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Exploring the Effect of Different Modes of ICT Use on School Performance Including Social Background

ABSTRACT

Nowadays the use of ICT, the Internet is indispensible in everyday life. We are supposed to go online for administration, working, entertainment and for learning as well. The different modes of use, whether for entertainment, recreation, or for learning or work, influence our position in the matrix of digital inequalities. Digital inequalities at the same time have an effect on educational inequalities. Therefore our paper focuses on the effect of ICT use for different purposes on school performance to reveal the correlation between digital inequalities and educational inequalities. Both types of inequalities are strongly influenced by social background. We intend to explain the relationship between these factors by showing the effect of ICT use on school performance when taking into consideration the socio-economic and cultural status. First we introduce the main theories and results from previous researches on the tie between on the one hand social background and academic achievement, on the other hand between social background and ICT use. Then we present the main outcomes of our analysis conducted on the Hungarian subsample of the latest PISA data from 2015. Finally conclusions are summarized and further research possibilities are suggested.

KEYWORDS

digital inequalities, ICT use, school performance, social background, PISA

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1. Social background and school performance

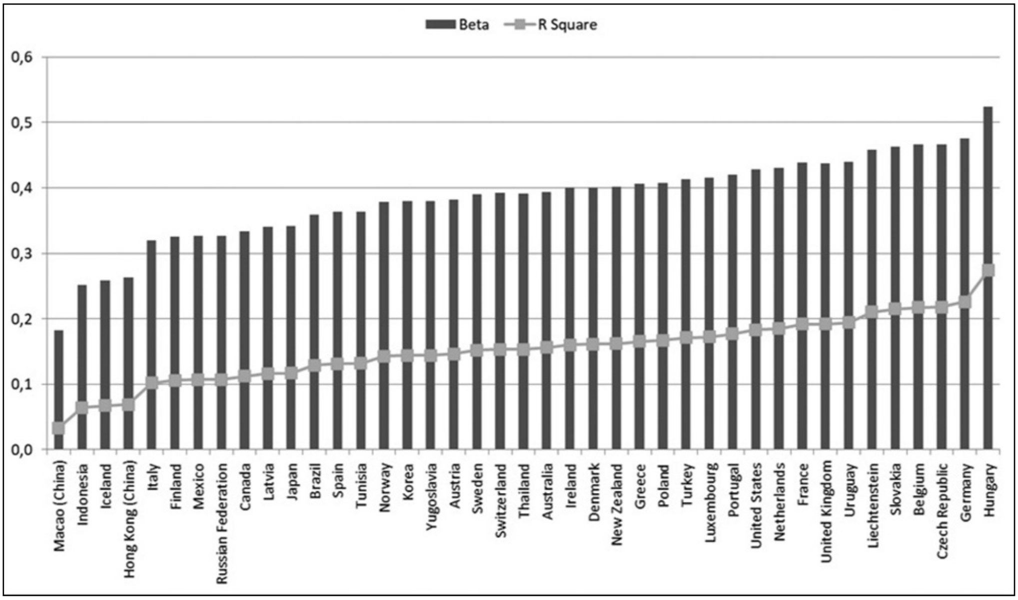
One of the initial functions of education was to diminish inequalities among students coming from different social backgrounds by offering everyone the same knowledge. However social theorists pointed out that school doesn't fulfil this expectation as inequalities are even strengthened by grading the performance of the students. Pierre Bourdieu (1974) called attention to this contradictory function of school. Due to his theory the inequalities are strengthened because school performance is not the outcome of diligence but of the cultural capital of the student's family. This means that the grade gained at school reflects for instance more the educational attainment of the parents then the hours spent on learning. Similarly Bernstein (1975) explained how school reinforces social inequalities on the level of sociolinguistics. He made a distinction between two codes of speaking, the restricted and the elaborated codes which correlate with social class position. The restricted code is characteristic for the working class and the elaborated code for the middle class. As education is dominated by the elaborated code, those who are not familiar with it bear disadvantages at school.

In his report about the American education system Coleman (1966) also highlightened the correlation between family background and school performance. In the 60's the American education system was suffering from ethnical segregation, leading to the enhancing of inequalities between the ethnic groups. This finding encouraged many reforms of the American education system.

In Hungary the correlation between social background and school performance was also found to be very strong. In the 1970's Ferge (1980) drew attention to the fact that contrary to the ideological concept school doesn't diminish the differences among students from different social background but sustains them and even intensifies them (Ferge 1980). There has been not much change in this correlation recently, as international researches report Hungary to be one of those nations where the effect of social status mostly determines school performance (Vári 2003). In Hungary the biggest proportion of students from a disadvantaged background, where parents have a low socio-economic status and low educational level, belong to the group of students with lowest competencies (Róbert 2004).

