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INFLUENCE OF EDUCATION SYSTEM QUALITY ON THE USE OF ICT IN TRANSITION COUNTRIES IN THE AGE OF INFORMATION SOCIETY [a]

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Abstract

The purpose of this paper is to investigate the impact of education on the development of information and communication technologies (ICT) in transition countries. The aim is to identify, by using the appropriate methodology, the connection between the level of education development and the development of ICT, which are measured by several indicators within the IDI (ICT Development Index). The research uses cluster analysis, descriptive statistics, and comparative, correlation, and regression analysis. The research results and discussion are organized in the following three segments: a) examination of interdependence between ICT development and education level, b) analysis of the impact of the Adult literacy rate, Secondary gross enrollment ratio and Tertiary gross enrollment ratio on the ICT development level, and c) heterogeneity test of transition economies according to the level of education, as well as its influence on the development of ICT. The results of the analysis indicate the existence of a positive correlation between the ICT development and the level of education development. The development of higher education has the most important influence on the development and application of ICT.

Key words: information and communication technologies, education, transition countries

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УТИЦАЈ КВАЛИТЕТА СИСТЕМА ОБРАЗОВАЊА НА УПОТРЕБУ ИНФОРМАЦИОНО-КОМУНИКАЦИОНИХ ТЕХНОЛОГИЈА У ЗЕМЉАМА У ТРАНЗИЦИЈИ У ЕРИ ИНФОРМАЦИОНОГ ДРУШТВА

Апстракт

Сврха рада је да се истражи утицај образовања на развој информационо-комуникационих технологија (ИКТ) у државама у транзицији. Циљ рада је да се одговарајућом методологијом идентификује повезаност достигнутог степена развоја образовања са развојем ИКТ који је мерен помоћу индикатора у оквиру комплексног индекса развоја ИКТ (енгл. ICT Development Index – IDI). Истраживање се реализује применом кластер анализе, дескриптивне статистике, компаративне, корелационе и регресионе анализе. Резултати истраживања и дискусија структурирани су у три следећа сегмента: а) испитивање међузависности нивоа развијености ИКТ и нивоа образовања, б) анализа утицаја стопе писмености одраслог становништва, стопе учешћа становништва са средњим образовањем и стопе учешћа становништва са високим образовањем на ниво развијености информационо-комуникационих технологија и в) испитивање хетерогености транзиционих економија према нивоу образовања, као и њен утицај на развој ИКТ. Резултати анализе указују на постојање позитивне корелационе везе између развоја ИКТ и нивоа развоја образовања, при чему најзначајнији утицај на развој и примену ИКТ има развој високог образовања.

Кључне речи: информационо-комуникационе технологије, образовање, државе у транзицији

INTRODUCTION

The development of the world economy, as well as the economic development of transition countries, is accomplished in a very turbulent environment. Comprehension of the fact that the personnel and their education and knowledge are an important factor of development increasingly prevails in the analysis of development factors of the global economy. As Lundvall wrote: "While secondary school certificates were the trump cards of industrialization, higher degrees are those of the knowledge economy. Lifelong training is essential" (Lundvall, 1998).

The ubiquity of information and communication technologies and their capacity to permeate and affect our social and cultural practices, transforms and gives rise to new forms of thinking, acting, learning, and relating to one another (Gil-Flores, Torres-Gordillo & Perera-Rodríguez, 2012). In current information society, people have to access knowledge via information and communication technologies (ICT) to keep pace with the latest developments (Sogol, Mohammadia & Rezvanfar, 2014).

The ability of the ICT industry to respond to the high demands of users who want more bandwidth and availability of different services with an appropriate level of quality depends on the ability of the personnel. The

development of ICT at the level of a country depends primarily on the ability of its personnel. The primary function of education is to teach people in order to create a top quality workforce (Radovanović & Savić, 2014).

Providing competent and capable personnel requires investments in the education system and scientific research. These investments are uneven throughout the world and depend on the degree of a country's economic development. Therefore, globally speaking, the higher development level of education and better personnel are concentrated in certain areas of the world.

On the one hand, modern ICT contributes in a large extent to the progress of the education system by introducing innovative methodologies in teaching, such as distance learning, or more generally, electronic learning (Giannetti, Michelini & D'Andrea, 2009). On the other hand, the development of ICT depends on the quality of the education system.

Special attention in the paper will be devoted to the latter aspect. We will analyse the impact of the education development level and the impact of education development indicators on the ICT development in transition countries. The research includes all transition countries (except Turkmenistan, due to a lack of data) analysed in the Transition Report 2012, which was prepared by the European Bank for Reconstruction and Development (The European Bank for Reconstruction and Development, 2012).

