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THE RELATION OF THE ICT USE PATTERNS WITH STUDENTS' READING LITERACY ACHIEVEMENT IN IEA PIRLS AND OECD PISA

ABSTRACT

The article deals with one of the contextual aspects that plays an important role in understanding the factors affecting modern reading literacy – the association of the information and communication technologies (ICT) use patterns with the students' literacy achievement. The relationship between the use of ICT and student achievement in reading literacy and the trends of overall development of achievement in reading literacy have been analyzed by using Latvian data from IEA PIRLS and OECD PISA studies. The research question is: How is the usage of ICT linked to the reading literacy achievement of students? The main results of the study show that there is a negative relationship between student achievement in reading and ICT use at school and at home in Latvia. Therefore it can be concluded that the role of technology in the field of general education might be heavily overrated or its full positive potential might be much harder to be meaningfully implemented in students' everyday learning activities as it seems at the first glance. Equipping a child and/or a teacher with huge amount of different ICT tools and letting them be is not the right approach if an excellence in education is what we are all heading to.

Keywords: *reading literacy, achievement in reading, ICT, PIRLS, PISA.*

Introduction

In this article the data from the IEA (*International Association for the Evaluation of Educational Achievement*) PIRLS study (the *Progress in International Reading Literacy Study*) and the OECD (the *Organisation for Economic Co-operation and Development*) PISA study (*Programme for International Student Assessment*) about students' reading achievement in

correlation with their reported frequency of the usage of ICT at home and at school environments are analyzed and compared.

IEA PIRLS is an international reading literacy study which is composed of a reading comprehension test for 4th grade students followed by a student questionnaire and accompanied with parent, teacher and school questionnaires to help to gather not only the achievement data but also as much context information as possible along with the test results. This approach of large scale studies covers up an enormous field of information to be used in evidence-based educational research and policy. PIRLS is conducted every 5 years since year 2001 and usually the size of a representative sample in each participating country is around 4000 students.

OECD PISA also is worldwide study which measures performance of 15-year-olds in the fields of reading, math and science. OECD PISA study also exploits context questionnaires along with the testing. Since 2000 PISA study is repeated every 3 years.

Since both – the PIRLS and the PISA study deal with students' achievement in reading, definitions of reading literacy used by each of the studies are provided. The definition of reading literacy driving the PIRLS 2016 cycle is as follows:

“Reading literacy is the ability to understand and use those written language forms required by society and/or valued by the individual. Readers can construct meaning from texts in a variety of forms. They read to learn, to participate in communities of readers in school and everyday life, for enjoyment.” (Mullis & Martin, 2015, p. 12).

In PISA 2015 a definition of reading literacy was rather similar:

“Reading literacy is understanding, using, reflecting on and engaging with written texts, in order to achieve one's goals, to develop one's knowledge and potential, and to participate in society.” (OECD, n.d.).

Reading literacy is a complex cultural and social phenomenon that has a profound impact on our lives, both at the individual and at the community level.

In general, this skill should be discussed in various dimensions (Knaflič, 2012):

- Linguistic,
- Cognitive,
- Social and cultural,
- Developmental,
- Educational.

Taking into account the place and role of reading in the development, growth and living of each person, the IEA and the OECD research programs (IEA PIRLS, OECD PISA) have been focusing on various aspects of reading literacy for more than 20 years, including context factors that could

be related to reading literacy achievement among different age students (Leino, 2014; OECD, 2005; OECD, 2015). In this article the authors draw attention to one of today's very topical issues related to reading literacy – the relationship between the use of information and communication technology (ICT) and the reading literacy achievement of students in general education.

The use of computers in the teaching process is based on a variety of grounds, including the need to provide students with the opportunity to become full members of today's digitalized society who have the necessary digital competence to successfully compete in the labor market. For teachers, the extensive use of ICT at school makes it possible to try and implement a new teaching methodology. For these reasons, significant resources are being allocated in many countries of the world for the purchase of computers, the Internet and software for school purposes. However, as illustrated by the results of the IEA PIRLS and OECD PISA studies, schools and education systems as a whole have not been as effective in capturing the potential of ICT as it could have been expected.

