.42***		22.87***
	(5.906)			(10.43)		(23.31)	(8.854)				(18.83)	(4.494)	(8.287)	(2.588)	(6.086)	(30.47)	(9.104)		(10.26)	(4.474)	(3.394)		(4.083)
graderep	-27.01***	-16.25***			-8.953**				-20.88*	-26.73***	-11.82**	-20.93**		-17.43***		-4.357*			-20.62***	-2.404		-6.825**	
	(3.046)	(4.658)			(2.744)				(8.247)	(5.503)	(3.483)	(7.857)		(2.421)		(2.106)			(3.798)	(2.698)		(2.392)	
native	5.454	43.72**	0.692	7.868**	15.66***	9.047**	14.16***	27.63***	-1.244	5.231	-2.054	7.810	35.09***	19.48***	6.469	8.098	14.75**	-124.9***	8.348*	-24.73**	7.162*	13.62***	-15.63
	(2.877)	(14.53)	(5.700)	(2.359)	(2.969)	(2.963)	(3.318)	(7.123)	(3.638)	(2.682)	(5.567)	(5.574)	(10.05)	(2.307)	(6.716)	(4.568)	(4.723)	(5.354)	(3.439)	(9.057)	(3.525)	(3.334)	(13.56)
single_parent	1.407	-10.19**	0.538	4.933*	0.271	1.278	2.659	-6.484*	-3.914	7.383*	4.133*	-2.682	-5.880	4.157**	-4.557*	-0.577	-0.261	-12.12***	9.838***	1.061	0.154	-4.252	-1.075
	(2.011)	(3.424)	(2.399)	(2.168)	(2.524)	(1.873)	(2.379)	(2.839)	(3.930)	(2.920)	(1.932)	(3.545)	(3.922)	(1.534)	(2.065)	(2.411)	(3.138)	(2.368)	(2.525)	(2.667)	(2.499)	(4.004)	(3.027)
mixed_family	-13.47	-24.93***	-24.77*	2.017	-33.57*	5.373	-21.10***	-34.80*	-39.92***	-28.12*	1.593	-24.24*	-41.27*	-21.03***	-10.77	-24.21***	-53.05***	-48.70***	1.200	-20.48**	-25.54***	-34.62***	-18.43***
	(9.571)	(4.518)	(12.13)	(11.68)	(15.06)	(8.523)	(4.306)	(13.18)	(6.223)	(11.35)	(6.020)	(10.06)	(15.73)	(6.075)	(8.316)	(4.401)	(11.84)	(8.213)	(5.252)	(6.675)	(6.248)	(7.270)	(3.696)
books_11_25	14.08***	14.60**	16.21***	11.71**	12.02**	12.81***	12.47*	25.50***	-4.054	5.780*	6.305	19.76***	1.777	8.248***	7.472**	9.956*	19.42***	7.837*	2.406	12.39**	4.782	12.07*	6.935**
	(3.014)	(5.447)	(4.010)	(3.925)	(3.612)	(3.549)	(5.819)	(6.869)	(4.532)	(2.711)	(4.117)	(3.865)	(8.686)	(1.621)	(2.717)	(4.255)	(5.159)	(3.218)	(3.100)	(4.079)	(2.911)	(4.875)	(2.578)
books_26_100	26.42***	35.77***	27.53***	20.02***	28.64***	28.23***	18.58***	41.15***	9.747*	16.23***	14.48***	41.52***	28.77***	16.24***	20.46***	23.40***	42.65***	28.89***	14.67***	29.86***	16.10***	24.15***	12.21***
	(2.707)	(5.193)	(3.362)	(2.941)	(3.604)	(3.112)	(4.922)	(4.906)	(3.981)	(2.325)	(3.907)	(3.861)	(7.920)	(1.606)	(2.808)	(3.851)	(4.194)	(2.790)	(3.085)	(3.657)	(2.770)	(4.840)	(2.817)
books_101_200	35.18***	41.31***	39.84***	26.64***	42.84***	39.00***	27.35***	55.37***	15.62**	22.44***	21.52***	62.65***	46.69***	20.24***	24.24***	32.43***	57.99***	45.58***	14.12***	40.17***	25.40***	36.18***	21.93***
	(3.171)	(7.027)	(3.891)	(3.063)	(4.413)	(3.219)	(5.128)	(4.907)	(5.048)	(3.272)	(3.917)	(4.168)	(7.515)	(1.698)	(2.956)	(4.519)	(4.403)	(3.499)	(3.151)	(4.354)	(3.469)	(5.198)	(3.479)
books_201_500	38.31***	39.05***	48.54***	38.76***	43.57***	44.45***	34.48***	65.46***	25.77***	23.43***	32.13***	73.54***	65.89***	31.00***	32.25***	44.38***	70.44***	56.57***	27.55***	46.30***	30.11***	58.50***	18.06***
	(3.511)	(6.403)	(4.328)	(3.496)	(4.396)	(4.128)	(5.742)	(5.855)	(5.481)	(4.162)	(4.465)	(4.493)	(8.014)	(1.651)	(3.892)	(4.117)	(4.684)	(4.243)	(3.633)	(5.286)	(4.116)	(5.389)	(4.420)
books_more500	40.22***	35.29***	45.60***	36.61***	39.07***	47.30***	38.40***	65.44***	26.59***	22.41***	38.15***	70.05***	53.58***	26.88***	35.58***	38.53***	71.15***	56.92***	18.63***	46.13***	25.13***	52.82***	16.69**
	(4.559)	(6.703)	(5.073)	(4.282)	(5.658)	(4.055)	(5.841)	(6.508)	(5.917)	(4.814)	(4.654)	(6.858)	(8.489)	(2.041)	(4.347)	(5.878)	(4.880)	(5.621)	(5.162)	(6.506)	(5.060)	(6.350)	(5.333)
totactivities	3.923***	2.704**	8.626***	5.203**	4.312*	2.813***	5.432***	17.72***	3.082***	2.613***	7.863*	6.628**	5.112**	2.617***	6.077***	4.392***	3.154*	4.037***	2.186	4.624***	2.798***	5.215***	2.500**
	(1.099)	(0.857)	(1.955)	(1.635)	(2.030)	(0.384)	(0.691)	(3.669)	(0.619)	(0.726)	(3.262)	(1.962)	(1.739)	(0.312)	(1.124)	(0.716)	(1.239)	(0.929)	(1.098)	(0.919)	(0.618)	(1.038)	(0.815)
tot_activities*ESCS	0.885	0.180	4.584***	0.874	1.425	-0.341	1.197	-7.191*	0.546	-0.127	3.310	0.757	0.173	0.588*	1.998	2.148*	1.040	1.662**	-0.601	0.134	-2.362***	0.791	0.861
	(1.429)	(0.750)	(1.053)	(1.831)	(1.628)	(0.291)	(0.966)	(3.124)	(0.365)	(0.630)	(2.068)	(1.561)	(1.032)	(0.270)	(1.265)	(0.974)	(1.111)	(0.580)	(0.860)	(1.115)	(0.660)	(1.202)	(0.448)
games_int	8.050**	7.592*	4.947	9.732**	8.668*	7.869**	3.560	6.919	12.14**	1.881	8.392**	4.933	-5.504	8.238***	9.229*	9.816**	-0.0584	6.623	7.461	7.704*	5.509	-9.657	-9.387*
	(2.835)	(3.257)	(3.000)	(3.054)	(3.479)	(2.537)	(3.964)	(4.767)	(4.010)	(3.650)	(2.788)	(4.334)	(6.366)	(1.520)	(3.729)	(3.166)	(4.961)	(3.421)	(3.882)	(3.591)	(2.926)	(5.039)	(4.531)
colcomm_int	-12.87*	-17.76*	-10.90	-13.81*	-34.89***	-2.480	-53.35***	-42.15***	-37.17***	-2.288	-17.52**	-22.60*	-43.26**	-1.297	-11.90	-23.11**	-76.48***	-52.24***	18.75*	6.134	-20.85**	-58.85***	1.321
	(5.229)	(7.968)	(6.817)	(6.882)	(7.450)	(4.298)	(9.103)	(9.307)	(7.133)	(6.325)	(5.774)	(8.823)	(15.03)	(3.357)	(6.196)	(8.356)	(13.17)	(8.184)	(7.127)	(6.536)	(6.322)	(11.33)	(8.275)
techinfo_int	-31.98***	2.230	-22.77*	-38.64***	-8.100	-25.25***	-32.82***	-42.94**	-20.83*	-12.80	-26.44***	-52.07***	-13.12	-44.16***	-42.59***	-53.35***	50.39***	-18.99*	-38.20***	-37.48***	-5.310	7.635	-23.51*
	(7.583)	(9.953)	(8.713)	(7.753)	(8.764)	(5.504)	(7.567)	(13.11)	(8.094)	(8.414)	(6.509)	(14.04)	(16.28)	(4.383)	(9.180)	(8.602)	(11.38)	(8.677)	(6.607)	(7.582)	(7.210)	(13.92)	(10.29)
contprob_int	-42.53***	-40.05***	-23.27***	-21.51***	-40.25***	-34.27***	-47.05***	-20.91	-33.33***	-41.02***	-37.30***	-29.94**	-11.23	-5.055*	-38.17***	-50.13***	-52.58***	-43.12***	-52.67***	-24.32***	-34.09***	-27.21**	-16.73**
	(5.837)	(6.917)	(5.511)	(5.755)	(6.998)	(5.019)	(9.045)	(10.76)	(6.288)	(5.649)	(4.658)	(8.856)	(10.60)	(2.360)	(6.124)	(6.833)	(7.841)	(8.037)	(5.081)	(6.007)	(5.006)	(9.498)	(6.108)
games_int*ESCS	8.627**	-3.753	2.537	-1.808	-1.465	4.009	1.207	0.323	-4.198	5.536	1.031	3.566	9.877	0.527	-4.385	-0.316	0.205	2.570	-0.624	-3.199	-5.442	8.163*	-4.294
	(2.859)	(3.309)	(3.470)	(3.754)	(2.902)	(2.109)	(3.571)	(4.477)	(3.438)	(3.739)	(2.841)	(4.493)	(5.133)	(1.619)	(3.335)	(4.125)	(4.255)	(3.457)	(2.646)	(3.142)	(2.922)	(3.684)	(2.549)
colcomm_int*ESCS	-9.238	-5.370	-9.026	-15.10*	-5.337	-1.285	-6.045	-2.794	4.678	-4.142	-4.385	-10.93	29.03*	0.762	-8.248	-25.22**	-12.65	-17.40	-4.529	-17.41*	4.264	1.103	4.902
	(6.922)	(8.407)	(10.13)	(6.918)	(8.407)	(4.568)	(7.716)	(9.037)	(7.475)	(7.196)	(5.425)	(9.682)	(12.04)	(3.583)	(7.665)	(8.419)	(9.847)	(9.153)	(5.309)	(8.500)	(6.927)	(12.86)	(5.167)
techinfo_int*ESCS	2.006	4.011	-4.420	14.66	-28.58**	-0.514	-11.57	-11.33	-8.614	-20.20*	-11.08	-29.60*	-41.49**	-12.25**	-16.60	-1.897	-5.037	-9.022	-4.379	-12.96	-2.673	-18.81	0.0945
	(7.352)	(11.76)	(10.58)	(8.624)	(9.544)	(5.283)	(7.905)	(11.11)	(10.65)	(8.562)	(6.439)	(12.52)	(14.63)	(3.684)	(8.594)	(9.899)	(10.35)	(10.50)	(5.846)	(9.263)	(8.362)	(16.22)	(6.634)
contprob_int*ESCS	-11.60*	-4.424	11.81	2.223	10.61	-9.340*	2.619	-9.162	-1.026	3.668	-2.446	5.873	-14.45	-0.290	1.564	2.013	-7.527	16.34*	2.157	11.86	-0.235	-11.12	-4.094
	(5.258)	(5.263)	(7.024)	(6.138)	(7.006)	(4.506)	(7.447)	(14.51)	(5.572)	(5.985)	(4.538)	(11.75)	(8.646)	(2.730)	(5.133)	(7.150)	(8.733)	(7.272)	(4.588)	(6.536)	(4.586)	(12.26)	(4.490)
Constant	95.64***	22.04	-116.8**	6.023	64.67	122.3***	27.31	-319.1***	44.18**	48.32**	-74.12	40.84	-92.20	-4.067	-8.014	87.05***	6.957	237.1***	251.3***	4.148	-3.295	-1.159	72.09**
	(26.82)	(28.09)	(43.47)	(34.84)	(44.72)	(12.75)	(19.45)	(84.93)	(16.31)	(18.26)	(71.90)	(48.23)	(47.48)	(8.516)	(27.09)	(21.93)	(34.08)	(24.28)	(27.68)	(26.89)	(15.28)	(27.85)	(23.50)
Observations	7,642	3,771	5,628	3,984	5,181	24,431	4,539	5,435	4,673	4,729	4,423	3,519	3,455	29,415	4,270	4,313	4,424	4,673	5,661	4,328	5,517	4,223	4,101
R-squared	0.597	0.591	0.562	0.654	0.370	0.509	0.445	0.342	0.497	0.529	0.718	0.407	0.282	0.614	0.507	0.472	0.357	0.425	0.501	0.573	0.678	0.380	0.593

Standard errors in parentheses

*** p<0.001, ** p<0.01, * p<0.05

Table C2.