The aim of this paper is to examine the effect of the education level on the level of ICT development in transition countries. The research is divided into several parts. In the first section of the paper, the authors provide an overview of empirical data on the development level of ICT and education level in the analysed transition countries. The level of ICT development is measured by the *ICT Development Index (IDI)*, created by the International Union for Telecommunication, and its subindex *(IDI access, IDI use, IDI skills)*, while the level of education is measured by pillars within the subindex IDI skills *(Adult literacy rate, Secondary gross enrollment ratio, and Tertiary gross enrollment ratio)*. The second part, comprising the research results, examines the relationship between the IDI and pillars within the subindex IDI skills. Subsequently, the influence of the education level on the development level of ICT is tested. Finally, heterogeneity of the analysed transition countries is observed according to the pillars within the *IDI skills* subindex.

THEORETICAL BACKGROUND

Education is considered to be one of the key factors to enhance the integration of persons with functional diversity in society and, in particular, in higher education institutions (Ministry of Education, 2008). Education should prepare people not only to enjoy the modern civilization, but also to creatively participate in the process of its further existence and development (Kruk, 2000).

Education has a significant influence on the development of the individual, the economy, and the society. Globalization and the development of technology increasingly emphasize the importance of education and its possibilities. Education is an important factor in the development and "the surest foundation for the future" (Delors, 1996).

Education is a subsystem that forms the design and functioning of other subsystems of society. Economic development and national competitiveness depend on the quality of the education system. The process of globalization requires educated people who will be able to adapt to social, economic, and cultural changes. The process of globalization that caused the interdependence of economies and economic entities contributed to the actualization of new issues related to personnel and their knowledge as a creative factor that influences profit.

"Education systems of countries have the subject or, even better, the goal to have the knowledge that is not divided but, on the contrary, universal and general" (Knežević & Veselinović, 2015, p. 152). A brief review of the historical development of the education system during different periods shows a significant correlation between socio-economic development, on the one hand, and development of education systems, on the other hand. Simple training in the agricultural age, classical education in the industrial age, and the transition from classical training to virtual education in the information age or individualism, represent both the desired and uninvited changes in education due to the fact that the education system should reflect the educational needs of society in that period (Miladi & Malekmohammadi, 2010). In the information age, education must simultaneously provide maps of a complex world in constant turmoil and the compass that will enable people to find their way in it (Delors, 1996).

Education is the basis for personal development and social integration in the challenges posed by the 21st century, such as:

- Development of the information society,
- Development of science and technology, which impacts the creation of a new model of life-long learning,
- The process of globalization, which creates a global market.

Nevertheless, education is an essential precondition for the development of ICT and the information society. Many efforts have been and are still being made to develop internationally comparable and reliable ICT statistics for measuring the information society (Petrović, Bojković, Antić & Petrović, 2012). In order to measure the development of ICT, International Union for Telecommunication has created and developed an index of ICT development (ICT Development Index – IDI). This index is calculated based on 11 indicators related to the development of information and telecommunication technologies, which enables a comparison between the countries (this methodology covered 155 countries in the world in 2008). The main objectives of the calculation of this index are measured by the following:

- The level and development of ICT over time,
- Changes in the development of ICT in the countries that achieve different levels of ICT development and changes in the development of ICT in developed countries compared to developing countries and transition countries,
- The digital gap,
- The development potential of ICT, or the extent to which countries can take advantage of ICT for the realization of economic growth and development, based on available capacity and skills of the population.

ICT is a factor of economic development, if applied and used appropriately. The process of development of ICT, as well as the process of transforming society into a knowledge and information society, involves the following phases:

1. ICT readiness that reflects the development level of network infrastructure and access to ICT,
2. ICT intensity that reflects the level of application of ICT in the observed countries,
3. ICT impact that reflects the efficiency and effectiveness of the use of ICT.

The development of ICT in these stages depends on the combination of the following three factors: a) the existence and accessibility of ICT infrastructure, b) a significant degree of use, and c) ability to effectively use ICT.