Analysing PISA data on long time series we found, that the effect of socio-economic and cultural status (measured by the ESCS index) on performance in mathematic is the biggest or one of the biggest in Hungary among all participating countries. In 2003 the relationship between the ESCS index and mathematics achievement was the strongest of all participating countries (Beta = 0,52), furthermore this index explained the biggest part (27%) of maths performance in Hungary (Graph 1).

In the following years of the survey similar correlations are found. In 2006 Hungary was again the last in the ranking based on the effect of ESCS index on maths performance, in 2009 next to last (Peru), in 2012 fourth from last and in 2015 fifth from last. Thus international comparison shows that in Hungary school performance is strongly influenced by the social, economic and cultural background of the student.



Graph 1 *The effect of ESCS index on PISA mathematics scores in 2003*

2. Social background and ICT use

When ICT began to spread, two concepts arose about its effect on social inequalities. One approach said that ICT will weaken inequalities by offering everyone independent from his social status the same chances, knowledge and information. Due to the other concept, which was more sceptic, inequalities won't be weakened but strengthened and a new form of inequalities will appear as access and the modes of use are determined by the socio-economic background (Pintér 2007, DiMaggio et al. 2001). This latter theory has been confirmed by empirical work, since ICT spread unequally and generated new forms of inequalities: first the digital divide, then digital inequalities.

In the beginning – at a lower level of penetration – researches focused on the digital divide, the differences between users and non-users. Within the society the borderline between users and non-users was signified by the traditional socio-demographic characteristics like gender, age, ethnicity, educational attainment, income and profession (Norris 2001). Later when info-communication technology reached a higher level of penetration, scholars called attention to the change of focus: from the digital divide to digital inequalities. DiMaggio and Hargittai (2001) worked out a model of digital inequalities, which consists of five dimensions: the technical means, autonomy of use, skills, social support and the purposes of use. This latter dimension is considered to be the most important of all regarding digital inequalities. Inequalities in these five dimensions are strongly influenced by demographic and socio-economic factors (DiMaggio – Hargittai 2001).

3. Data and methods

Our investigation on the relationship between social background, ICT use and school performance is based on the Hungarian subsample of the latest student-level dataset of PISA recorded in 2015. This huge, extensive international survey aims to evaluate education systems by testing student skills and knowledge in three main fields: mathematics, reading and science with a focus on one every three years since 2000 when the first survey was conducted. In each participating country[1] a random sample of the population of 15-year old students is involved in the survey from randomly selected schools. The main survey is supplemented among others[2] by an ICT questionnaire which gathers information about ICT access and use inside and outside of school.

The Hungarian sample comprises 5658 students from 250 schools in 2015. Our analysis builds on linear regression models to reveal the effect of the different modes of ICT use on school performance. The dependent variables (Table 3) in our analysis are measures of student performance in mathematics, reading comprehension and science. As the students participating in the survey fill out different combinations of different tests, the achievement scores are estimated by five plausible values in each field.[3] On large samples using one plausible value or five plausible values does not make a substantial difference between mean estimates and standard error estimates (OECD 2009: 44.). Therefore in our analysis we use the first plausible value of mathematics, reading and science achievement.

The independent variables in the first set of regression models are measures of different modes of ICT use. The PISA ICT questionnaire included a set of items referring to the purpose of computer and Internet use outside of school. The students reported the frequency of use on each item.[4] In our analysis we applied principal components based on these items (Table 1). Three principal components have been separated. The first (FUN) refers to a frequent use of entertainment and communication activities on the internet except for playing games. The second one (PLAY) stands for a frequent use of playing games. Finally the third principal component shows the frequent use of ICT for gathering information on the internet by reading news or searching for practical information (INFO).