The beginning of the 80's of the last century was a time when the world was increasingly focused on the rapid development of modern technology and its growing influence on various areas of society's life, including education. Integrating ICT in education is a complex process that involves both changes in teacher education and the changes in the content and goals of teaching, and the provision of special infrastructure in educational institutions. Given the complexity of the integration process, the uncertainties about the effectiveness of ICT use in learning and the need for research on innovative ICT-related pedagogy, between the years 1990 and 2006, the IEA organized and implemented a number of full-scale, detailed research on the integration of modern technology and its role in general education schools as well as the study of various methodological and didactic aspects related to the use of ICT in training (COMPED (*Computers in Education Study*), SITES (*Second Information Technology in Education Study*) and SITES 2006) (Pelgrum, Plomp, 1991; Pelgrum, Anderson, 2000; Pelgrum, Janssen-Reinen, Plomp, 1993; Grinfelds, Kangro, 1996). At least two major studies on ICT education should be noted in the period to 2015: International Report ICILS (Frailon, et al., 2013) issued by IEA in 2013 and European Commission Survey on ICT in Education, 2013 (European Commission, 2013).

Methods and results

All data on student achievement in reading literacy used in this section is derived from public databases of the international studies of IEA PIRLS and OECD PISA. Standard error calculations were performed according to an internationally accepted methodology (see for example, Martin, M. O.,

Mullis, I. V. S., & Hooper, M., (2017). All differences of achievement regarding different groups of students and contextual factors presented in tables were statistically significant. One of the contextual factors of these studies was the use of information and communication technology habits and their possible links with the achievements in reading literacy (Ozola, 2017; Geske, Ozola, 2007; Geske, et al., 2015).

In both studies student surveys included questions about how often computers were used. In the IEA PIRLS 2016 study 4th grade students were asked how often they use computer at home and at school (see Figure 1).

How often do you use a computer or tablet in each of these places for schoolwork (including classroom tasks, homework, or studying outside of class)?

Fill one circle for each line.

	Every day or almost every day	Once or twice a week	Once or twice a month	Never or almost never
a) At home	↓ ○	↓ ○	↓ ○	↓ ○
b) At school	○	○	○	○

Figure 1. A student questionnaire item about the frequency of computer use from the IEA PIRLS 2016 study

The Latvian students' answers to this question were summarized, linking them with the average reading literacy achievement. The study found that the increased use of computers both at home and at school was associated with lower average achievement in reading literacy (see Table 1).

It should be noted that the negative link was more pronounced in terms of computer use at school: the students who replied that they used computers at school every day, had 32 points lower average reading literacy result than those who said that they did not use computers at school.

The more frequent use of the computer at home was also associated with lower average achievement, but the difference was less pronounced – for the students who replied that they use computer at home every day, the average score in the reading literacy test was 15 points lower than for those students who said that they did not use the computer at home at all.

Contrary, when students' access levels of digital devices at home are analyzed in the context of reading literacy achievement, results show that higher access to devices is associated with higher average achievement score in the PIRLS test (Mullis, Martin, Foy, Hooper, 2017). According to (Martin, Mullis, Hooper, 2017), those children whose parents reported having computer/tablet and internet connection along with 7 or more

Table 1. The average achievement in reading comprehension of Latvian 4th grade students in relation to the frequency of use of computers at home and at school (IEA PIRLS 2016)

Computer use	Frequency of computer use and average achievement (Latvia; IEA PIRLS 2016 reading test)				Achievement difference between answer categories “never...” and “every day...”
	Never or almost never	Once or twice a month	Once or twice a week	Every day or almost every day	
At home	567	572	563	552	-15 points
At school	567	565	550	535	-32 points

digital devices and a digital device for reading both for parent and a child, were fitted in the high index category. The average reading achievement of Latvian students in this category was 572 score points. The medium access category included children whose parents responded that they have a computer/tablet or an Internet connection, 4–6 digital devices and a digital device for reading either for parents or children. The average reading literacy score of pupils in this index category in Latvia was 556 points which is significantly lower than in the high access index category. And pupils who did not have a digital device for reading, computer/tablet or internet at home and whose family only had up to three digital devices in the household, were assigned to the index category of low access to digital devices at home. In Latvia the average PIRLS score of this index group could not be estimated because there were almost no students who fitted in the low access index category. The same pattern where a higher access to digital devices at home was associated with higher students' reading literacy scores was found in all PIRLS 2016 countries.