Accordingly, the first two stages are related to two important components of the IDI, and these are *IDI access* and *IDI use*. The effectiveness of the implementation of the last phase depends on the third component of the IDI – *IDI skills*, which determines the effectiveness of the use of modern technology. The third component of the IDI – *IDI skills*, is determined on the basis of the following indicators: a) *Adult literacy rate*, b) *Secondary gross enrollment ratio*, and c) *Tertiary gross enrollment ratio*. Literacy is an obvious feature of the knowledge economy, but not necessarily critical to other forms of economic organization, such as agriculture-based societies. It is hard to imagine how citizens could participate in or contribute to a knowledge economy without not only basic reading and writing skills, but also some measure of computer literacy, including the use of the Internet (Weber, 2011).

These three indicators reflect the level of development, but not the skills in using ICT. Indicators related to the computer literacy of the population and language skills are considered more appropriate to measure these skills (Evans & Yen, 2005; Ferro, Helbig, & Gil-Gracia, 2011). Therefore, these three selected indicators will be used to assess and analyse the level of education in transition countries.

ANALYSIS OF TRANSITION COUNTRIES' POSITION ACCORDING TO THE LEVEL OF ICT DEVELOPMENT AND LEVEL OF EDUCATION

Given the fact that the aim of this study is to examine the impact of education on the development of ICT in transition countries, Table 1 provides an overview of relevant data for 31 transition countries in 2013. Review of the data enables consideration of their positions in the field of ICT and education.

Table 1. IDI score, IDI subindices score, and pillars within the IDI skills subindex in transition countries (2013)

Country	IDI	IDI subindices			Pillars within the IDI skills subindex		
		IDI ACCESS	IDI USE	IDI SKILLS	Adult literacy rate	Secondary gross enrollment ratio	Tertiary gross enrollment ratio
1. Albania	4.72	4.62	3.26	7.82	96.8	82.4	55.5
2. Armenia	5.08	5.64	3.02	8.04	99.6	95.9	46
3. Azerbaijan	5.65	6.07	4.4	7.33	99.8	100.3	20.4
4. Belarus	6.89	7.39	4.99	9.69	99.6	106.4	91.5
5. Bosnia and Herzegovina	5.23	5.63	3.71	7.5	98.2	89.3	37.7
6. Bulgaria	6.31	6.77	4.77	8.46	98.4	93.1	62.7
7. Croatia	6.9	7.31	5.62	8.63	99.1	98.4	61.6
8. Egypt	4.45	5.09	2.87	6.33	73.9	86.3	30.1
9. Estonia	7.68	7.82	6.77	9.21	99.9	107.1	76.7
10. FYR Macedonia	5.77	6.55	4.22	7.29	97.5	82.8	38.5
11. Georgia	4.86	5.99	2.58	7.14	99.7	86.8	27.9
12. Hungary	6.52	7.32	4.67	8.62	99.4	101.6	59.6
13. Jordan	4.62	5.47	2.22	7.74	97.9	87.8	46.6
14. Kazakhstan	6.08	6.84	4.33	8.06	99.7	97.7	44.5
15. Kyrgyzstan	3.78	4.05	1.59	7.62	99.2	88.2	41.3
16. Latvia	7.03	7.29	5.91	8.75	99.9	97.7	65.1
17. Lithuania	6.74	7	5.29	9.12	99.8	105.9	73.9
18. Moldova	5.72	6.56	3.94	7.57	99.1	88.2	40.1
19. Mongolia	4.32	4.79	1.69	8.64	98.3	103.5	61.1
20. Montenegro	5.67	6.74	3.37	8.15	98.4	90.9	55.5
21. Morocco	4.27	5.63	2.5	5.07	67.1	68.9	16.2
22. Poland	6.6	7.04	4.94	9.01	99.8	97.7	73.2
23. Romania	5.83	6.62	3.87	8.17	98.6	95	51.6
24. Russia	6.7	7.25	4.97	9.03	99.7	95.3	76.1
25. Serbia	6.24	7.22	4.34	8.07	98.2	91.7	52.4
26. Slovakia	6.58	7.03	5.28	8.28	99.5	93.9	55.1
27. Slovenia	7.13	7.91	5.21	9.43	99.7	97.6	86
28. Tunisia	4.23	4.56	2.59	6.86	79.7	91.1	35.2
29. Turkey	5.29	5.83	3.24	8.34	94.9	86.1	69.4
30. Ukraine	5.15	6.16	2.11	9.23	99.7	97.8	79.7
31. Uzbekistan	3.4	2.95	2.09	6.94	99.5	105.2	8.9

Legend: Countries with the lowest value of index/subindex/pillar
Countries with the highest value of index/subindex/pillar

Source: ITU. (2014). Measuring the Information Society Report 2014, https://www.itu.int/en/ITU-D/Statistics/Documents/publications/mis2014/MIS2014_without_Annex_4.pdf

Regarding the *ICT development index*, Estonia, Latvia, Lithuania, Belarus, and Kazakhstan recorded the best results among the 31 analyzed transition countries. On the other hand, the worst positioned transition countries according to the *ICT Development Index (IDI)* are Uzbekistan, Kyrgyzstan, Egypt, Mongolia, Morocco, and Tunisia.