In 2015 the PISA ICT questionnaire included a set of items referring to the use of ICT outside of school for learning or for school related tasks. The students reported the frequency of use

[1] In 2015 the following 72 economies took part in the survey: Albania, Algeria, Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, China (People's Republic of), Colombia, Costa Rica, Croatia, Czech Republic, Denmark, Dominican Republic, Estonia, Finland, France, Georgia, Germany, Greece, Hong Kong-China, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Japan, Jordan, Kazakhstan, Korea, Kosovo, Latvia, Lebanon, Liechtenstein, Lithuania, Luxembourg, Macao-China, Former Yugoslav Republic of Macedonia, Malaysia, Malta, Mexico, Moldova, Republic of Montenegreo, Netherlands, New Zealand, Norway, Peru, Poland, Portugal, Qatar, Romania, Russian Federation, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Chinese Taipei, Thailand, Trinidad and Tobago, Tunisia, Turkey, United Arab Emirates, United Kingdom, United States, Uruguay, Vietnam

[2] The PISA assessment also includes a questionnaire for school principals who provide information about the schools' composition regarding students and teaching staff and also the teaching and learning environment of the school.

[3] The concept of using plausible values instead of other measuring methods is explained in detail in OECD (2009): PISA Data Analysis Manual: SPSS, Second edition.

[4] The answer categories were: 'Never or hardly ever'; 'Once or twice a month'; 'Once or twice a week'; 'Almost every day', 'Every day'.

on each item.[5] Therefore the fourth principal component (LEARN) stands for a frequent use of ICT for learning purposes or schoolwork (Table 2).

As outlined in the first section both performance and ICT use are influenced by socio-economic and cultural background of the student. Therefore in the second set of linear regression models the effect of ICT use on test scores has been accounted for social background. We applied the index of economic-social-cultural status (ESCS) as independent variable which comprises the highest educational attainment of both parents, the professional status of parents, the quantity of household goods, and the quantity of books in the household – to test the cultural status of the family.

Table 3 and Table 4 present descriptive statistics for the dependent variables and independent variables applied in the analysis.

Items	Principal components		
	1. FUN	2. PLAY	3. INFO
Social networks (e.g. <Facebook>, <MySpace>)	0,852		
<Chatting online> (e.g. <MSN®>)	0,766		
Browsing the Internet for fun videos, e.g. <YouTube>)	0,725		
Playing collaborative online games		0,902	
Playing one-player games		0,894	
Reading news on the Internet (e.g. current affairs)			0,885
Obtaining practical information from the Internet			0,876

Table 1 *Rotated Component Matrix*

Items	Principal components
	4. LEARN
Downloading science learning apps on a mobile device	0,84
Downloading learning apps on a mobile device	0,837
Doing homework on a computer	0,816
Doing homework on a mobile device	0,806
Using email for communication with teacher\submit of homework or other schoolwork	0,803
Using email for communication with other students about schoolwork	0,774
Browsing the Internet to follow up lessons, e.g. for finding explanations	0,771
Download\upload\browsing from school website (e.g. time table or course materials	0,758
Checking the schools website for announcements, e.g. absence of teachers	0,741
Browsing the Internet for schoolwork (e.g. for preparing an essay or presentation	0,696

Table 2 *Component Matrix*

[5] The answer categories were: 'Never or hardly ever'; 'Once or twice a month' 'Once or twice a week'; 'Almost every day', 'Every day'.

	N	Minimum	Maximum	Mean	Std. deviation
Mathematics score (PV1MATH)	5658	185,9	782,7	484,3	91,7
Reading comprehension score (PV1READ)	5658	163,5	754,6	476,6	95,6
Science score (PV1SCIE)	5658	156,8	763,8	484,8	93,4

Table 3 *Descriptive statistics for dependent variables*

	N	Minimum	Maximum	Mean	Std. deviation
ESCS	5570	–6,7872	3,0072	–0,17724	0,943751
1. FUN	4948	–3,4741	1,42179	0	1
2. PLAY	4948	–1,44212	2,38812	0	1
3. INFO	4948	–2,34611	2,28994	0	1
4. LEARN	4690	–1,34977	2,82802	0	1