In this case the positive relationship between access to digital devices at home and reading literacy results in PIRLS can very well be attributed to the socio-economic status of the family. It has been well proven that the socio-economic situation of the family is the strongest factor influencing student achievement (Papanastasiou, Papanastasiou, 2007; Tinklin, 2003; Johansone, 2009).

Many studies have shown that various proxy measures of social class (usually referred to as socio-economic status, or SES), such as mother's education, parents' education, articles or books in the home, are correlated with students' academic achievement (Carnoy, et al., 2013). Researchers (Papanastasiou, Papanastasiou, 2007) claim that it is a well-known fact that students' SES influences their learning achievement at school. There are proofs of learning performance correlating with social advantages found in econometric research as well (Entorf, Minoiu, 2004). So, the availability of digital devices at home has to be perceived solely as an indicator of

family SES and the fact of owning a wide range of ICT devices cannot help to predict a purposefulness of its usage and capacity of raising students' reading literacy.

In the OECD PISA study, since the first cycle in the year 2000, survey respondents – fifteen-year-olds in general education also had to respond to a number of questions related to the use of information and communication technology, including the length of time students use computers at school and at home, and the use of different peripherals, Internet etc. In this paper, authors drew attention to just a few of the factors mentioned above and their possible association with student achievement in the reading literacy domain of the OECD PISA test.

The Latvian students' achievements in reading skills in the OECD PISA 2009–2015 cycles were negatively related to the frequency of use of ICT at school (see Table 2). The average reading achievement of 15-year-olds who “rarely or totally not” used computers at school was by 68 points higher than for students who used computer at school “often or every day”.

Table 2. The frequency of use of ICT in school and the average achievement of Latvian students in the OECD PISA 2015 test

Reading literacy part of OECD PISA test	The frequency of ICT use in school and the average achievement of Latvian students in the OECD PISA 2015 test		
	Never or hardly ever	Sometimes	Frequently or every day
Reading	506	480	438

The OECD PISA 2009 survey found similar results in relation to the average student achievement in reading and computer use at school (see Table 3).

Table 3. Average achievement of Latvian students in reading, mathematics and science depending on the intensity of computer use at school (OECD PISA 2009)

School subject	Duration of computer use in the subject within a study week	Average performance in OECD PISA 2009
Latvian language*	None	494
	1–30 minutes	477
	31–60 minutes	439
	More than 60 minutes	431

* If the student participated in the survey using the Russian language, the wording here was “Russian language”.

The result was similar also in other countries participating in the OECD PISA study, such as Germany, Greece, Japan and Korea. Overall, more intensive use of computer at school in about half of the research countries was associated with lower student achievement not only in reading but also in other areas of the test content (mathematics and science). Why is this happening? An unequivocal answer cannot be given, as the education systems of the countries are different, and the ICT use strategy is different.

Discussion and conclusions

Neither IEA PIRLS nor the OECD PISA study did a detailed and thorough study of the various uses of ICT in a general education school.

The IEA PIRLS study did not focus in detail on ICT use and reading literacy, as the student questionnaire contained only three questions about computer use at school and at home.

Students' questionnaires of OECD PISA in all cycles, from 2000, included a wider ICT module with 10 to 15 questions on various computer, peripheral, Internet, and software habits at school and at home. Considering that the inclusion of the ICT question module in the survey was not mandatory, a detailed analysis of ICT usage and achievement commitment was not put forward as the main task of the study.

It must be admitted that the IEA PIRLS and OECD PISA research on the use of ICT and the Internet is slightly superficial, but they indicate that there is no positive relationship with the more intensive use of ICT and reading achievement for students from grade 4 to grade 9.

In general the relationship between the use of ICT and students' reading achievement is not unequivocal. As stated by Tse, Lam, Loh, and Cheung (2017, p. 4–5) "as for the use of computer software or Internet materials in reading lessons, analysis of the evidence gathered in PIRLS 2016 is not sufficiently comprehensive to establish with certainty whether more extensive use of information and communications technology (ICT) in lessons was definitely associated with higher literacy attainment". The researchers from Hong Kong also concluded that teachers seem to need more support in using computer hard and software to facilitate students' high-level reading strategy development (Tse, et al., 2017).