Similar results were observed with regard to subindices within the IDI.

Thus, the highest score of the *IDI access* subindex is recorded in Estonia, Belarus, Hungary, Latvia, and Slovenia, while the countries with the lowest score of this subindex are Uzbekistan, Kyrgyzstan, Albania, Mongolia, and Tunisia.

The top five countries according to the value of the *IDI use* subindex are Estonia, Croatia, Latvia, Slovakia, and Lithuania, while the lowest value of this subindex is recorded in Jordan, Kyrgyzstan, Mongolia, Ukraine, and Uzbekistan.

When it comes to the third subindex within the IDI, *IDI skills* subindex, the best ranking countries are Estonia, Belarus, Lithuania, Slovenia, and Ukraine. Five transition countries with the lowest score of this subindex are Egypt, Morocco, Georgia, Tunisia, and Uzbekistan.

The second part of the table shows the achievements of countries in transition in the field of education. The second part of the table shows the values of three pillars within the IDI skills subindex *(Adult literacy rate, Secondary gross enrollment ratio, and Tertiary gross enrolment ratio)*.

Leading transition countries according to *adult literacy rate* are Latvia, Lithuania, Poland, and Azerbaijan, while the lowest adult literacy rate is recorded in Morocco, Egypt, FYR Macedonia, and Turkey in 2013.

The top ranking transition countries, according to the *secondary gross enrolment ratio* are Estonia, Lithuania, Belarus, Mongolia, and Uzbekistan, and the worst ranked countries are Egypt, Morocco, Albania, Macedonia, and Turkey.

Finally, the highest *tertiary gross enrollment ratio* is recorded in Belarus, Estonia, Lithuania, Slovenia, and Ukraine, while the lowest is recorded in Uzbekistan, Morocco, Egypt, Azerbaijan, and Georgia in 2013.

The data presented in Table 1 indicate the existence of a positive relationship between ICT development and education levels in transition countries. Finally, Estonia, Lithuania, Belarus, and Kazakhstan can be viewed as leaders in almost all areas of ICT and education.

INFORMATION BASE, METHODOLOGY AND HYPOTHESIS

The purpose of this paper is to examine the interdependence and impact of educational level on the level of ICT development in transition countries. The aim of the study is to identify the critical factors in the field of education that has the most significant impact on the development

level of ICT in the transition countries. In accordance with the aim and purpose of the research, this study tested the following hypothesis:

There is interdependence between and impact of education on the development level of ICT in transition countries.

The following methods are used in this paper: correlation analysis, regression analysis, and cluster analysis. Correlation analysis in this paper examines the relationship between the *ICT development index (IDI)* and pillars within the *IDI skills* subindex *(Adult literacy rate, Secondary gross enrollment ratio, and Tertiary gross enrollment ratio)*. Regression analysis is used in this study to examine the impact of the aforementioned pillars on the development level of ICT. Cluster analysis in this research is performed in order to group the countries and in order to identify the countries where further efforts and activities to improve the education system are needed.

Information base of analysis is the report by the International Telecommunication Union (ITU) – the United Nations specialized agency for information and communication technologies for 2014 (ITU, 2014).

RESULTS AND DISCUSION

The results and discussion are organized in the following three segments:

a) Examination of interdependence between ICT development and education level;

b) Analysis of the impact of the Adult literacy rate, Secondary gross enrollment ratio, and Tertiary gross enrollment ratio on the ICT development level;

c) Heterogeneity test of transition economies according to the level of education, as well as its influence on the development of ICT.

a) Examining the interdependence between ICT development and education level

The interdependence between ICT development level and education in transition countries is tested by calculating the Pearson correlation coefficient between the IDI and pillars within the IDI skills subindex. The results of the correlation analysis are shown in Table 2.