Language of instruction: results from Model 2 by country

Variable	BEL	BGR	CZE	DEU	DNK	ESP	EST	FIN	GRC	HRV	HUN	IRL	ISL	ITA	LTU	LVA	NOR	POL	PRT	SVK	SVN	SWE	TUR
ESCS	3.954***	7.919***	7.643***	2.249*	15.68***	1.770*	10.08***	15.26***	9.968***	4.141**	3.142*	11.54***	12.05***	0.818	9.56	9.899***	15.49***	15.73***	8.020***	6.849***	0.834	17.55***	4.272***
	(0.948)	(1.809)	(2.000)	(1.107)	(1.510)	(0.824)	(1.362)	(1.679)	(1.212)	(1.296)	(1.248)	(1.973)	(1.599)	(0.579)	(-1.322	(1.848)	(1.652)	(1.704)	(0.937)	(1.359)	(1.299)	(1.830)	(1.067)
Average score at school	0.668***	0.726***	0.820***	0.776***	0.673***	0.628***	0.765***	0.804***	0.792***	0.819***	0.825***	0.658***	0.827***	0.855***	0.733***	0.676***	0.726***	0.595***	0.411***	0.781***	0.855***	0.712***	0.796***
	(0.0150)	(0.0233)	(0.0116)	(0.0138)	(0.0245)	(0.0199)	(0.0197)	(0.0221)	(0.0190)	(0.0164)	(0.0126)	(0.0485)	(0.0471)	(0.00748)	(0.0223)	(0.0303)	(0.0251)	(0.0227)	(0.0290)	(0.0183)	(0.0121)	(0.0257)	(0.0173)
female	11.98***	35.23***	24.60***	27.25***	24.40***	18.06***	36.24***	47.17***	30.82***	23.77***	17.87***	20.85***	40.63***	17.71***	47.95***	35.74***	41.62***	39.96***	21.79***	30.97***	18.24***	37.84***	18.10***
	(1.876)	(2.915)	(2.494)	(1.973)	(2.539)	(1.476)	(2.595)	(2.355)	(2.679)	(1.977)	(1.664)	(2.783)	(2.887)	(1.015)	(2.592)	(2.733)	(3.156)	(2.517)	(2.403)	(2.656)	(2.134)	(2.897)	(1.766)
grade7	-85.94***	-14.00	-88.64***	-85.65***	-53.46	-98.25**	-132.5***	-127.4***	4.616		-25.51**			12.75	-94.19***	-75.82***		-90.33***	-87.60***	-76.40***		-167.7***	-35.94
	(13.90)	(16.03)	(12.51)	(12.98)	(26.97)	(29.21)	(12.37)	(20.31)	(28.90)		(7.989)			(12.54)	(21.00)	(8.738)		(11.73)	(7.559)	(12.95)		(23.85)	(19.47)
grade8	-45.08***	-16.71	-60.34***	-59.71***	-45.11***	-106.8***	-62.43***	-56.83***	10.48	138.3***	-0.0605	-72.79***		16.00*	-36.02***	-68.88***		-75.93***	-57.12***	-50.94***	-44.00***	-73.39***	-15.69
	(5.243)	(8.684)	(5.626)	(3.204)	(8.316)	(2.697)	(7.443)	(13.66)	(16.59)	(7.094)	(4.797)	(12.38)		(6.538)	(4.878)	(6.059)		(8.426)	(4.965)	(8.845)	(6.778)	(8.157)	(7.898)
grade9	-27.76***	-15.40*	0.872	-31.30***	-11.05	-57.84***	-26.53***	-20.03	27.89**	-30.25***	-21.12***	-12.67	-49.23***	-22.79***	-18.23***	-27.72***	-28.95	0.332	-18.24***	4.855	-0.296	3.394	-27.22***
	(2.791)	(7.608)	(1.484)	(1.974)	(7.881)	(1.592)	(7.477)	(13.29)	(8.186)	(1.804)	(1.893)	(7.618)	(11.04)	(1.925)	(3.453)	(5.016)	(19.95)	(5.923)	(4.198)	(2.707)	(2.522)	(3.715)	(2.347)
grade_above10	42.40***			37.27***		67.51**	128.6***				23.12	-5.679	2.738	13.72***	70.59***	38.31	16.54		57.05***	14.54**	25.30***		21.52***
	(5.913)			(10.68)		(23.02)	(8.759)				(18.88)	(4.363)	(8.162)	(2.548)	(5.946)	(30.93)	(9.301)		(10.31)	(4.471)	(3.392)		(3.804)
graderep	-27.45***	-16.88***			-8.725**				-22.57**	-27.13***	-11.82**	-18.24*		-17.91***		-4.333*			-20.01***	-2.662		-6.073**	
	(3.181)	(4.918)			(2.637)				(7.898)	(5.596)	(3.546)	(7.397)		(2.336)		(2.159)			(3.747)	(2.785)		(2.297)	
native	6.414*	40.71**	0.497	8.048**	17.17***	9.842**	16.82***	28.75***	0.341	5.421	-3.061	14.55*	36.48***	20.23***	6.151	9.043	18.38***	-126.7***	7.922*	-24.06**	7.534*	14.92***	-15.70
	(2.904)	(14.08)	(5.662)	(2.426)	(2.831)	(3.003)	(3.293)	(7.567)	(3.511)	(2.723)	(5.606)	(5.598)	(9.645)	(2.321)	(6.711)	(4.603)	(5.146)	(5.411)	(3.542)	(8.935)	(3.502)	(3.117)	(13.43)
single_parent	1.943	-10.29**	0.141	6.018**	-0.410	1.304	1.864	-6.940*	-4.525	7.057*	4.635*	-3.024	-6.320	4.259**	-4.540*	0.199	-0.958	-13.31***	9.955***	0.671	0.0515	-5.301	-1.688
	(1.971)	(3.466)	(2.448)	(2.164)	(2.456)	(1.677)	(2.364)	(2.827)	(3.797)	(3.053)	(1.981)	(3.568)	(3.867)	(1.567)	(2.040)	(2.421)	(3.286)	(2.414)	(2.520)	(2.643)	(2.471)	(4.114)	(2.913)
mixed_family	-13.58	-24.35***	-22.97*	2.979	-33.08*	3.309	-21.47***	-39.05***	-41.65***	-27.48*	0.944	-25.83*	-37.19*	-23.41***	-9.607	-25.99***	-53.52***	-54.88***	0.850	-19.74**	-25.47***	-35.41***	-21.19***
	(9.346)	(4.455)	(11.38)	(11.65)	(14.42)	(8.224)	(4.240)	(10.55)	(5.803)	(11.01)	(6.103)	(10.58)	(15.37)	(5.909)	(8.394)	(5.661)	(11.36)	(9.375)	(5.351)	(6.332)	(6.205)	(6.995)	(4.829)
books_11_25	14.19***	14.43*	15.07***	11.38**	11.88**	14.36***	13.62*	23.96***	-5.159	6.722*	7.049	20.88***	1.511	7.577***	8.006**	10.70*	17.28**	6.696*	2.288	11.50**	5.368	12.29**	6.644*
	(2.949)	(5.574)	(4.005)	(3.923)	(3.513)	(3.639)	(5.874)	(5.961)	(4.606)	(2.702)	(4.229)	(4.054)	(8.597)	(1.584)	(2.750)	(4.280)	(5.259)	(3.257)	(3.102)	(4.194)	(2.844)	(4.651)	(2.712)
books_26_100	26.56***	34.33***	26.84***	20.48***	28.33***	29.74***	19.51***	39.94***	8.820*	17.82***	14.32***	42.12***	28.67***	15.93***	21.05***	23.68***	40.94***	28.33***	14.35***	29.07***	16.73***	23.45***	12.07***
	(2.648)	(5.012)	(3.434)	(3.010)	(3.424)	(2.972)	(4.932)	(4.643)	(4.003)	(2.334)	(4.186)	(3.757)	(7.866)	(1.567)	(2.776)	(3.928)	(4.293)	(2.718)	(3.069)	(3.680)	(2.784)	(4.593)	(2.718)
books_101_200	35.32***	40.79***	39.23***	26.82***	42.66***	39.86***	28.55***	55.37***	15.15**	23.50***	21.47***	62.20***	46.63***	19.76***	24.54***	32.09***	57.26***	45.09***	13.86***	38.32***	25.91***	36.18***	21.41***
	(3.176)	(6.937)	(3.854)	(3.245)	(4.428)	(3.295)	(5.095)	(5.031)	(4.947)	(3.328)	(4.099)	(4.122)	(7.522)	(1.714)	(2.979)	(4.541)	(4.483)	(3.462)	(3.145)	(4.274)	(3.415)	(5.082)	(3.474)
books_201_500	38.61***	38.53***	48.10***	38.94***	43.78***	46.37***	36.55***	64.43***	25.45***	23.46***	32.14***	74.40***	65.29***	30.37***	32.72***	45.23***	69.13***	56.32***	27.45***	44.52***	30.55***	59.86***	17.83***
	(3.375)	(6.184)	(4.271)	(3.711)	(4.252)	(3.998)	(5.767)	(5.609)	(5.285)	(4.490)	(4.696)	(4.600)	(8.206)	(1.625)	(3.796)	(4.106)	(4.866)	(4.253)	(3.643)	(5.174)	(4.061)	(5.214)	(4.348)
books_more500	39.92***	34.65***	42.25***	35.62***	38.89***	48.05***	39.79***	64.74***	25.12***	22.49***	38.13***	68.10***	51.22***	26.08***	35.93***	39.67***	70.69***	55.25***	18.61***	42.55***	25.97***	51.23***	16.54**
	(4.416)	(6.598)	(5.095)	(4.358)	(5.278)	(3.852)	(6.038)	(6.188)	(5.956)	(4.844)	(4.799)	(6.929)	(8.383)	(2.111)	(4.100)	(5.988)	(5.176)	(5.625)	(5.123)	(6.770)	(5.001)	(6.092)	(5.437)
stz_games	4.641***	6.546***	2.935*	1.676***	6.201**	3.854***	7.761	4.936*	6.551***	3.265	3.585***	4.920**	-3.274	4.215***	6.115**	9.882***	1.684	1.801**	3.136*	4.190*	6.757*	-1.354	-1.124
	(1.306)	(1.704)	(1.178)	(0.410)	(2.009)	(1.035)	(3.921)	(2.255)	(1.604)	(1.977)	(0.907)	(1.863)	(10.03)	(0.605)	(2.181)	(2.648)	(2.480)	(0.595)	(1.570)	(1.601)	(2.898)	(1.810)	(0.589)
stz_colcomm	-1.880	-4.176	-1.529	-0.753	-8.818***	0.347	-22.52***	-8.478***	-11.14***	-0.523	-3.173*	-4.198	-26.36*	-0.266	-3.102	-6.246	-16.18***	-4.432***	5.041**	2.211	-10.10**	-9.102***	0.450
	(1.222)	(2.884)	(1.520)	(0.496)	(2.179)	(1.097)	(4.656)	(2.020)	(2.136)	(2.372)	(1.205)	(2.384)	(11.23)	(0.827)	(1.948)	(3.504)	(3.158)	(0.767)	(1.811)	(1.698)	(3.561)	(1.953)	(0.773)
stz_techinfo	-5.304**	5.420	-4.355*	-1.857***	2.112	-3.721**	-8.087*	-5.141	-3.141	-1.773	-4.059***	-6.415*	-1.690	-8.139***	-11.43***	-17.68***	16.76***	-1.304	-9.121***	-8.280***	0.284	5.868**	-1.756
	(1.678)	(3.522)	(1.907)	(0.522)	(2.219)	(1.212)	(3.644)	(3.034)	(2.073)	(2.733)	(1.167)	(3.034)	(11.42)	(0.949)	(2.717)	(3.346)	(2.979)	(0.780)	(1.631)	(1.794)	(3.740)	(2.089)	(0.897)
stz_contprob	-9.508***	-17.72***	-5.888***	-1.551***	-12.55***	-9.090***	-27.18***	-5.338*	-8.854***	-14.39***	-8.106***	-8.285***	-9.386	-0.933	-13.32***	-20.92***	-16.31***	-4.016***	-15.51***	-6.203***	-23.65***	-6.417***	-1.576**
	(1.310)	(2.757)	(1.352)	(0.413)	(2.242)	(1.363)	(4.992)	(2.328)	(1.795)	(1.970)	(1.049)	(2.078)	(8.631)	(0.622)	(2.108)	(2.624)	(2.345)	(0.753)	(1.481)	(1.398)	(3.170)	(1.690)	(0.547)
stz_games*ESCS	3.551**	-1.907	1.051	-0.341	-1.060	1.565	0.0956	-0.227	-2.013	2.284	0.497	0.895	17.29*	-0.0737	-2.281	0.814	0.392	0.283	-0.378	-1.909	-5.470	3.003*	-0.451
	(1.252)	(1.588)	(1.337)	(0.519)	(1.674)	(0.848)	(3.612)	(1.846)	(1.372)	(2.019)	(0.962)	(1.898)	(7.987)	(0.635)	(1.888)	(3.031)	(2.116)	(0.604)	(1.067)	(1.393)	(2.906)	(1.431)	(0.359)
stz_colcomm*ESCS	-2.141	-1.609	-1.781	-1.072*	-0.807	-0.103	-2.476	-1.719	1.559	-1.076	-0.480	-2.868	23.19*	0.432	-2.948	-6.956	-3.470	-1.296	-1.336	-4.735*	1.413	-0.438	0.575
	(1.662)	(3.144)	(2.228)	(0.511)	(2.388)	(1.083)	(3.796)	(2.364)	(2.239)	(2.591)	(1.123)	(2.684)	(9.408)	(0.872)	(2.421)	(3.588)	(2.249)	(0.819)	(1.407)	(2.202)	(3.920)	(2.189)	(0.508)
stz_techinfo*ESCS	0.237	2.832	-0.235	1.110	-8.226**	0.245	-2.647	-3.610	-2.265	-6.134*	-1.940	-6.468*	-25.34*	-3.132***	-4.976*	-0.0684	-0.992	-0.957	-0.812	-3.131	-0.915	-4.831*	0.0395
	(1.712)	(3.843)	(2.233)	(0.578)	(2.427)	(1.217)	(3.778)	(2.232)	(2.732)	(2.807)	(1.152)	(2.721)	(10.57)	(0.801)	(2.481)	(3.931)	(2.731)	(0.940)	(1.436)	(2.217)	(4.286)	(2.287)	(0.549)
stz_contprob*ESCS	-2.851*	-3.024	2.485	0.0603	2.468	-2.958*	0.910	-1.787	-0.761	0.415	-0.708	0.721	-14.75*	-0.398	0.628	-0.503	-2.534	1.277	0.416	2.695	-0.216	-1.104	-0.532
	(1.208)	(2.203)	(1.649)	(0.438)	(2.295)	(1.141)	(4.062)	(3.104)	(1.583)	(2.135)	(0.959)	(2.710)	(7.009)	(0.705)	(1.778)	(2.939)	(2.609)	(0.676)	(1.369)	(1.511)	(3.013)	(2.040)	(0.392)
Constant	154.4***	61.90**	48.95***	95.00***	123.2***	157.4***	96.40***	30.20	79.80***	85.67***	77.34***	129.0***	-13.79	33.84***	100.1***	145.0***	47.63**	294.6***	285.6***	89.36***	38.73***	78.37***	109.3***
	(9.312)	(19.16)	(9.255)	(6.979)	(14.87)	(11.17)	(11.99)	(20.28)	(9.840)	(8.662)	(9.648)	(24.71)	(26.35)	(4.360)	(12.56)	(16.90)	(13.99)	(16.65)	(15.43)	(13.69)	(6.476)	(14.04)	(16.40)
Observations	7,772	3,973	5,716	4,109	5,341	24,911	4,591	5,592	4,738	4,801	4,473	3,639	3,501	29,917	4,304	4,374	4,504	4,723	5,688	4,387	5,649	4,331	4,284
R-squared	0.599	0.589	0.557	0.650	0.358	0.508	0.438	0.340	0.488	0.525	0.712	0.405	0.272	0.615	0.505	0.462	0.352	0.423	0.500	0.572	0.676	0.374	0.592