Table 4 *Descriptive statistics for independent variables*

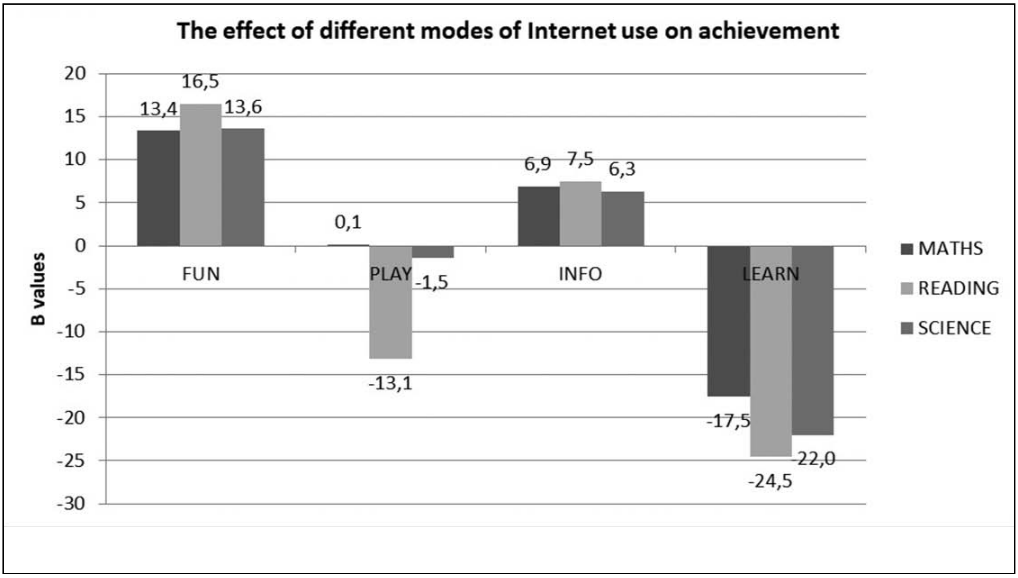
4. Results

4.1 ICT use and school performance

First the effect of the different modes of ICT use at home was tested on school performance (Graph 2). Two of the separated types of use have a positive impact on achievement, namely the use for fun and communication, and the use for browsing for information. Thus those students who frequently use the internet for social networking, chatting or watching fun videos reach on average 13 points more on the maths and science tests and 16 points more on the reading comprehension test compared to those who don't. Similarly the frequent browsing for practical information and reading news on the internet increases the test scores on average for 6 to 7,5 points in the three fields of competencies.

As for the negative impact of modes of internet use on school performance in the case of playing there is a significant difference between the tested competencies. It seems that playing on the internet alone or in collaboration does not influence mathematic competencies.[6] Scientific literacy is biased moderately. However students who frequently play on the internet alone or in collaboration get worse results in reading comprehension tests: test scores are lowered

[6] The linear regression model is not statistically significant ($p > 0,5$).



GRAPH 2

on average for about 13 points. The outcome of the relationship of internet use for learning and school related tasks and academic achievement might be surprising. The linear regression model shows that out of the modes of internet use in our investigation the frequent use for learning has the biggest impact on test results. However this effect is negative. Students who frequently do school related tasks on the internet or use the internet for learning reach 17,5 points less in mathematics, 22 points less in science and 24,5 points less in reading comprehension.

When interpreting the results of the first linear regression models we need to consider that beyond the found correspondences there might be other influencing factors. As outlined in the first section, socio-economic and cultural statuses play a crucial role in both school performance and ICT use. Therefore the next section investigates the effect of social background on the relationship between different modes of internet use and the three fields of literacy.

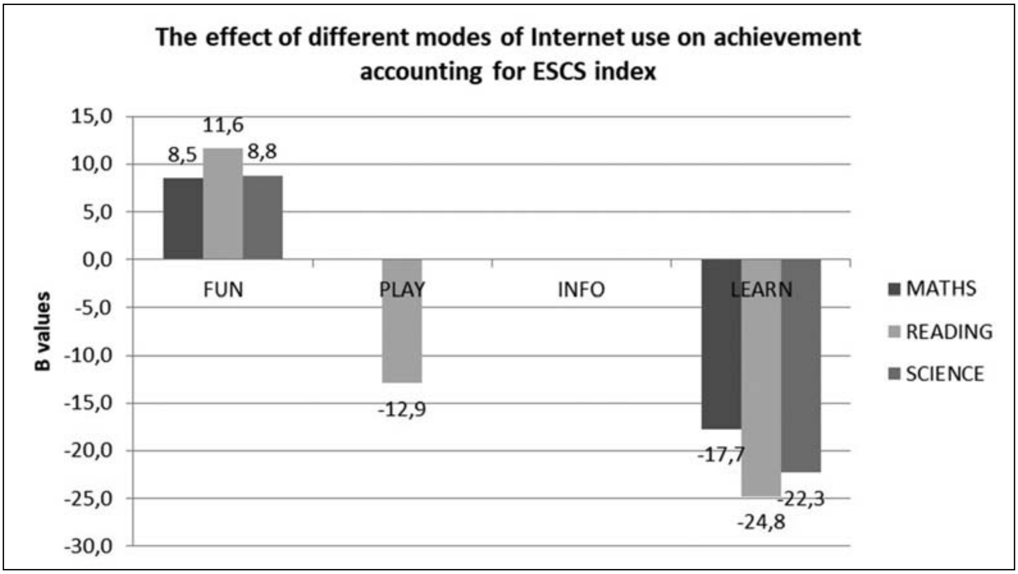
4.2. Social background, ICT use and school performance

In the following regression models the effect of the principal components indicating different ways of internet use outside of school has been accounted for the economic-social-cultural (ESCS) index. As the correlation coefficients show (Table 5), the socio-economic and cultural status is statistically in relation with the use for fun and the practical use. Nonetheless playing on the internet and the use for learning purposes don't depend on one's social background.