Table 2. Pearson correlation coefficient – interdependence between the IDI and pillars within the IDI skills subindex

		IDI	Adult literacy rate	Secondary gross enrollment ratio	Tertiary gross enrollment ratio
IDI	Pearson Correlation	1	0.435(*)	0.458(**)	0.700(**)
	Sig. (2-tailed)		0.015	0.010	0.000
	N	31	31	31	31
Adult literacy rate	Pearson Correlation	0.435(*)	1	0.597(**)	0.435(*)
	Sig. (2-tailed)	0.015		0.000	0.014
	N	31	31	31	31
Secondary gross enrolment ratio	Pearson Correlation	0.458(**)	0.597(**)	1	0.466(**)
	Sig. (2-tailed)	0.010	0.000		0.008
	N	31	31	31	31
Tertiary gross enrolment ratio	Pearson Correlation	0.700(**)	0.435(*)	0.466(**)	1
	Sig. (2-tailed)	0.000	0.014	0.008	
	N	31	31	31	31

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Source: Prepared by the authors (SPSS Statistics 19)

There is a positive correlation between the IDI and all pillars within the *IDI skills* subindex. At the same time, moderate positive correlation exists between the IDI and the pillar *Adult literacy rate* (the value of the correlation coefficient of 0.435) and *Secondary gross enrollment ratio* (the value of the correlation coefficient of 0.458). The highest positive correlation is observed between the IDI and the pillar *Tertiary gross enrollment ratio*.

b) Examining the impact of education level on the level of ICT development

Regression analysis is applied to examine the impact of education on the level of ICT development in transition countries. The results of regression analysis are shown in Table 3.

Table 3. The value of regression coefficients – influence of pillars within the subindex IDI skills on the IDI

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Model					
(Constant)	1.129	2.061		0.548	0.588
Adult literacy rate	0.015	0.024	0.104	0.610	0.547
Secondary gross enrollment ratio	0.015	0.023	0.115	0.664	0.512
Tertiary gross enrollment ratio	0.032	0.008	0.601	3.884	0.001
Dependent Variable: IDI					

Source: Prepared by the authors (SPSS Statistics 19)

According to the values of the regression coefficients shown in Table 3, it can be concluded that the pillar *Tertiary gross enrollment ratio* has the highest statistically significant impact on the IDI in transition countries (the value of the regression coefficient of 0.032). Smaller impact is recorded for the pillar *Adult literacy rate* and the pillar *Secondary gross enrollment ratio*. The value of the regression coefficient for these two pillars is 0.015 and is not statistically significant.

Based on the results of correlation and regression analyses, it can be concluded that the main hypothesis of this research is confirmed. Namely, there is a positive relationship between the level of ICT development and the level of education in transition countries.

There is also the influence of the education level on the level of development of ICT, whereby the greatest impact is recorded for higher education, i.e. the percentage of the population registered in higher education institutions.

c) Examining the heterogeneity of the transition countries according to education level

Previous segment of analysis indicated a positive correlation between the ICT development level and education level in the analysed transition countries. It also indicates a positive impact of education level on the level of the IDI, with the greatest impact of the *Tertiary gross enrollment ratio*. Given these results, we grouped the transition countries in clusters according to their level of education, or according to the pillar within the *IDI skills* subindex by using cluster analysis (Table 4).

Table 4. Members of cluster and distances from respective cluster center

Cluster 1		Cluster 2		Cluster 3		Cluster 4	
Members	Distance	Members	Distance	Members	Distance	Members	Distance
C_1	6.766608	C_4	7.525720	C_3	7.81288	C_8	2.96398
C_2	6.023394	C_9	3.837569	C_5	4.27670	C_21	10.58813
C_6	3.791260	C_17	4.290830	C_10	6.82521	C_28	7.81350
C_7	4.048555	C_22	4.180828	C_11	3.20130		
C_12	4.849186	C_24	3.913990	C_15	6.42593		
C_13	6.596272	C_27	4.222760	C_18	5.76812		
C_14	7.119546	C_30	1.914801	C_31	14.84795		
C_16	5.633432						
C_19	6.185185						
C_20	1.822437						
C_23	2.717376						
C_25	2.559639						
C_26	0.864837						
C_29	9.116042						

Source: Prepared by the authors (STATISTICA 8.0)

The second cluster includes transition countries which have the IDI skills subindex greater than 9. Specifically, the second cluster consists of the following countries: Belarus, Estonia, Lithuania, Poland, Russia, Slovenia, and Ukraine. These countries recorded the highest percentage of *Adult literacy rate*, as well as the highest *Secondary gross enrollment ratio* and *Tertiary gross enrollment ratio*.