Standard errors in parentheses

*** p<0.001, ** p<0.01, * p<0.05

Table C3.
Mathematics: results from Model 1 by country

Variable	BEL	BGR	CZE	DEU	DNK	ESP	EST	FIN	GRC	HRV	HUN	IRL	ISL	ITA	LTU	LVA	NOR	POL	PRT	SVK	SVN	SWE	TUR
ESCS	9.134	4.998	-28.87	-31.02	-8.791	5.699	4.736	98.77	10.17	5.250	-75.35	-1.569	-1.021	-2.211	-16.45	-12.03	-18.00	-30.75**	-9.743	-8.184	49.75*	37.12	-11.14
	(29.33)	(11.39)	(18.24)	(31.29)	(32.47)	(12.98)	(24.03)	(83.63)	(6.241)	(11.56)	(48.00)	(27.93)	(19.52)	(5.617)	(38.03)	(18.16)	(22.23)	(10.33)	(24.09)	(24.91)	(22.15)	(27.40)	(6.666)
Average score at school	0.689***	0.788***	0.846***	0.797***	0.751***	0.615***	0.822***	0.836***	0.803***	0.883***	0.847***	0.672***	0.806***	0.891***	0.736***	0.682***	0.764***	0.640***	0.420***	0.801***	0.879***	0.716***	0.858***
	(0.0121)	(0.0215)	(0.00899)	(0.0140)	(0.0231)	(0.0228)	(0.0197)	(0.0265)	(0.0199)	(0.0126)	(0.0113)	(0.0388)	(0.0428)	(0.00773)	(0.0202)	(0.0288)	(0.0313)	(0.0259)	(0.0242)	(0.0174)	(0.0140)	(0.0239)	(0.0121)
female	-28.96***	-10.45***	-18.62***	-24.18***	-18.28***	-28.53***	-16.40***	-11.65***	-26.26***	-23.52***	-25.23***	-12.73***	-6.852*	-23.65***	-5.698*	-13.46***	-9.957**	-16.17***	-27.03***	-11.92***	-20.14***	-6.263*	-28.31***
	(1.748)	(2.222)	(2.239)	(1.880)	(2.456)	(1.706)	(2.878)	(3.182)	(2.343)	(2.059)	(1.863)	(2.217)	(2.971)	(0.942)	(2.770)	(2.483)	(3.102)	(2.455)	(2.073)	(2.530)	(2.399)	(2.518)	(1.424)
grade7	-48.64**	-12.64	-53.50***	-106.2***	-39.50	-77.02***	-119.6***	-70.04**	-5.338		-3.632			-16.43	-80.14***	-72.85***		-82.45***	-66.13***	-51.38**		-123.4***	-13.78
	(15.54)	(13.92)	(10.62)	(12.02)	(39.37)	(18.35)	(11.53)	(20.08)	(29.34)		(6.885)			(13.41)	(21.22)	(9.987)		(17.75)	(6.521)	(19.33)		(18.67)	(11.20)
grade8	-57.44***	-23.47*	-34.14***	-66.35***	-41.80***	-87.22***	-68.90***	-45.60***	44.80**	-8.958	-3.198	-59.60***		-2.336	-42.69***	-71.53***		-74.47***	-46.62***	-28.24**	-16.97	-36.88***	1.060
	(6.749)	(9.972)	(6.526)	(4.015)	(7.715)	(6.067)	(7.065)	(10.08)	(13.74)	(4.879)	(4.164)	(12.06)		(4.764)	(5.408)	(5.642)		(12.02)	(5.538)	(9.636)	(11.44)	(9.965)	(4.571)
grade9	-33.78***	-24.40**	-2.202	-36.31***	-16.45*	-43.19***	-40.40***	-14.84	41.54**	-33.61***	-16.76***	-23.60***	-74.36***	-31.73***	-28.99***	-33.12***	-51.06**	-6.808	-6.096	4.028*	-5.470	-8.326*	-22.23***
	(3.952)	(7.595)	(1.451)	(1.947)	(7.108)	(6.421)	(6.947)	(8.775)	(12.22)	(1.874)	(1.710)	(2.994)	(19.49)	(3.318)	(3.410)	(5.023)	(17.97)	(6.383)	(3.476)	(1.678)	(4.760)	(4.106)	(2.480)
grade_above10	46.00***			52.03***		114.8***	141.5***				23.95	1.433	17.27	20.12***	82.25***	35.86	9.195		77.21***	25.02***	25.67***		26.81***
	(6.199)			(14.05)		(32.36)	(8.257)				(24.62)	(3.530)	(9.058)	(2.986)	(6.183)	(25.99)	(7.240)		(9.670)	(4.231)	(3.767)		(3.809)
graderep	-21.63***	-25.12**	-35.16***	-11.37***	-39.44***	-23.10***	-32.69***	-53.79***	-40.01**	-36.49***	-11.15***	-27.76***	-60.24***	-4.121	-46.70***	-19.26***		-16.10	-42.95***	-40.86***	-7.709	-45.18***	-21.22***
	(3.822)	(7.848)	(6.009)	(2.737)	(5.457)	(5.824)	(5.626)	(9.559)	(14.89)	(6.766)	(2.903)	(3.642)	(16.26)	(3.453)	(6.108)	(5.449)		(9.669)	(3.232)	(7.154)	(8.663)	(5.764)	(3.380)
native	6.403*	23.49	12.91**	6.351*	19.08***	6.987*	10.40**	12.37	3.206	2.945	5.927	5.966	18.43	13.31***	12.04	11.99**	3.904	-186.2***	7.499*	8.639	13.14***	8.535*	-56.76***
	(2.652)	(17.16)	(4.732)	(2.426)	(3.266)	(2.670)	(3.547)	(7.087)	(3.376)	(2.839)	(5.478)	(5.396)	(10.23)	(2.149)	(6.271)	(4.318)	(4.643)	(9.249)	(3.449)	(10.96)	(3.780)	(3.550)	(10.10)
single_parent	0.212	-5.484*	-7.375**	1.378	5.681*	-2.046	-1.597	-10.77***	-0.0271	-1.827	-0.106	-4.407	-8.981*	3.033*	-3.142	2.409	0.754	-12.34***	2.535	-5.529	-5.848	-2.730	-4.092
	(1.922)	(2.561)	(2.160)	(2.178)	(2.831)	(2.166)	(2.163)	(2.899)	(3.673)	(2.706)	(2.043)	(3.573)	(3.678)	(1.318)	(2.387)	(2.305)	(3.057)	(3.071)	(2.541)	(2.819)	(2.968)	(3.855)	(3.203)
mixed_family	-20.41*	-14.66**	-19.74	-6.247	-13.22	-3.073	-19.41***	-23.74	-35.11***	-36.97**	-8.004	-25.52*	-60.60***	-15.29*	-16.74*	-22.08***	-28.99**	-46.00***	-6.569	-27.35**	-36.11***	-31.33***	-25.85***
	(9.953)	(5.314)	(12.14)	(13.92)	(14.54)	(7.294)	(4.643)	(13.99)	(6.451)	(12.32)	(6.694)	(11.89)	(15.60)	(5.861)	(8.315)	(6.192)	(8.772)	(7.218)	(5.140)	(8.726)	(8.377)	(6.984)	(3.675)
books_11_25	14.24***	0.466	11.21**	3.284	14.84***	20.09***	7.958	16.96*	-0.447	8.318**	17.08***	20.19***	18.57*	3.677*	-0.984	-1.172	22.44***	5.480	1.641	15.13***	-2.986	7.634	8.341***
	(3.547)	(4.859)	(4.201)	(3.520)	(3.794)	(3.507)	(5.638)	(6.836)	(3.876)	(2.694)	(4.732)	(3.866)	(7.464)	(1.659)	(2.661)	(3.929)	(5.278)	(3.677)	(3.087)	(4.416)	(3.567)	(5.238)	(2.071)
books_26_100	25.46***	27.01***	21.27***	10.02***	24.38***	35.16***	16.46***	30.08***	12.41***	19.32***	25.35***	36.32***	31.81***	15.64***	20.06***	16.13***	41.46***	25.17***	15.43***	24.83***	12.61***	23.07***	17.31***
	(2.927)	(4.510)	(3.821)	(2.909)	(3.313)	(3.390)	(4.525)	(5.016)	(3.627)	(2.407)	(4.337)	(3.753)	(7.328)	(1.659)	(2.839)	(4.197)	(4.659)	(3.036)	(3.115)	(3.946)	(3.202)	(4.856)	(2.291)
books_101_200	35.06***	34.24***	32.68***	14.95***	33.77***	52.26***	23.84***	42.90***	29.88***	27.20***	37.14***	52.35***	48.95***	20.20***	26.35***	23.93***	61.11***	43.42***	19.78***	35.22***	30.70***	23.36***	23.02***