This conclusion is totally in-line with what has been found as the result of the analysis presented in this paper. It is clear that Latvian teachers definitely need well targeted support and methodological advice on how to use computers meaningfully and fruitfully in the process of learning and especially in the process of learning to read during all stages of general education.

In both the OECD PISA and the IEA PIRLS study, more intensive computer use at school is associated with lower reading performance. It may be explained in one of the following ways, however, without further research, one cannot safely assert which ones are relevant and which are the less important:

- The strategy of the teaching process envisages more intensive work with computers for students whose achievement is lower,
- To students with lower achievement working with computers takes a relatively longer time,
- A longer time at a computer can be a demotivating factor in learning.

Taking into account that similar results were also obtained in the OECD PISA study cycle 2006, it can be argued that the integration of ICT in education and the methodology of computer use in general education schools is not sufficiently substantiated and elaborated. These results require a serious reflection on issues related to the use of ICT in the learning process, as it cannot be considered appropriate to use intensive computer and Internet-based methodology in the school associated with a decline in achievements in such important learning areas as reading.

Therefore, it should generally be acknowledged that the three OECD PISA cycles found that the increase in intensive use of computers at school is not related to student achievement growth in any of the content areas of the study, including reading. This raises the important issue of ICT integration in education: How can computer use improve the learning process by creating the added value of directly using ICT? This is confirmed by OECD Education Director A. Schleier's saying that "school technology has raised too many false hopes" (Coughlan, 2015).

Summary

- The OECD PISA research data on ICT infrastructure and usage shows that schools and education systems as a whole have not been as effective in attracting technology potential in the learning process as they could have been expected.
- The significant amount of investment in ICT infrastructure does not meet our expected impact of ICT use in general schools.
- The results of the OECD PISA and IEA PIRLS studies showed negative relationship between student achievement in reading and ICT use at school and at home. Therefore, the added value associated with ICT usage at school is currently not ensured in the learning process.

References

- Carnoy, M., Khavenson, T., Ivanova, A., Rothstein, R. (2013). *Can International Test Score Comparisons Inform Educational Policy? A Closer Look at Student Performance in Russia and its Neighbors*. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2289188
- Coughlan, S. (2015). *Computers 'do not improve' pupil results, says OECD*. Retrieved from <http://www.bbc.com/news/business-34174796>.
- Entorf, H., Minoiu, N. (2004). What a Difference Immigration Law Makes: PISA Results, Migration Background and Social Mobility in Europe and Traditional Countries of Immigration. *Discussion Paper Series*, IZA DP No. 1021. Retrieved from <ftp.zew.de/pub/zew-docs/dp/dp0417.pdf>.
- European Commission (2013). *Survey of Schools: ICT in Education. Benchmarking Access, Use and Attitudes to Technology in Europe's Schools. FINAL REPORT*. A study prepared for the European Commission DG Communications Networks, Content & Technology. Belgium, Brussels. DOI:10.2759/94499.
- Eurydice (2011). *Lasītprasmes mācīšana Eiropā: konteksts, rīcībpolitika un prakse*. Belgium, Brussels, Education, Audiovisual and Culture Executive Agency.
- Frailon, J., Ainley, J., Schulz, W., Friedman, T., Gebhardt, E. (2014). *Preparing for Life in a Digital Age. The IEA International Computer and Information Literacy Study International Report*. Springer Open.
- Geske, A., Grinfelds, A., Kangro, A. (Ed.), Kiseļova, R., Mihno, L. (2015). *Quality of Education: International Comparison. Latvia in OECD Programme for International Student Assessment*. Educational Research in Latvia, No. 8. Riga: University of Latvia. Retrieved from https://www.ipi.lu.lv/fileadmin/user_upload/lu_portal/projekti/ipi/Publikācijas/Quality_of_Education_-_WEB.pdf.
- Geske, A., Ozola, A. (2007). *Skolēnu sasniegumi lasītprasēm Latvijā un pasaulē*. Izglītības pētniecība latvijā, Nr. 5. Riga: LU Akadēmiskais apgāds.
- Grinfelds, A., Kangro, A. (1996). Policies on Computers in Education in the Republic of Latvia. Technology-Based education Series. Vol. I. *Cross National Policies and Practices on Computers in eucation*. Tj. Plomp, R. Anderson, G. Kontogiannopoulou-Polidorides (Eds.). The Netherlands: Kluwer Academic Publishers, p. 319–339.
- Johansone, I. (2009). *Managing primary education in Latvia to assure quality and achievement equity*. Promotion Paper. Riga: University of Latvia.
- Knaflič, L. (2012). Psychological aspects of literacy. *Libellarium*, VII, 1, 41–53. UDC: 028.2:159.946.4. Proceedings of the Summer School in User Studies (SSUS). Zadar, Croatia, 11–14 April, 2012.
- Leino K. (2014). *The relationship between ICT use and reading literacy*. Finland: Jyväskylä University Press.
- Martin, M. O., Mullis, I. V. S., & Hooper, M. (Eds.) (2017). *Methods and Procedures in PIRLS 2016*. Retrieved from <https://timssandpirls.bc.edu/publications/pirls/2016-methods.html>.
- Mullis, I. V. S., & Martin, M. O. (Eds.) (2015). *PIRLS 2016 Assessment Framework*. 2nd ed. Retrieved from <http://timssandpirls.bc.edu/pirls2016/framework.html>.