In accordance with the results of the Pearson's correlation, the regression models have modified when including the ESCS index as explanatory variable (Graph 3).

	FUN	PLAY	INFO	LEARN
ESCS	**0,123****	**–0,005**	**0,137****	**0,003**
Sig. (2-tailed)	0	0,731	0	0,845
N	4925	4925	4925	4673

Table 5 *Correlation between ESCS index and the principal components of ICT use (** Correlation is significant at the 0.01 level]2-tailed].)*



Graph 3

The effect of the use for fun and communication on test scores decreases a little but still stays positive when controlling for the ESCS index. Playing on the internet has still a quite significant negative impact on reading literacy independent of social background. However scientific competencies are no more influenced by playing when integrating ESCS in the regression. In the second set of regression models the former positive effect of the use for searching information on the internet on achievement disappears in case of all three competencies. As the correlation coefficient indicated this mode of use is strongly influenced by socio-economic and cultural background. Since correlation was not statistically significant between the ESCS index and the frequent use of the internet for learning and school related tasks, the noteworthy negative effect of this mode of use on school performance stays almost the same when accounting for social background.

5. Conclusions

The results of the analysis on the Hungarian subsample of the PISA dataset from 2015 reveal interesting correspondences between school performance, different modes of ICT use and social background. The frequent use of the internet for networking and fun outside of school influences all three fields of literacy positively even when accounting for socio-economic and cultural status. We assume that this mode of use enhances the social capital in an online field which in turn has a positive impact on achievement (Pusztai 2009, Gábor 2012, Jancsák 2013). The influence of playing on the internet is ambiguous. On the one hand mathematics and science achievement is not affected, on the other hand reading comprehension is notably brought down by this mode of internet use. In our analysis the third mode of internet use, frequent browsing for practical information and reading news on the internet has first shown a moderate but positive impact on test scores, however it turned out that this correspondence is due to the effect of social background. A privileged socio-economic and cultural status leads to such use of the internet and to better academic achievement at the same time.

The most unexpected outcome of our analysis is the effect of frequent internet use for learning purposes or school related tasks on school performance. We found that this mode of use has a notably negative impact on each field of literacy even when accounting for social background. This means that those students who frequently do school related tasks on the internet or learn with the help of ICT perform worse on the PISA mathematic, reading comprehension and science tests. Furthermore we found that this mode of use outside of school is not related to the socio-economic or cultural status of the student.

There might be several explanations for these findings which need further investigations. One of these might be the opposition of quantity and quality or form and content. The PISA ICT questionnaire measured the frequency of use of each listed item referring to the use for learning. We might suppose that the frequency of use does not reflect properly the effectiveness of use. Maybe the frequent use of ICT for learning is misleading as the technology gets more emphasized than the content, the gaining of knowledge. This might be one explanation for the worse test scores. In this context another question arises: why social background does not correspond with the use of ICT for learning and school purposes? We assume that this mode of use outside of school is more influenced by the school's and the teachers' expectations and teaching methods. This means that students use the internet for learning and school related tasks not because of internal motivations or ambitions but external pressure or expectations. Of course the negative results found regarding the relationship between the use of ICT for learning and school performance need deeper and more detailed analysis. We have to consider that our findings are limited to Hungary therefore international comparison regarding this correspondence could make the picture more clearer: Is the negative effect of frequent use of ICT for learning on school performance a universal pattern or specific for Hungary or for groups of nations including Hungary? How do other factors (demographic, school characters, etc.) modify this correlation?

Some of these questions and hypotheses can be answered best by deeper quantitative analyses on PISA data, however others are better to investigate by qualitative research. The author of this paper intends to do interviews among students and teachers to bring the deeper correspondences to surface and shed light on how the 'digital natives' and (mostly) 'digital immigrants' themselves see the relationship between ICT use and school performance and how they explain the role of ICT in learning and teaching and academic achievement.

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