	(3.679)	(5.876)	(3.763)	(3.416)	(4.292)	(4.540)	(4.602)	(5.546)	(4.500)	(3.922)	(4.365)	(4.252)	(6.893)	(1.773)	(3.407)	(4.494)	(5.170)	(4.238)	(3.528)	(4.190)	(4.100)	(5.388)	(2.854)
books_201_500	36.59***	33.58***	41.78***	31.35***	49.03***	58.48***	31.45***	56.20***	39.38***	34.12***	41.60***	59.16***	71.25***	30.25***	31.12***	36.07***	78.23***	48.35***	36.25***	47.01***	35.93***	56.53***	22.77***
	(3.571)	(5.836)	(4.275)	(3.615)	(4.202)	(4.692)	(5.304)	(5.330)	(5.228)	(4.230)	(4.811)	(4.437)	(7.305)	(1.858)	(4.296)	(4.601)	(5.066)	(5.023)	(4.002)	(4.799)	(4.545)	(5.325)	(3.916)
books_more500	41.35***	36.56***	45.44***	25.98***	43.55***	58.35***	41.29***	63.43***	36.97***	25.39***	52.39***	56.28***	62.75***	28.45***	41.04***	34.49***	78.85***	58.25***	20.37***	52.57***	26.14***	55.24***	20.47***
	(3.964)	(6.379)	(4.941)	(4.176)	(5.883)	(4.528)	(5.919)	(6.411)	(5.744)	(5.262)	(5.069)	(6.594)	(7.768)	(2.332)	(4.358)	(5.814)	(5.925)	(6.211)	(5.190)	(6.270)	(5.653)	(5.910)	(3.640)
totactivities	2.348**	1.671*	6.407***	2.409	4.015	1.955	5.698***	16.26***	2.396***	1.821*	9.526**	5.364**	4.473**	2.130***	5.722**	3.325***	2.772*	4.225***	0.964	5.532***	3.391***	3.393***	1.371
	(0.882)	(0.745)	(1.527)	(1.494)	(2.927)	(1.386)	(0.683)	(4.230)	(0.467)	(0.768)	(3.521)	(1.973)	(1.450)	(0.317)	(1.781)	(0.491)	(1.205)	(0.906)	(1.291)	(1.183)	(0.791)	(0.702)	(0.711)
tot_activities*ESCS	-0.310	0.252	2.064*	1.663	1.542	-0.225	0.612	-3.567	0.159	0.0668	3.637	0.969	0.995	0.216	1.764	1.450	2.166*	2.396***	1.166	1.293	-2.252*	-0.668	0.805*
	(1.338)	(0.537)	(0.825)	(1.414)	(1.460)	(0.606)	(1.128)	(3.827)	(0.283)	(0.556)	(2.181)	(1.274)	(0.922)	(0.249)	(1.730)	(0.818)	(1.058)	(0.517)	(1.107)	(1.124)	(1.006)	(1.275)	(0.317)
games_int	6.967**	9.306**	7.354*	17.65***	8.540*	12.96***	6.686	7.662	14.40***	6.840	8.427**	5.903	1.669	11.82***	15.15***	9.786**	11.84*	6.745	8.661**	14.63***	8.796*	-2.223	-7.079
	(2.491)	(3.343)	(3.021)	(2.809)	(3.481)	(2.660)	(3.678)	(4.298)	(4.157)	(3.489)	(2.998)	(4.035)	(5.905)	(1.704)	(3.745)	(3.142)	(4.642)	(3.443)	(3.199)	(3.359)	(3.379)	(4.999)	(3.900)
colcomm_int	-18.24**	-8.427	-12.03	-1.758	-41.63***	-3.571	-36.00***	-44.73***	-22.32**	6.799	-25.19***	-24.59**	-35.57*	3.442	-8.675	-22.76*	-68.39***	-40.32***	10.54	15.20*	-21.06**	-54.49***	13.54
	(5.856)	(9.204)	(6.303)	(7.365)	(7.453)	(4.963)	(8.686)	(9.182)	(7.106)	(6.449)	(6.790)	(7.639)	(14.94)	(3.508)	(7.693)	(8.869)	(12.37)	(9.641)	(7.636)	(6.865)	(6.198)	(11.32)	(7.795)
techinfo_int	-22.64**	2.016	-14.63*	-32.53***	-25.86**	-36.73***	-32.20***	-56.36***	-32.38***	-1.019	-18.64**	-25.18	-16.93	-45.98***	-46.14***	-53.38***	51.90***	-31.85**	-33.71***	-44.97***	-6.118	-4.041	-43.68***
	(7.596)	(10.11)	(7.201)	(7.992)	(8.433)	(6.632)	(7.925)	(12.74)	(8.676)	(9.170)	(6.697)	(13.02)	(15.21)	(4.956)	(9.438)	(9.393)	(10.11)	(9.412)	(8.166)	(6.965)	(7.861)	(12.95)	(8.523)
contprob_int	-30.69***	-35.69***	-21.43***	-25.30***	-25.60***	-26.20***	-34.06***	-16.39	-25.79***	-45.04***	-39.69***	-43.41***	-10.81	-1.252	-42.78***	-26.95***	-58.39***	-45.11***	-41.97***	-14.99*	-32.50***	-22.68**	-6.199
	(5.623)	(5.704)	(5.143)	(5.250)	(7.325)	(5.042)	(8.602)	(13.04)	(4.995)	(6.135)	(4.574)	(7.549)	(11.40)	(2.468)	(6.337)	(6.713)	(6.946)	(8.095)	(5.947)	(6.321)	(5.604)	(7.952)	(5.988)
games_int*ESCS	2.596	-7.208*	5.053	-3.639	-1.581	2.013	-0.269	0.444	-3.142	3.529	7.180*	2.207	3.266	0.576	-3.081	-3.070	-1.806	0.207	-5.064	3.664	-3.839	3.790	-1.118
	(2.782)	(2.901)	(3.102)	(3.282)	(3.463)	(2.220)	(3.828)	(4.219)	(3.891)	(3.880)	(3.033)	(4.159)	(4.797)	(1.373)	(3.766)	(3.640)	(4.109)	(3.792)	(2.545)	(3.358)	(3.450)	(3.831)	(2.733)
colcomm_int*ESCS	-5.767	1.939	-0.459	-1.607	4.723	4.817	3.091	-10.39	12.45*	-3.486	-4.457	-12.58	6.733	-0.471	-8.764	-10.91	-14.62	-21.67*	-5.060	-21.38*	2.135	-8.154	1.436
	(7.054)	(8.963)	(9.281)	(6.861)	(8.543)	(5.055)	(8.127)	(10.29)	(6.222)	(7.371)	(5.958)	(10.16)	(12.31)	(3.860)	(7.589)	(7.579)	(9.721)	(10.68)	(5.700)	(8.804)	(8.563)	(12.16)	(5.055)
techinfo_int*ESCS	10.15	8.670	-22.61*	-3.954	-24.63*	-1.535	-23.09**	-7.814	-19.04	-16.00	-10.68	-21.42	-26.92*	-9.508*	-16.51	-7.649	-14.49	-3.000	-3.798	-12.68	4.648	-5.404	-5.649
	(6.825)	(10.99)	(9.738)	(8.517)	(10.45)	(7.103)	(8.243)	(10.84)	(9.731)	(9.106)	(7.594)	(13.93)	(12.89)	(4.135)	(9.774)	(9.047)	(10.66)	(12.11)	(6.946)	(9.051)	(10.86)	(15.72)	(6.689)
contprob_int*ESCS	-5.940	-9.187	5.967	6.385	-0.118	-9.339	3.988	-20.17	0.402	1.207	-2.206	6.429	-10.06	-0.571	3.456	1.515	1.228	15.49	-4.950	7.100	-8.756	-3.046	3.906
	(5.761)	(4.972)	(6.628)	(5.499)	(7.306)	(5.578)	(7.251)	(13.01)	(5.629)	(6.789)	(5.050)	(10.42)	(10.04)	(2.665)	(5.759)	(7.186)	(8.434)	(7.830)	(4.361)	(6.939)	(6.130)	(9.720)	(3.933)
Constant	133.0***	56.58*	-73.45*	83.60*	55.62	157.9***	25.07	-258.6*	55.50***	40.47*	-125.4	47.54	-42.16	6.465	28.58	130.4***	15.09	301.2***	297.8***	-38.09	-15.45	66.76**	124.5***
	(21.47)	(24.76)	(34.20)	(32.66)	(62.96)	(31.31)	(19.90)	(96.32)	(13.15)	(16.14)	(76.65)	(46.53)	(45.05)	(8.594)	(39.88)	(19.56)	(35.06)	(26.33)	(28.94)	(30.24)	(21.08)	(20.92)	(18.75)
Observations	7,642	3,771	5,628	3,984	5,181	24,431	4,539	5,435	4,673	4,729	4,423	3,519	3,455	29,415	4,270	4,313	4,424	4,673	5,661	4,328	5,517	4,223	4,101
R-squared	0.636	0.581	0.585	0.684	0.357	0.507	0.388	0.283	0.431	0.480	0.706	0.380	0.283	0.573	0.463	0.423	0.329	0.376	0.510	0.546	0.625	0.351	0.689