The first cluster includes transition countries with the *IDI skills* subindex from 7.74 to 8.75: Albania, Armenia, Bulgaria, Croatia, Hungary, Jordan, Kazakhstan, Latvia, Mongolia, Montenegro, Romania, Serbia, Slovakia, and Turkey. These countries recorded *Adult literacy rate, Secondary gross enrollment ratio*, and *Tertiary gross enrollment ratio* with lower values compared to the countries in transition that constitute the second cluster.

Countries in transition which have the *IDI skills* subindex from 6.94 to 7.62 are in the third cluster: Azerbaijan, Bosnia and Herzegovina, Macedonia, Georgia, Kyrgyzstan, Moldova, and Uzbekistan. These countries recorded a higher percentage of literacy in relation to the countries that make up the first cluster, and lower than the countries that make up the second cluster. However, these countries recorded a lower *Secondary gross enrollment ratio* and *Tertiary gross enrollment* ratio in relation to the countries that make up the first cluster.

The fourth cluster includes countries in transition which have the lowest *IDI skills* subindex. It consists of the following countries: Morocco, Tunisia, and Egypt. These countries recorded the lowest values of observed indicators upon which we conducted the analysis of the development of education in the surveyed countries.

Results of descriptive statistics for each cluster are given in Table 5.

Table 5. Descriptive statistics within the cluster analysis

Descriptive Statistics for Cluster 1 (Cluster contains 14 cases)			
	Mean	Standard Deviation	Variance
Adult literacy rate	98.47857	1.334269	1.78028
Secondary gross enrollment ratio	93.97857	5.886644	34.65258
Tertiary gross enrollment ratio	56.19286	7.500304	56.25456
Descriptive Statistics for Cluster 2 (Cluster contains 7 cases)			
	Mean	Standard Deviation	Variance
Adult literacy rate	99.7429	0.097590	0.00952
Secondary gross enrollment ratio	101.1143	5.090327	25.91143
Tertiary gross enrollment ratio	79.5857	6.790785	46.11476
Descriptive Statistics for Cluster 3 (Cluster contains 7 cases)			
	Mean	Standard Deviation	Variance
Adult literacy rate	99.00000	0.84853	0.7200
Secondary gross enrollment ratio	91.54285	8.05726	64.9195
Tertiary gross enrollment ratio	30.68571	12.24560	149.9548
Descriptive Statistics for Cluster 4 (Cluster contains 3 cases)			
	Mean	Standard Deviation	Variance
Adult literacy rate	73.56667	6.30661	39.7733
Secondary gross enrollment ratio	82.10000	11.68075	136.4400
Tertiary gross enrollment ratio	27.16667	9.83379	96.7033

Source: Prepared by the authors (STATISTICA 8.0)

Analysis of variance in Table 6 tests the significance level of differences between clusters, regarding the pillars within the *IDI skills* subindex *(Adult literacy rate*, *Secondary gross enrollment ratio*, and *Tertiary gross enrollment ratio)*. Based on the results of the analysis shown in Table 6, we can conclude that, as regards the pillar *Adult literacy rate*, a statistically significant difference exists between the fourth and all the other clusters. In other words, countries within the first, second, and third clusters are fairly homogenous in terms of this parameter. According to the parameter, i.e. the pillar *Secondary gross enrollment ratio*, statistically significant difference

Table 6. Multiple comparisons

Dependent Variable	(I) Cluster Number of Case	(J) Cluster Number of Case	Mean Difference (I-J)	Std. Error	Sig.
Adult literacy rate	1.00	2.00	-1.26429	.92181	.527
		3.00	-.52143	.92181	.941
		4.00	24.91190(*)	1.26691	.000
	2.00	1.00	1.26429	.92181	.527
		3.00	.74286	1.06442	.897
		4.00	26.17619(*)	1.37416	.000
	3.00	1.00	.52143	.92181	.941
		2.00	-.74286	1.06442	.897
		4.00	25.43333(*)	1.37416	.000
	4.00	1.00	-24.91190(*)	1.26691	.000
		2.00	-26.17619(*)	1.37416	.000
		3.00	-25.43333(*)	1.37416	.000
Secondary gross enrollment ratio	1.00	2.00	-7.13571	3.17274	.136
		3.00	2.43571	3.17274	.868
		4.00	11.87857	4.36051	.051
	2.00	1.00	7.13571	3.17274	.136
		3.00	9.57143	3.66356	.065
		4.00	19.01429(*)	4.72964	.002
	3.00	1.00	-2.43571	3.17274	.868
		2.00	-9.57143	3.66356	.065
		4.00	9.44286	4.72964	.214
	4.00	1.00	-11.87857	4.36051	.051
		2.00	-19.01429(*)	4.72964	.002
		3.00	-9.44286	4.72964	.214
Tertiary gross enrollment ratio	1.00	2.00	-23.39286(*)	4.08358	.000
		3.00	25.50714(*)	4.08358	.000
		4.00	29.02619(*)	5.61235	.000
	2.00	1.00	23.39286(*)	4.08358	.000
		3.00	48.90000(*)	4.71532	.000
		4.00	52.41905(*)	6.08745	.000
	3.00	1.00	-25.50714(*)	4.08358	.000
		2.00	-48.90000(*)	4.71532	.000
		4.00	3.51905	6.08745	.938
	4.00	1.00	-29.02619(*)	5.61235	.000
		2.00	-52.41905(*)	6.08745	.000
		3.00	-3.51905	6.08745	.938