- Mullis, I. V. S., Martin, M. O., Foy, P., & Hooper, M. (2017). *PIRLS 2016 International Results in Reading*. Retrieved from <http://timssandpirls.bc.edu/pirls2016/international-results/>; Library of Congress Catalog Card Number: 2017951161, ISBN: 978-1-889938-44-8.
- OECD (2005). *Are Students Ready for a Technology-Rich World? What PISA Studies Tell Us*. Paris, OECD Publications.
- OECD (2015). *Students, Computers and Learning. Making the Connection*. PISA, OECD Publishing.
- OECD [n. d.]. *PISA 2018 reading literacy framework*. Retrieved from <http://www.anep.edu.uy/anep/index.php/codicen-publicaciones/category/143-pisa2018?download=2162:marco-conceptual-lectura-pisa2018>.
- Ozola A. (2017). *Starptautiskā lasītprasmes novērtēšanas pētījuma IEA PIRLS 2016 pirmie rezultāti par 4. klašu skolēnu lasītprasmi Latvijā un pasaulē*. Rīga, Latvijas Universitāte.
- Papanastasiou, E. C., Paparistodemou, E. (2007). *Examining educational technology and achievement through latent variable modeling*. In: Loveless, T. (Ed.) *Lessons Learned: What International Assessments Tell Us about Math Achievement*. Washington, D.C.: Brookings Institution Press. Retrieved from http://www.iea.nl/fileadmin/user_upload/IRC/IRC_2006/Papers/IRC2006_Papanastasiou_Paparistodemou.pdf.
- Pelgrum, W. J., Anderson, R. E. (2000). *ICT and the Emerging Paradigm for Life Long Learning: a Worldwide Educational Assesment of Infrastructure, Goals and Practices*. The Netherlands, University of Twente.
- Pelgrum, W. J., Janssen Reinen, I. A. M. and Plomp, Tj. (Eds.) (1993). *Schools, Teachers, Students and Computers: a Cross-National Perspective*. IEA-Comped Study Stage 2. The Netherlands, Enschede, IEA.
- Pelgrum, W. J., Plomp, Tj. (1991). *The Use of Computers in Education Worldwide. Results from the IEA "Computers in Education" Survey in 19 Education Systems*. United Kingdom: Pergamon Press.
- Tinklin, T. (2003). Gender Differences and High Attainment. *British Educational Research Journal*, 29(3), 307–325.
- Tse, S. K., Lam, W. I., Loh, K. Y., Cheung, W. M. (2017). *Progress in International Reading Literacy Study (PIRLS) 2016 International Report (Hong Kong Section)*. Press Release. Retrieved from https://www.hku.hk/f/upload/17208/PIRLS2016_e.pdf.