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05

Table C4.
Mathematics: results from Model 2 by country

Variable	BEL	BGR	CZE	DEU	DNK	ESP	EST	FIN	GRC	HRV	HUN	IRL	ISL	ITA	LTU	LVA	NOR	POL	PRT	SVK	SVN	SWE	TUR
ESCS	3.785***	8.356***	9.976***	3.114**	14.96***	0.493	8.093***	12.32***	9.485***	1.131	1.678	11.52***	13.24***	-0.830	12.01***	10.94***	15.09***	15.40***	9.286***	9.850***	0.0661	19.14***	5.103***
	(0.930)	(1.664)	(1.597)	(1.085)	(1.502)	(1.158)	(1.491)	(1.569)	(1.361)	(1.434)	(1.165)	(1.760)	(1.573)	(0.654)	(1.310)	(1.769)	(1.706)	(1.732)	(1.024)	(1.544)	(1.131)	(1.512)	(0.958)
Average score at school	0.697***	0.795***	0.857***	0.802***	0.752***	0.627***	0.843***	0.845***	0.818***	0.892***	0.855***	0.704***	0.800***	0.900***	0.746***	0.697***	0.776***	0.651***	0.420***	0.809***	0.886***	0.722***	0.862***
	(0.0121)	(0.0216)	(0.00892)	(0.0135)	(0.0212)	(0.0222)	(0.0210)	(0.0276)	(0.0173)	(0.0131)	(0.0104)	(0.0399)	(0.0422)	(0.00752)	(0.0187)	(0.0299)	(0.0292)	(0.0287)	(0.0236)	(0.0176)	(0.0141)	(0.0253)	(0.0118)
female	-28.49***	-9.203***	-17.52***	-23.59***	-17.88***	-27.60***	-15.04***	-10.62**	-24.00***	-21.45***	-24.04***	-10.22***	-5.074	-22.74***	-3.903	-11.33***	-7.536*	-14.13***	-26.90***	-11.36***	-19.19***	-3.459	-27.24***
	(1.744)	(2.234)	(2.314)	(1.776)	(2.426)	(1.721)	(2.945)	(3.044)	(2.421)	(1.961)	(1.949)	(2.389)	(3.015)	(0.943)	(2.813)	(2.473)	(3.134)	(2.437)	(2.040)	(2.511)	(2.365)	(2.550)	(1.417)
grade7	-61.53***	-10.77	-56.72***	-107.1***	-49.08	-96.67***	-119.6***		2.221		-3.152	-77.04***		-11.34	-81.42***	-74.64***		-71.49***	-66.29***	-61.59**		-118.3***	-18.51
	(11.57)	(12.90)	(10.29)	(11.36)	(37.84)	(19.18)	(11.18)		(27.75)		(7.375)	(6.718)		(12.82)	(21.16)	(10.48)		(17.92)	(6.539)	(18.63)		(14.20)	(11.53)
grade8	-58.19***	-19.35*	-34.25***	-66.81***	-41.82***	-89.09***	-71.56***	33.84	45.07**	-5.834	-3.180	-62.21***		1.793	-43.19***	-74.33***		-69.39***	-46.52***	-31.18**	-10.58	-38.75***	2.941
	(6.781)	(9.148)	(6.415)	(4.050)	(7.538)	(5.785)	(7.220)	(16.80)	(13.26)	(4.678)	(3.945)	(12.53)		(4.610)	(5.498)	(5.887)		(12.45)	(5.507)	(9.674)	(11.30)	(9.984)	(4.819)
grade9	-34.12***	-23.02**	-1.737	-36.70***	-14.95*	-44.15***	-41.22***	66.17***	41.08**	-33.74***	-17.29***	-22.89***	-75.86***	-32.60***	-29.72***	-33.75***	-48.86**	-6.547	-6.381	4.293*	-2.845	-8.815*	-22.79***
	(4.074)	(7.304)	(1.334)	(1.914)	(6.906)	(6.100)	(6.975)	(17.14)	(12.27)	(1.903)	(1.763)	(3.091)	(18.97)	(3.189)	(3.488)	(5.062)	(18.31)	(6.343)	(3.431)	(1.733)	(4.736)	(3.582)	(2.534)
grade_above10	46.52***			52.21***		115.0***	150.5***	81.60***			25.82	3.166	15.24	20.39***	79.76***	36.62	8.752		76.83***	25.20***	26.77***		27.15***
	(6.157)			(14.03)		(31.80)	(8.812)	(20.91)			(24.63)	(3.609)	(9.239)	(2.994)	(6.102)	(26.07)	(7.200)		(9.608)	(4.144)	(3.737)		(3.730)
graderep	-21.84***	-24.93***	-34.56***	-10.29***	-38.89***	-21.92***	-32.44***	-55.16***	-40.20**	-36.54***	-11.04***	-28.21***	-62.67***	-4.034	-46.64***	-19.94***		-25.80*	-42.52***	-37.15***	-11.03	-45.72***	-20.85***
	(4.099)	(7.114)	(6.059)	(2.779)	(5.703)	(5.548)	(5.526)	(8.647)	(14.29)	(6.718)	(2.896)	(3.669)	(16.37)	(3.302)	(5.981)	(5.667)		(10.06)	(3.205)	(7.339)	(8.564)	(5.990)	(3.577)
native	7.181**	22.64	12.37**	5.829*	20.42***	7.708**	13.11***	14.63*	4.278	2.994	4.561	11.24*	18.94	13.76***	11.69	12.87**	7.401	-181.5***	7.344*	9.530	12.23**	9.939**	-56.95***
	(2.485)	(16.85)	(4.631)	(2.535)	(3.140)	(2.746)	(3.524)	(5.910)	(3.377)	(2.886)	(5.590)	(5.489)	(9.535)	(2.117)	(6.220)	(4.357)	(4.899)	(10.07)	(3.420)	(11.04)	(3.777)	(3.242)	(10.03)
single_parent	0.744	-7.502*	-7.841***	2.269	4.803	-2.093	-2.717	-10.83***	-0.672	-1.833	0.275	-4.318	-9.204*	3.521*	-3.348	2.520	-0.360	-13.09***	2.631	-6.140*	-5.436	-3.431	-4.508
	(1.941)	(2.953)	(2.140)	(2.192)	(2.886)	(2.070)	(2.352)	(2.853)	(3.604)	(2.753)	(2.143)	(3.627)	(3.664)	(1.363)	(2.371)	(2.263)	(3.128)	(3.159)	(2.539)	(2.789)	(2.913)	(3.881)	(3.104)
mixed_family	-20.54*	-13.12*	-21.16	-6.784	-13.17	-4.456	-19.72***	-26.17*	-37.41***	-37.20**	-8.204	-27.55*	-56.52***	-16.80**	-15.55	-25.16***	-30.61**	-48.27***	-6.695	-29.09***	-35.36***	-32.07***	-26.45***
	(9.693)	(5.260)	(10.69)	(13.69)	(13.91)	(7.047)	(4.627)	(12.22)	(6.482)	(11.87)	(6.753)	(11.93)	(15.30)	(5.599)	(8.285)	(6.599)	(9.277)	(7.430)	(5.189)	(8.467)	(8.295)	(6.602)	(3.565)
books_11_25	13.92***	-0.205	10.16*	2.372	14.53***	20.76***	7.975	16.14*	-1.526	9.107***	18.01***	20.93***	17.55*	2.924	-0.610	-0.979	20.32***	4.775	1.045	15.63***	-2.746	7.613	8.507***
	(3.491)	(5.013)	(4.225)	(3.406)	(3.640)	(3.523)	(5.680)	(5.994)	(3.855)	(2.638)	(4.840)	(3.895)	(7.261)	(1.666)	(2.714)	(4.059)	(5.350)	(3.672)	(3.050)	(4.510)	(3.555)	(5.225)	(2.049)
books_26_100	25.30***	25.58***	21.09***	9.977**	23.83***	36.24***	16.62***	30.07***	11.45**	20.80***	25.15***	37.60***	32.00***	15.24***	20.57***	17.13***	39.89***	24.78***	15.09***	24.68***	12.88***	22.13***	16.93***
	(2.879)	(4.335)	(3.867)	(2.946)	(3.216)	(3.350)	(4.576)	(4.723)	(3.583)	(2.406)	(4.681)	(3.758)	(7.245)	(1.616)	(2.839)	(4.247)	(4.794)	(3.060)	(3.069)	(3.970)	(3.187)	(4.600)	(2.274)
books_101_200	34.95***	34.53***	32.27***	14.16***	33.49***	52.77***	23.83***	43.49***	29.34***	28.35***	37.20***	53.06***	49.17***	19.65***	26.77***	23.88***	59.66***	42.70***	19.44***	34.86***	31.19***	23.36***	22.08***
	(3.719)	(5.670)	(3.724)	(3.311)	(4.195)	(4.427)	(4.540)	(5.422)	(4.421)	(3.967)	(4.593)	(4.203)	(6.841)	(1.790)	(3.429)	(4.596)	(5.276)	(4.322)	(3.481)	(4.150)	(3.999)	(5.239)	(2.809)
books_201_500	36.67***	33.59***	41.37***	30.40***	48.83***	59.71***	32.40***	56.11***	38.95***	34.51***	41.87***	60.46***	70.79***	29.82***	31.54***	37.18***	76.91***	48.39***	35.99***	46.60***	36.29***	57.45***	21.96***
	(3.552)	(5.695)	(4.201)	(3.649)	(4.225)	(4.600)	(5.262)	(4.850)	(5.053)	(4.448)	(5.068)	(4.325)	(7.253)	(1.856)	(4.234)	(4.602)	(5.182)	(5.075)	(3.957)	(4.752)	(4.452)	(5.065)	(3.845)
books_more500	40.82***	36.34***	43.13***	24.82***	42.81***	59.10***	40.87***	63.81***	36.18***	25.63***	52.48***	54.94***	61.50***	27.84***	41.36***	36.08***	77.52***	56.49***	20.90***	50.35***	26.52***	53.57***	20.47***
	(3.928)	(6.417)	(5.048)	(4.160)	(5.502)	(4.257)	(6.038)	(6.617)	(5.701)	(5.295)	(5.264)	(6.633)	(7.576)	(2.371)	(4.203)	(5.768)	(6.259)	(6.238)	(4.886)	(6.386)	(5.625)	(5.742)	(3.655)
stz_games	3.742***	6.058**	3.773**	2.580***	5.584**	5.809***	10.37**	5.371**	7.163***	5.565**	3.619***	4.828**	4.057	5.405***	9.636***	10.27***	7.130**	1.762**	3.799**	7.292***	10.21**	0.903	-0.663
	(1.071)	(1.780)	(1.231)	(0.376)	(1.961)	(1.027)	(3.726)	(1.973)	(1.649)	(1.953)	(0.969)	(1.733)	(9.450)	(0.684)	(2.244)	(2.551)	(2.420)	(0.594)	(1.324)	(1.530)	(3.383)	(1.792)	(0.491)
stz_colcomm	-3.451*	-1.247	-1.977	-0.105	-10.96***	0.0530	-14.04**	-9.221***	-6.652**	2.529	-4.802***	-5.138*	-25.60*	0.975	-2.120	-6.158	-14.42***	-3.302***	2.945	4.315*	-10.06**	-8.405***	1.362
	(1.329)	(3.237)	(1.425)	(0.557)	(2.224)	(1.319)	(4.794)	(2.453)	(2.158)	(2.421)	(1.365)	(2.089)	(11.10)	(0.861)	(2.468)	(3.594)	(3.016)	(0.888)	(1.960)	(1.780)	(3.460)	(1.894)	(0.752)
stz_techinfo	-3.714*	3.926	-2.728	-2.065***	-3.961	-6.862***	-8.484*	-8.446**	-6.385**	1.575	-2.704*	-2.125	-6.057	-8.789***	-12.59***	-17.74***	17.19***	-2.376**	-8.379***	-10.14***	0.569	3.013	-3.447***
	(1.732)	(3.892)	(1.517)	(0.558)	(2.161)	(1.479)	(3.584)	(2.830)	(2.266)	(2.938)	(1.228)	(2.777)	(10.58)	(1.073)	(2.773)	(3.521)	(2.615)	(0.835)	(1.997)	(1.740)	(4.078)	(1.981)	(0.743)
stz_contprob	-6.917***	-16.27***	-5.349***	-1.811***	-8.891***	-7.036***	-19.86***	-4.118	-6.729***	-15.72***	-8.381***	-11.08***	-7.643	-0.0546	-14.47***	-11.64***	-17.84***	-4.309***	-12.54***	-4.015**	-23.14***	-5.127***	-0.698
	(1.275)	(2.351)	(1.280)	(0.375)	(2.400)	(1.376)	(4.860)	(3.415)	(1.432)	(2.142)	(0.970)	(1.795)	(9.132)	(0.659)	(2.146)	(2.626)	(2.132)	(0.747)	(1.740)	(1.513)	(3.601)	(1.403)	(0.541)
stz_games*ESCS	0.951	-3.440*	2.090	-0.472	-0.756	0.838	-0.914	-0.490	-1.332	1.785	2.485*	0.458	7.717	0.198	-1.445	-2.493	-0.392	-0.127	-2.078*	1.004	-3.781	1.251	0.0352
	(1.184)	(1.568)	(1.271)	(0.454)	(1.957)	(0.879)	(4.034)	(2.129)	(1.512)	(2.111)	(1.005)	(1.673)	(7.547)	(0.535)	(2.145)	(2.648)	(2.061)	(0.667)	(1.030)	(1.492)	(3.463)	(1.494)	(0.364)
stz_colcomm*ESCS	-1.257	0.246	0.0699	-0.0854	1.756	1.470	2.026	-3.312	3.704*	-1.270	-0.581	-3.469	6.977	-0.106	-3.138	-2.333	-3.540	-1.587	-1.169	-5.685*	0.550	-1.845	0.217
	(1.684)	(3.366)	(2.035)	(0.494)	(2.470)	(1.273)	(3.954)	(2.416)	(1.768)	(2.700)	(1.182)	(2.732)	(9.440)	(0.934)	(2.409)	(2.989)	(2.282)	(0.950)	(1.454)	(2.284)	(4.790)	(2.132)	(0.484)
stz_techinfo*ESCS	1.931	4.282	-3.956	0.0228	-6.596*	0.122	-7.066	-2.636	-5.297*	-4.278	-1.979	-3.670	-17.22	-2.183*	-4.858	-3.290	-3.821	-0.301	-0.760	-2.759	3.147	-2.800	-0.408
	(1.578)	(3.486)	(2.058)	(0.599)	(2.685)	(1.568)	(4.264)	(2.532)	(2.510)	(3.046)	(1.397)	(2.887)	(9.095)	(0.884)	(2.856)	(3.488)	(2.779)	(1.059)	(1.673)	(2.217)	(5.479)	(2.174)	(0.537)
stz_contprob*ESCS	-1.373	-3.840*	0.975	0.315	-0.803	-2.972*	0.899	-4.538	-0.330	-0.735	-0.562	0.822	-10.17	-0.507	0.695	-0.563	-0.0599	1.274	-1.655	1.457	-5.858	0.131	0.145
	(1.320)	(1.928)	(1.659)	(0.386)	(2.380)	(1.439)	(3.990)	(2.850)	(1.615)	(2.428)	(1.082)	(2.436)	(8.161)	(0.666)	(2.004)	(2.788)	(2.519)	(0.736)	(1.270)	(1.663)	(3.892)	(1.708)	(0.346)
Constant	164.4***	80.81***	49.27***	127.1***	107.8***	176.8***	106.4***	-23.81	80.44***	72.21***	61.55***	123.5***	36.48	37.87***	129.5***	166.2***	52.29***	355.9***	306.7***	70.65***	41.96***	109.7***	139.5***
	(7.379)	(19.14)	(6.895)	(7.378)	(13.85)	(11.78)	(12.82)	(22.67)	(9.009)	(7.112)	(8.426)	(20.80)	(25.67)	(4.072)	(10.86)	(16.46)	(15.22)	(22.34)	(12.82)	(14.56)	(7.543)	(13.89)	(12.11)
Observations	7,772	3,973	5,716	4,109	5,341	24,911	4,591	5,592	4,738	4,801	4,473	3,639	3,501	29,917	4,304	4,374	4,504	4,723	5,688	4,387	5,649	4,331	4,284
R-squared	0.637	0.577	0.582	0.683	0.350	0.507	0.382	0.281	0.425	0.477	0.698	0.377	0.274	0.572	0.462	0.423	0.321	0.375	0.511	0.547	0.623	0.351	0.687

Standard errors in parentheses
*** p<0.001, ** p<0.01, * p<0.05

Table C5.