* The mean difference is significant at the 0.05 level.

Source: Prepared by the authors (SPSS Statistics 19)

exists between the countries in the second and the countries in the fourth cluster. There is a statistically significant difference between all clusters in terms of the pillar *Tertiary gross enrollment ratio*.

Therefore, countries in the fourth cluster are significantly lagging behind other countries in clusters 1, 2, and 3 according to all analysed segments of education. In contrast, among the countries in cluster 2 (a cluster with the best performance) and countries in clusters 1 and 3, a significant difference is found only regarding the pillar *Tertiary gross enrollment ratio*.

The pillar *Tertiary gross enrollment ratio* is the main reason for the lagging of countries in clusters 1, 3, and 4 behind the countries of cluster 2 concerning the level of education. The pillar *Tertiary gross enrollment ratio* has also been identified as a pillar with the strongest positive correlation with the *ICT development index* and as a pillar of the strongest positive impact on the *ICT development index* in the transition countries.

CONCLUSION

Education is a subsystem that affects the development of other subsystems of society. The technological development increasingly emphasizes the importance of educational development. There is interdependence and connectedness between the educational development and the level of ICT development. On the one hand, ICT encourages the education system development through the use of innovative methodologies in the education process. On the other hand, the development of ICT depends on the quality of the personnel. The level of development of the education system is one of the most important factors that determine the quality of the personnel. This paper gave special attention to the second aspect, or the impact of educational development and its indicators on ICT development.

A comparative analysis of data on the IDI and its subindices and pillars regarding the level of education in the transition countries (three pillars within the *IDI skills* subindex – *Adult literacy rate*, *Secondary gross enrollment ratio*, and *Tertiary gross enrolment ratio*) led us to a conclusion that, within the transition economies, certain countries stood out as leaders in both the level of ICT development and in the sphere of education. Namely, Latvia, Lithuania, Belarus, and Kazakhstan are leaders according to the value of the IDI. As regards the recorded *IDI access* subindex, the leaders are Estonia, Belarus, Hungary, Latvia, and Slovenia. According to the values of the IDI use subindex, the leaders are Estonia, Croatia, Latvia, Slovakia, and Lithuania. According to the value of the IDI skills subindex, the leaders are Estonia, Belarus, Lithuania, Slovenia, and Ukraine. Similar results were observed in the domain of education. Thus, according to the *Adult literacy rate*, the leading transition countries are Latvia, Lithuania, Poland, and Azerbaijan; according to the *Secondary gross enrollment ratio*, the leaders are Estonia, Lithuania, Belarus, Mongolia, and Uzbekistan; and according to the *Tertiary gross enrollment ratio*, the leading countries

are Belarus, Estonia, Lithuania, Slovenia, and Ukraine. Thus, certain countries (Estonia, Lithuania, Belarus, and Slovenia) are leaders both in the field of ICT development and in the field of education.

The relationship between the *ICT Development Index* and pillars within the *ICT skills* subindex was examined by means of correlation analysis. The results suggested a positive link between the IDI and all the analyzed pillars *(Adult literacy rate, Secondary gross enrollment ratio*, and *Tertiary gross enrollment ratio)*, but the strongest positive correlation was observed between the IDI and the pillar *Tertiary gross enrollment ratio*. The influence of education level on the level of ICT development was examined by means of regression analysis. Consequently, it can be concluded that all three pillars within the *ICT skills* subindex have a positive impact on the IDI in countries in transition, but also that the pillar *Tertiary gross enrollment ratio* exhibited the highest statistically significant impact. Results of correlation and regression analyses show the greatest significance of higher education *(Tertiary gross enrollment ratio)* for the level of ICT development in the countries in transition.