Science: results from Model 1 by country

Variables	BEL	BGR	CZE	DEU	DNK	ESP	EST	FIN	GRC	HRV	HUN	IRL	ISL	ITA	LTU	LVA	NOR	POL	PRT	SVK	SVN	SWE	TUR
totict_games_ratio	6.386*	9.361**	9.188**	14.64***	13.60***	14.16***	6.683	8.383	16.78***	2.524	7.928*	2.951	-4.869	10.10***	8.236*	11.33**	1.651	4.577	7.235*	12.68**	5.641	-1.405	-4.579
	(2.686)	(2.869)	(3.017)	(3.217)	(3.827)	(2.486)	(4.676)	(4.399)	(4.274)	(3.304)	(3.017)	(4.495)	(5.902)	(1.907)	(3.346)	(3.392)	(5.204)	(3.405)	(3.507)	(3.873)	(3.610)	(5.391)	(4.381)
totict_colcomm_ratio	-12.99*	-19.02*	-8.339	-7.643	-31.48***	-6.903	-57.53***	-38.32**	-18.30**	-4.606	-23.23***	-29.76**	-51.65**	0.305	-22.41**	-24.57***	-76.64***	-58.34***	7.687	2.995	-27.25***	-70.82***	8.477
	(5.701)	(9.512)	(7.720)	(6.990)	(7.977)	(5.250)	(8.614)	(10.06)	(6.494)	(6.601)	(6.236)	(8.981)	(15.62)	(3.745)	(7.348)	(7.050)	(12.08)	(8.940)	(7.750)	(6.399)	(6.399)	(11.76)	(7.200)
totict_techinfo_ratio	-19.33*	6.970	-26.07**	-33.37***	-14.36	-39.52***	-38.30***	-68.95***	-31.84***	-16.41	-26.58***	-23.83	-14.04	-44.83***	-34.38**	-51.34***	51.93***	-21.70*	-39.38***	-42.81***	-1.657	-7.644	-23.20**
	(7.794)	(9.602)	(7.870)	(8.189)	(9.348)	(6.257)	(8.368)	(15.30)	(8.529)	(8.619)	(6.833)	(14.03)	(16.66)	(4.970)	(10.99)	(8.787)	(10.19)	(9.364)	(7.689)	(7.611)	(8.449)	(13.41)	(8.444)
totict_contprob_ratio	-37.23***	-33.99***	-25.42***	-28.80***	-33.42***	-17.56***	-32.40***	-20.97	-30.77***	-23.24***	-31.02***	-39.88***	-11.17	-5.968*	-35.63***	-48.90***	-61.40***	-36.33***	-40.94***	-15.17*	-30.03***	-21.44*	-10.88
	(5.749)	(5.480)	(5.815)	(5.739)	(7.774)	(4.594)	(9.062)	(11.72)	(5.838)	(5.215)	(4.595)	(8.660)	(10.07)	(2.526)	(6.299)	(6.373)	(7.302)	(8.083)	(5.268)	(6.252)	(5.590)	(8.999)	(5.594)
tot_nonmiss	3.991***	2.661**	10.61***	3.214	5.557*	4.025***	7.071***	17.17***	2.452***	3.118***	4.150	6.003**	4.343*	2.546***	4.098**	2.685***	3.846**	4.937***	2.779*	5.442***	2.707***	3.559***	2.265***
	(1.009)	(0.820)	(1.862)	(1.775)	(2.252)	(0.397)	(0.681)	(3.422)	(0.693)	(0.700)	(3.986)	(2.202)	(1.705)	(0.292)	(1.400)	(0.542)	(1.224)	(0.964)	(1.145)	(1.148)	(0.678)	(0.784)	(0.625)
ict_games_escs_r	5.795*	4.401	2.261	2.401	2.333	2.541	0.465	1.520	2.194	5.028	5.070	5.088	7.556	0.472	-0.130	-1.346	1.455	1.528	1.219	0.842	4.359	4.068	-3.519
	(2.843)	(3.020)	(3.652)	(3.659)	(3.313)	(2.181)	(3.859)	(3.003)	(3.747)	(4.012)	(3.121)	(4.896)	(4.494)	(1.661)	(3.509)	(3.636)	(4.201)	(3.720)	(2.793)	(4.112)	(3.101)	(3.927)	(2.694)
ict_colcomm_escs_r	0.523	-6.571	-0.549	-11.32	-2.726	-2.684	0.238	-8.672	2.293	5.046	-5.563	-11.67	15.33	-0.575	-13.60	-13.45	-13.25	-10.51	-8.403	-20.84*	-3.056	1.968	5.614
	(6.967)	(8.602)	(9.463)	(8.085)	(9.513)	(5.137)	(7.536)	(9.203)	(5.354)	(7.235)	(5.186)	(12.73)	(13.46)	(3.979)	(7.826)	(8.804)	(10.76)	(10.03)	(5.675)	(9.499)	(7.950)	(13.95)	(4.415)
ict_techinfo_escs_r	8.277	6.225	-15.01	9.579	-35.55**	0.0414	-18.86*	-2.083	-17.18	-20.85*	-15.48*	-27.82	-31.56*	-10.78*	-16.07	-9.296	-9.557	-6.653	-5.557	-11.49	1.506	-15.07	-1.221
	(7.223)	(11.74)	(10.63)	(11.28)	(10.51)	(6.732)	(9.049)	(12.47)	(9.501)	(9.500)	(6.207)	(15.81)	(14.40)	(4.533)	(10.63)	(10.13)	(11.16)	(11.08)	(6.414)	(10.23)	(10.16)	(17.47)	(5.748)
ict_contprob_escs_r	-10.89	-10.06	3.598	5.585	8.187	-5.836	2.114	-18.22	-0.280	-0.963	-0.829	8.363	-7.976	-2.469	3.224	3.542	-1.933	9.619	4.392	4.672	-3.522	-8.354	-1.965
	(5.747)	(5.280)	(7.453)	(5.741)	(7.379)	(5.519)	(7.256)	(11.39)	(5.768)	(6.038)	(4.064)	(11.95)	(8.201)	(3.132)	(6.394)	(8.575)	(8.663)	(7.885)	(4.131)	(6.646)	(5.426)	(11.93)	(3.943)
tot_nonmiss_escs	1.110	0.775	5.675**	1.688	2.360	-0.426	-0.316	-7.482**	0.371	0.0382	1.692	2.710*	1.734	0.410	0.967	2.133*	1.776	1.911***	0.889	-0.361	-2.724**	0.535	1.023**
	(1.367)	(0.725)	(1.750)	(1.752)	(1.835)	(0.305)	(0.876)	(2.462)	(0.438)	(0.529)	(2.672)	(1.156)	(1.177)	(0.214)	(1.531)	(0.980)	(1.036)	(0.545)	(0.855)	(1.335)	(0.805)	(1.050)	(0.316)
ESCS	-24.72	-4.196	-111.8**	-35.67	-21.86	12.45	25.51	183.9**	5.986	5.051	-31.15	-40.52	-21.92	-4.848	0.250	-28.12	-11.83	-23.60*	-5.790	25.22	55.95**	11.21	-19.84**
	(30.08)	(15.46)	(38.59)	(38.55)	(40.73)	(6.375)	(18.55)	(54.63)	(9.469)	(11.28)	(58.83)	(25.20)	(25.92)	(4.652)	(33.65)	(21.37)	(21.97)	(11.72)	(18.62)	(29.51)	(17.46)	(22.94)	(6.605)
SMPV1	0.672***	0.739***	0.849***	0.769***	0.707***	0.646***	0.801***	0.799***	0.807***	0.871***	0.866***	0.692***	0.829***	0.877***	0.787***	0.723***	0.724***	0.647***	0.405***	0.801***	0.892***	0.694***	0.856***
	(0.0142)	(0.0195)	(0.00989)	(0.0126)	(0.0249)	(0.0252)	(0.0201)	(0.0276)	(0.0200)	(0.0124)	(0.0141)	(0.0454)	(0.0470)	(0.00742)	(0.0193)	(0.0291)	(0.0302)	(0.0274)	(0.0336)	(0.0169)	(0.0128)	(0.0259)	(0.0132)
female	-17.30***	-2.247	-10.26***	-16.70***	-11.62***	-16.17***	-6.272*	4.656	-2.316	-9.681***	-14.79***	-6.418*	-5.825*	-14.65***	5.975*	-4.112	-3.455	-7.167**	-10.89***	-11.37***	-11.56***	-4.366	-5.127***
	(1.578)	(2.528)	(2.711)	(2.072)	(2.492)	(1.756)	(3.070)	(2.675)	(2.288)	(2.139)	(1.720)	(2.509)	(2.841)	(1.015)	(2.378)	(2.556)	(3.187)	(2.472)	(2.252)	(2.606)	(2.552)	(2.882)	(1.496)
grade7	-61.37**	-18.25	-105.5***	-100.8***	-26.91	-63.95**	-123.0***		-12.87		-4.385			-22.38	-90.70***	-77.12***		-83.29***	-72.94***	-75.93***		-130.7***	-10.33
	(23.22)	(12.99)	(12.67)	(15.58)	(26.56)	(18.77)	(10.46)		(31.74)		(7.139)			(18.38)	(17.93)	(10.48)		(13.10)	(6.263)	(14.80)		(16.26)	(22.08)
grade8	-37.40***	-19.51*	-58.05***	-60.71***	-39.72***	-97.08***	-56.78***	65.33***	16.09	69.78***	-1.679	-54.76***		24.54**	-37.34***	-73.68***		-71.84***	-48.65***	-38.90***	-56.86***	-69.00***	-8.647
	(5.031)	(8.533)	(6.387)	(3.590)	(8.906)	(2.634)	(6.615)	(15.49)	(18.61)	(6.738)	(4.604)	(14.02)		(8.723)	(5.226)	(6.341)		(8.022)	(4.738)	(8.013)	(7.647)	(9.826)	(5.315)
grade9	-24.06***	-19.24**	0.188	-30.23***	-7.823	-52.31***	-27.28***	102.6***	32.75***	-25.38***	-16.43***	0.0201	-127.1***	-25.12***	-19.92***	-33.32***	-45.44*	-2.933	-11.29***	6.725**	-1.053	-5.991	-19.63***
	(3.086)	(6.630)	(1.320)	(1.997)	(8.253)	(1.851)	(6.686)	(13.97)	(8.223)	(1.850)	(1.445)	(8.551)	(13.38)	(2.014)	(3.776)	(5.465)	(20.28)	(5.346)	(3.208)	(2.499)	(3.576)	(5.836)	(2.248)
grade_above10	42.41***			55.19***		80.73***	162.1***				2.270	-4.581	11.48	12.93***	60.74***	43.56	15.77		67.62***	9.932*	21.27***		17.42***
	(6.161)			(11.77)		(14.97)	(8.763)				(25.97)	(4.532)	(9.765)	(3.256)	(6.557)	(28.88)	(7.939)		(10.71)	(3.888)	(3.935)		(4.950)
graderep	-27.76***	-17.62***			-13.29***			-126.8***	-26.00**	-22.40***	-12.61**	-27.76**		-13.35***		-3.912			-22.68***	-10.68***		-9.751***	
	(3.352)	(3.856)			(3.258)			(15.25)	(7.792)	(5.221)	(3.943)	(8.711)		(2.565)		(2.137)			(3.099)	(2.922)		(2.684)	
native	12.34***	51.68*	12.44	20.64***	25.96***	11.51***	17.41***	32.30**	-7.941*	11.14***	0.859	4.168	26.41*	21.94***	11.13	16.36**	23.74***	-200.5***	5.861	7.877	15.43***	19.49***	-34.06*
	(2.812)	(20.02)	(6.486)	(2.482)	(3.262)	(2.764)	(3.810)	(8.507)	(3.720)	(2.708)	(5.287)	(6.524)	(11.52)	(2.613)	(7.039)	(4.927)	(4.737)	(6.067)	(3.439)	(9.512)	(3.932)	(3.661)	(14.23)
single_parent	0.929	-2.857	-0.873	1.648	3.060	3.249	3.856	-5.783	-4.980	0.624	-1.811	1.784	-5.720	2.659	-2.347	2.521	3.008	-15.57***	6.829**	2.414	3.123	-1.361	-1.400
	(2.056)	(2.991)	(2.334)	(2.380)	(2.953)	(1.843)	(2.516)	(3.460)	(3.859)	(2.599)	(2.025)	(4.018)	(3.578)	(1.606)	(2.395)	(2.538)	(3.024)	(2.665)	(2.243)	(2.963)	(2.493)	(4.081)	(2.750)
mixed_family	-22.76*	-20.90***	-8.153	2.422	-38.00*	2.915	-23.45***	-23.40	-34.87***	-29.24*	-9.966	-20.72	-51.90**	-9.944	-0.124	-13.57**	-38.61***	-47.99***	-8.054	-11.16	-14.77*	-32.97***	-20.18***
	(10.21)	(5.675)	(14.24)	(13.17)	(15.55)	(8.385)	(4.364)	(11.22)	(5.976)	(11.45)	(7.374)	(11.15)	(16.02)	(5.798)	(7.959)	(4.767)	(11.17)	(7.797)	(5.323)	(8.108)	(7.391)	(8.088)	(3.669)
books_11_25	10.94***	5.425	15.26***	8.048*	11.89**	16.56***	19.08**	20.03**	7.249	7.634**	5.832	18.99***	6.030	13.78***	4.124	4.278	24.65***	10.01**	2.509	16.77***	11.71**	21.50***	4.129
	(2.724)	(5.475)	(4.374)	(3.814)	(3.604)	(3.877)	(5.976)	(6.315)	(4.715)	(2.685)	(4.088)	(4.493)	(8.862)	(1.728)	(2.833)	(4.406)	(5.061)	(3.529)	(2.755)	(4.287)	(3.754)	(5.971)	(2.554)
books_26_100	24.65***	23.53***	30.51***	17.11***	30.98***	30.03***	21.94***	36.87***	18.72***	20.25***	17.66***	43.25***	36.36***	19.74***	14.49***	17.66***	42.22***	31.29***	15.09***	34.50***	28.49***	31.53***	12.36***
	(2.433)	(5.010)	(3.507)	(2.977)	(3.690)	(3.609)	(5.121)	(5.189)	(3.935)	(2.413)	(3.980)	(4.420)	(8.775)	(1.785)	(2.744)	(4.113)	(4.469)	(3.126)	(2.696)	(3.836)	(3.581)	(5.601)	(2.763)
books_101_200	34.24***	37.34***	37.82***	23.62***	45.89***	42.76***	39.13***	57.24***	25.55***	27.61***	22.18***	62.99***	47.58***	25.87***	25.70***	28.60***	64.28***	44.24***	16.79***	46.66***	39.43***	41.79***	24.22***
	(3.123)	(6.965)	(3.802)	(3.579)	(4.737)	(3.928)	(5.153)	(5.395)	(4.460)	(3.773)	(4.123)	(4.764)	(8.283)	(1.846)	(3.316)	(4.459)	(4.863)	(4.159)	(3.320)	(4.360)	(4.326)	(6.032)	(3.393)
books_201_500	41.39***	34.59***	56.39***	36.67***	46.78***	52.94***	42.70***	68.78***	33.23***	33.15***	28.75***	71.10***	72.73***	36.55***	27.64***	40.59***	79.09***	63.35***	28.77***	56.50***	49.27***	68.33***	15.40**
	(3.393)	(5.533)	(4.735)	(3.727)	(4.919)	(4.294)	(5.866)	(5.925)	(4.840)	(4.569)	(4.606)	(5.230)	(8.721)	(1.827)	(4.266)	(4.668)	(4.762)	(4.639)	(3.785)	(5.211)	(5.374)	(5.876)	(4.626)
books_more500	46.19***	19.08**	46.77***	45.13***	52.59***	57.23***	51.91***	71.49***	38.82***	39.75***	42.53***	76.87***	73.46***	35.39***	44.55***	34.84***	79.05***	63.88***	23.86***	68.42***	30.36***	63.03***	19.44***
	(3.848)	(6.825)	(5.073)	(4.230)	(6.609)	(4.496)	(6.160)	(5.843)	(5.838)	(4.862)	(4.726)	(7.628)	(8.950)	(2.580)	(4.427)	(5.852)	(5.390)	(6.504)	(4.953)	(7.054)	(6.029)	(6.490)	(4.806)
Constant	88.07***	28.45	-176.0***	58.73	14.03	89.38***	-15.14	-283.2**	48.67**	8.326	-3.725	24.03	-55.15	-10.82	31.36	117.4***	-2.660	288.9***	262.8***	-40.10	-22.75	59.56**	63.24**
	(25.26)	(30.50)	(39.29)	(38.58)	(48.77)	(16.04)	(20.30)	(83.73)	(15.88)	(15.39)	(87.57)	(55.47)	(48.81)	(8.867)	(31.32)	(19.98)	(37.70)	(27.18)	(31.25)	(29.76)	(16.95)	(22.44)	(19.99)
Observations	7,642	3,771	5,628	3,984	5,181	24,431	4,539	5,435	4,673	4,729	4,423	3,519	3,455	29,415	4,270	4,313	4,424	4,673	5,661	4,328	5,517	4,223	4,101
R-squared	0.585	0.548	0.529	0.653	0.359	0.467	0.367	0.271	0.442	0.458	0.676	0.356	0.277	0.561	0.427	0.410	0.341	0.356	0.450	0.517	0.602	0.335	0.580

Standard errors in parentheses

*** p<0.001, ** p<0.01, * p<0.05

Table C6.

Science: results from Model 2 by country

Variable	BEL	BGR	CZE	DEU	DNK	ESP	EST	FIN	GRC	HRV	HUN	IRL	ISL	ITA	LTU	LVA	NOR	POL	PRT	SVK	SVN	SWE	TUR
ESCS	2.818**	11.83***	7.423***	1.728	16.11***	1.483	9.394***	14.79***	9.413***	1.943	0.128	10.03***	12.12***	0.353	11.02***	9.220***	15.96***	14.30***	9.481***	6.443***	-3.362*	18.47***	2.051*
	(1.042)	(2.102)	(2.019)	(1.149)	(1.626)	(0.980)	(1.573)	(1.756)	(1.154)	(1.456)	(1.182)	(2.213)	(1.574)	(0.662)	(1.395)	(1.708)	(1.786)	(1.727)	(0.887)	(1.479)	(1.344)	(1.998)	(1.029)
SMPV1	0.685***	0.751***	0.865***	0.787***	0.714***	0.667***	0.812***	0.816***	0.822***	0.887***	0.872***	0.737***	0.837***	0.889***	0.796***	0.731***	0.737***	0.658***	0.405***	0.808***	0.902***	0.703***	0.867***
	(0.0147)	(0.0215)	(0.00977)	(0.0126)	(0.0230)	(0.0256)	(0.0207)	(0.0181)	(0.0179)	(0.0121)	(0.0126)	(0.0450)	(0.0477)	(0.00660)	(0.0187)	(0.0287)	(0.0286)	(0.0294)	(0.0333)	(0.0168)	(0.0129)	(0.0292)	(0.0124)
female	-16.21***	-0.776	-9.028**	-14.91***	-10.84***	-14.95***	-4.213	7.195*	-0.515	-6.733***	-14.08***	-4.098	-3.403	-13.39***	7.498**	-2.798	-0.897	-4.682	-10.84***	-10.44***	-10.76***	-0.773	-5.222***
	(1.675)	(2.569)	(2.749)	(2.040)	(2.490)	(1.798)	(3.020)	(2.980)	(2.423)	(1.968)	(1.743)	(2.646)	(2.984)	(1.016)	(2.426)	(2.564)	(3.145)	(2.518)	(2.237)	(2.542)	(2.508)	(3.040)	(1.493)
grade7	-77.13***	-16.89	-103.8***	-100.8***	-39.70	-92.44***	-124.4***	-136.5***	-5.901		-3.799	-91.55***		-13.49	-92.02***	-80.68***		-82.48***	-73.92***	-79.18***		-125.5***	-18.78
	(14.64)	(12.12)	(14.84)	(15.09)	(28.50)	(22.73)	(10.23)	(16.88)	(30.86)		(7.234)	(8.995)		(16.32)	(18.47)	(10.75)		(13.17)	(6.298)	(13.30)		(11.86)	(22.03)
grade8	-38.19***	-15.87*	-58.81***	-61.06***	-40.84***	-97.86***	-59.35***	-64.47***	18.19	78.15***	-1.330	-58.97***		20.32***	-38.36***	-75.90***		-74.35***	-49.52***	-38.14***	-54.01***	-70.88***	-7.989
	(5.325)	(7.662)	(6.359)	(3.553)	(8.710)	(2.484)	(6.627)	(10.77)	(17.92)	(7.008)	(4.487)	(13.25)		(5.576)	(5.365)	(6.533)		(8.170)	(4.735)	(7.835)	(7.466)	(9.244)	(6.407)
grade9	-23.82***	-18.55**	0.836	-30.52***	-6.798	-52.15***	-27.80***	-24.44*	33.42***	-25.16***	-16.82***	0.610	-129.2***	-24.79***	-20.65***	-33.81***	-42.96*	-2.667	-12.11***	6.703*	0.605	-6.643	-20.55***
	(3.126)	(6.047)	(1.149)	(1.981)	(8.008)	(1.863)	(6.653)	(10.37)	(8.214)	(1.926)	(1.444)	(8.172)	(12.64)	(1.927)	(3.757)	(5.515)	(20.58)	(5.504)	(3.145)	(2.570)	(3.621)	(5.021)	(2.262)
grade_above10	43.07***			54.98***		81.45***	170.9***				4.113	-2.107	8.440	12.98***	58.89***	44.20	15.33		67.33***	10.03*	22.35***		17.96***
	(6.189)			(11.89)		(14.46)	(8.459)				(25.87)	(4.520)	(9.571)	(3.274)	(6.486)	(28.99)	(7.946)		(10.66)	(3.832)	(3.888)		(4.891)
graderep	-29.17***	-19.17***			-13.13***				-27.16***	-23.08***	-12.84**	-27.11**		-14.60***		-4.009			-21.96***	-10.54***		-9.261***	
	(3.470)	(4.177)			(3.169)				(7.824)	(5.358)	(4.058)	(8.207)		(2.501)		(2.165)			(3.028)	(2.948)		(2.566)	
native	13.22***	49.14*	12.06	20.55***	27.41***	11.70***	20.58***	35.56***	-7.441*	12.07***	-0.0318	10.05	28.13*	23.66***	10.73	16.08**	27.68***	-204.0***	5.848	7.126	15.48***	20.63***	-34.27*
	(2.874)	(19.64)	(6.520)	(2.416)	(3.132)	(2.702)	(3.780)	(6.492)	(3.642)	(2.682)	(5.266)	(6.562)	(11.10)	(2.406)	(7.024)	(4.881)	(5.177)	(6.239)	(3.478)	(9.428)	(3.875)	(3.373)	(14.03)
single_parent	1.590	-3.618	-1.524	2.905	1.900	2.481	3.054	-6.255	-5.159	-0.172	-1.356	2.104	-6.186	2.132	-2.322	2.842	1.737	-17.08***	6.907**	2.009	3.288	-2.200	-1.927
	(2.018)	(2.946)	(2.358)	(2.323)	(2.902)	(1.754)	(2.534)	(3.291)	(3.711)	(2.872)	(2.068)	(3.994)	(3.580)	(1.738)	(2.334)	(2.505)	(3.076)	(2.846)	(2.256)	(2.926)	(2.451)	(4.139)	(2.651)
mixed_family	-22.36*	-20.23***	-8.382	1.887	-37.23*	0.0173	-23.79***	-28.12*	-36.08***	-30.29*	-10.30	-23.13*	-46.77**	-11.29*	0.988	-17.05**	-38.00***	-53.12***	-8.444	-14.09	-14.18	-34.45***	-21.16***
	(10.03)	(5.516)	(13.89)	(13.53)	(15.04)	(8.247)	(4.348)	(10.40)	(5.711)	(11.48)	(7.359)	(11.37)	(15.87)	(5.567)	(7.957)	(5.714)	(10.50)	(8.587)	(5.291)	(7.710)	(7.240)	(8.004)	(3.898)
books_11_25	11.17***	5.228	13.97**	6.788	11.56**	18.53***	20.24**	17.29*	6.664	8.512**	6.383	19.96***	6.750	13.57***	4.901	4.784	22.41***	9.242*	2.195	16.26***	11.98**	21.32***	4.169
	(2.686)	(5.300)	(4.429)	(3.608)	(3.487)	(4.061)	(5.941)	(6.649)	(4.755)	(2.701)	(4.085)	(4.431)	(8.934)	(1.862)	(2.794)	(4.350)	(5.212)	(3.584)	(2.716)	(4.423)	(3.689)	(6.072)	(2.592)
books_26_100	25.16***	21.73***	30.19***	17.12***	30.62***	32.03***	22.68***	35.34***	18.01***	21.63***	17.38***	44.38***	37.48***	19.62***	15.17***	18.02***	40.52***	30.94***	14.66***	34.13***	28.91***	30.15***	12.10***
	(2.404)	(4.669)	(3.551)	(2.985)	(3.667)	(3.614)	(5.060)	(5.703)	(3.893)	(2.504)	(4.168)	(4.297)	(8.723)	(1.810)	(2.688)	(4.047)	(4.477)	(3.059)	(2.630)	(3.845)	(3.563)	(5.445)	(2.658)
books_101_200	34.82***	37.36***	37.48***	22.99***	45.57***	44.66***	40.04***	56.87***	25.08***	28.63***	22.06***	62.70***	48.69***	25.27***	25.96***	27.79***	63.75***	43.91***	16.43***	46.01***	39.76***	40.86***	22.87***
	(3.150)	(6.626)	(3.742)	(3.532)	(4.675)	(3.875)	(5.063)	(5.940)	(4.469)	(3.900)	(4.228)	(4.522)	(8.263)	(1.887)	(3.302)	(4.526)	(4.740)	(4.176)	(3.290)	(4.298)	(4.319)	(5.875)	(3.339)
books_201_500	42.15***	33.72***	56.16***	36.00***	46.58***	55.38***	44.83***	67.28***	33.21***	33.14***	28.64***	72.14***	73.06***	35.77***	28.06***	40.94***	78.53***	63.38***	28.58***	55.25***	49.48***	69.14***	14.42**
	(3.310)	(5.327)	(4.636)	(3.768)	(4.803)	(4.197)	(5.839)	(5.938)	(4.649)	(4.925)	(4.744)	(5.063)	(8.898)	(1.880)	(4.160)	(4.593)	(4.709)	(4.704)	(3.748)	(5.108)	(5.275)	(5.725)	(4.450)
books_more500	46.08***	18.64**	43.70***	43.53***	51.76***	58.04***	53.16***	70.39***	38.23***	39.13***	41.94***	75.22***	72.63***	34.58***	44.99***	35.57***	78.68***	62.27***	23.38***	66.39***	30.99***	60.58***	19.38***
	(3.755)	(6.689)	(5.499)	(4.260)	(6.234)	(4.303)	(6.222)	(7.200)	(5.781)	(5.183)	(4.888)	(7.431)	(8.874)	(2.595)	(4.316)	(5.858)	(5.442)	(6.443)	(4.902)	(7.174)	(6.005)	(6.357)	(4.940)