Given the perceived importance of education level for the level of ICT development in the transition countries, we grouped countries based on the indicators of education level, or on the basis of three pillars within the *IDI skills* subindex using cluster analysis. We concluded that the cluster with the worst performance consists of only three countries (Morocco, Tunisia, and Egypt). Unenviable level of education in these countries in all three analyzed segments *(Adult literacy rate, Secondary gross enrollment ratio*, and *Tertiary gross enrollment ratio)* is a significant obstacle to their better positioning in the ICT development level ranking. Countries in the first and third clusters are far behind the best transition countries in the field of education (cluster 2) only in terms of the *Tertiary gross enrollment ratio*. To improve its position, measures and activities in these countries must be directed towards the improvement of higher education. Higher education is identified as a critical factor for improving the development of ICT in the transition countries. In this sense, development policies of transition countries should especially focus on measures and activities that will contribute to their better position regarding higher education.

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УТИЦАЈ КВАЛИТЕТА СИСТЕМА ОБРАЗОВАЊА НА ЕФЕКТИВНОСТ КОРИШЋЕЊА ИНФОРМАЦИОНО-КОМУНИКАЦИОНИХ ТЕХНОЛОГИЈА У ЗЕМЉАМА У ТРАНЗИЦИЈИ У ЕРИ ИНФОРМАЦИОНОГ ДРУШТВА

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Резиме

У условима глобализације евидентан је значајан развој и примена информационо-комуникационих технологија у развијеним, али и земљама у транзицији. На развој и коришћење информационо-комуникационих технологија (ИКТ) утиче велики број економских и друштвених фактора. Систем образовања представља један од најзначајнијих фактора који утиче на развој и коришћење ИКТ.

Образовање представља подсистем који обликује дизајн и функционисање осталих подсистема друштва. Основна функција система образовања је усавршавање особа у циљу стварања квалитетних кадрова. Квалитет система образовања представља значајан фактор развоја привреде и друштва. Квалитетан систем образовања обезбеђује квалитетан будући кадар, али и развој савремене технике и технологије што доприноси повећању стопе запослености, као и привредном расту и развоју.

Сврха рада је да се анализира утицај система образовања на развој и примену ИКТ у земљама у транзицији. Циљ рада је да се одговарајућом методологијом идентификује међузависност развоја система образовања и развоја ИКТ мереног помоћу IDI (енгл. ICT Development Index).

Највиши ниво развоја и коришћења ИКТ мерен путем IDI забележиле су Естонија, Летонија, Литванија, Белорусија и Словенија. С друге стране, најнижи ниво развоја ИКТ су забележиле Узбекистан, Киргистан, Египат, Монголија, Мароко и Тунис. Слични резултати забележени су када су у питању подиндекси у оквиру IDI (IDI приступ, IDI употреба и IDI вештине).

Посебна пажња у раду је посвећена анализи нивоа развоја образовања који је мерен помоћу три стуба (стопа писмености одраслог становништва, стопа становништва са средњим образовањем и стопа становништва са високим образовањем) у оквиру субиндекса IDI вештине. Резултати корелационе анализе између нивоа развијености ИКТ и нивоа образовања у земљама у транзицији показали су да постоји највећа међузависност IDI и стопе становништва са високим образовањем.

Регресионом анализом је испитан утицај три стуба (стопа писмености одраслог становништва, стопа становништва са средњим образовање и стопа становништва са високим образовањем) на ниво развијености ИКТ. Резултати регресионе анализе су указали да посматрани стубови имају позитиван утицај на IDI у земљама у транзицији. Резултати корелационе и регресионе анализе су указали да највећи утицај на развијеност ИКТ у земљама у транзицији има стопа становништва са високим образовањем.

Полазећи од посматраних стубова, аутори су извршили кластер анализу. На основу ове анализе посматране земље су подељене у четири кластера. Земље које

бележе највиши ниво развоја образовања налазе се у другом кластеру. За земљама другог кластера заостају земље првог и трећег кластера једино према стопи становништва са високим образовањем. У четвртом кластеру се налазе земље са најлошијим перформансама. Анализом варијансе је испитан ниво значајности разлике између четири посматрана кластера, када су у питању стубови у оквиру субиндекса IDI вештина. Резултати анализе варијансе су указали да постоји значајна разлика између свих посматраних кластера када је у питању стуб - стопа становништва са високим образовањем. Резултати корелационе, регресионе анализе, као и анализе варијансе су указали да стопа становништва са високим образовањем представља критичан фактор развоја ИКТ у земљама у транзицији.