stz_ict_games	4.094**	6.930***	4.604***	2.422***	9.198***	6.628***	12.02**	6.007**	7.946***	4.385*	3.258**	3.480	-2.213	5.097***	5.699**	10.27***	2.196	1.451*	2.868*	6.818***	6.656	1.640	-0.576
	(1.236)	(1.557)	(1.199)	(0.449)	(2.114)	(1.026)	(4.416)	(2.173)	(1.666)	(1.840)	(0.974)	(1.891)	(9.337)	(0.778)	(1.956)	(2.676)	(2.626)	(0.598)	(1.406)	(1.690)	(3.618)	(1.970)	(0.563)
stz_ict_colcomm	-1.970	-4.335	-0.917	-0.269	-7.621**	-0.490	-23.04***	-7.684**	-5.694**	-1.379	-4.369***	-6.169*	-33.30**	0.0229	-6.496**	-7.568*	-16.15***	-4.845***	2.354	1.269	-13.59***	-11.08***	0.969
	(1.320)	(3.371)	(1.693)	(0.509)	(2.391)	(1.347)	(4.744)	(2.387)	(1.925)	(2.488)	(1.277)	(2.442)	(11.72)	(0.940)	(2.374)	(2.907)	(2.948)	(0.832)	(2.018)	(2.030)	(3.577)	(2.010)	(0.673)
stz_ict_techinfo	-2.458	6.315	-5.092**	-1.556**	0.461	-7.055***	-9.661*	-9.734*	-6.466**	-2.447	-4.305***	-1.553	-2.834	-8.029***	-9.337**	-17.48***	17.53***	-1.592	-9.344***	-9.572***	2.922	3.237	-1.850*
	(1.718)	(3.429)	(1.706)	(0.577)	(2.401)	(1.379)	(3.792)	(3.835)	(2.178)	(2.771)	(1.240)	(3.108)	(11.83)	(1.062)	(3.170)	(3.274)	(2.581)	(0.871)	(1.893)	(1.876)	(4.331)	(2.063)	(0.721)
stz_ict_contprob	-8.410***	-15.26***	-6.334***	-2.091***	-11.16***	-4.915***	-19.77***	-4.841	-8.091***	-8.287***	-6.560***	-10.29***	-9.881	-1.130	-12.22***	-20.17***	-18.32***	-3.474***	-12.16***	-3.975**	-21.10***	-5.243**	-0.996
	(1.294)	(2.154)	(1.432)	(0.411)	(2.528)	(1.235)	(5.025)	(2.628)	(1.657)	(1.827)	(0.966)	(2.036)	(8.110)	(0.680)	(2.162)	(2.410)	(2.291)	(0.753)	(1.528)	(1.465)	(3.623)	(1.638)	(0.502)
stz_ict_games_escs	2.223	2.345	0.944	0.277	1.183	0.957	-0.886	0.507	0.752	1.500	1.863	1.932	13.57	-0.445	0.0584	-0.838	1.198	0.0854	0.465	-0.293	4.361	1.474	-0.360
	(1.221)	(1.534)	(1.439)	(0.509)	(1.862)	(0.854)	(3.914)	(1.854)	(1.409)	(2.206)	(1.051)	(2.051)	(7.102)	(0.755)	(2.011)	(2.704)	(2.129)	(0.663)	(1.128)	(1.820)	(3.092)	(1.527)	(0.361)
stz_ict_colcomm_escs	0.149	-2.687	-0.00238	-0.869	-0.256	-0.331	0.778	-2.980	0.675	2.056	-0.880	-3.192	12.23	0.346	-4.444	-2.311	-3.238	-0.545	-2.140	-5.699*	-2.568	-0.0123	0.560
	(1.657)	(3.233)	(2.033)	(0.587)	(2.740)	(1.273)	(3.684)	(2.645)	(1.610)	(2.616)	(1.047)	(3.459)	(10.43)	(1.007)	(2.469)	(3.346)	(2.536)	(0.866)	(1.475)	(2.466)	(4.487)	(2.438)	(0.426)
stz_ict_techinfo_escs	1.418	3.477	-2.317	0.879	-9.377***	0.242	-5.954	-1.955	-4.480	-6.534*	-2.613*	-4.916	-18.69	-3.872***	-5.257	-3.359	-2.225	-0.945	-1.158	-2.986	0.670	-3.979	0.0759
	(1.733)	(3.767)	(2.328)	(0.779)	(2.666)	(1.501)	(4.476)	(2.471)	(2.424)	(3.027)	(1.112)	(3.395)	(10.23)	(1.126)	(3.078)	(3.846)	(2.998)	(1.015)	(1.582)	(2.426)	(5.141)	(2.527)	(0.476)
stz_ict_contprob_escs	-2.643*	-4.719*	0.145	0.289	1.410	-2.084	-0.161	-4.334	-0.413	-1.316	-0.347	1.001	-8.820	-0.466	1.301	0.145	-1.435	0.762	1.033	0.996	-1.853	-1.036	-0.386
	(1.296)	(2.103)	(1.822)	(0.402)	(2.423)	(1.394)	(4.005)	(2.832)	(1.645)	(2.103)	(0.841)	(2.767)	(6.384)	(0.837)	(2.195)	(3.386)	(2.641)	(0.748)	(1.202)	(1.567)	(3.455)	(2.111)	(0.342)
Constant	153.4***	71.36**	32.65**	107.9***	106.1***	148.2***	86.77***	45.67**	77.11***	55.32***	64.65***	104.1***	3.283	24.59***	94.82***	143.2***	48.14**	365.3***	307.4***	64.06***	15.45*	97.80***	100.3***
	(9.381)	(22.43)	(9.695)	(6.938)	(15.39)	(14.33)	(12.61)	(14.57)	(8.911)	(6.849)	(9.907)	(24.57)	(27.95)	(4.619)	(10.91)	(14.71)	(16.53)	(18.28)	(17.40)	(13.82)	(7.207)	(15.96)	(16.36)
Observations	7,772	3,973	5,716	4,109	5,341	24,911	4,591	5,592	4,738	4,801	4,473	3,639	3,501	29,917	4,304	4,374	4,504	4,723	5,688	4,387	5,649	4,331	4,284
R-squared	0.590	0.547	0.524	0.652	0.351	0.463	0.356	0.268	0.438	0.452	0.669	0.356	0.267	0.563	0.428	0.407	0.333	0.354	0.450	0.517	0.600	0.331	0.582

Standard errors in parentheses

*** p<0.001, ** p<0.01, * p<0.05

Appendix D – Correlation between *totactivities* and *ESCS*

Country	Correlation
BE	0.1837*
BG	0.1336*
CZ	0.0877*
DE	0.1464*
DK	0.0440*
ES	0.0571*
EE	0.0320*
FI	0.0420*
EL	0.0692*
HR	0.1107*
HU	0.0418*
IE	0.0909*
IS	0.0114
IT	0.0818*
LT	0.0833*
LV	0.1004*
NO	0.0511*
PL	0.0980*
PT	0.0442*
SK	0.1562*
SI	0.1391*
SE	0.0702*
TK	0.1471*

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Abstract
Based on PISA 2009 data, this paper studies the relationship between students' computer use and their achievement in reading, mathematics and science in 23 countries. After having categorized computer use into a set of different activities according to the skills they involve, we correlate PISA test-scores with an index capturing the intensity a student uses computers for each of these activities and with the total number of activities s/he performs. Overall, we find that students' PISA test scores in reading, mathematics and science increase with the intensity of computer use for Gaming activities while they decrease with the intensity of computer use for activities that are more related with school curricula (i.e. Communication and Collaboration activities; Technical Operations/Info Retrieval activities; Creation of Content and Knowledge Problem Solving activities). However the number of activities (and hence the diversification of activities), irrespective of the intensity of computer use, is positively correlated with students' proficiency in all the three PISA domains in the vast majority of countries, indicating that computers breadth of use, as opposed to intensity of use in a given activity, has some positive effect on students' performance.

Highlights
► Gaming activities, when significant, are positively correlated with PISA-test scores. ► The use of ICT for Communication and Collaboration activities and for Technical Operations/Info Retrieval activities are negatively correlated with students' PISA test-score in most of the countries. ► The use of ICT for Creation of Content and Knowledge Problem Solving activities, when significant, hinders students' proficiency in the large majority of the countries. ►The number of activities (and hence the diversification of activities), is positively correlated with students' PISA score in the vast majority of countries.

Keywords
Academic performance; Comparative study; Secondary education

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